

**MATHEMATICS ANXIETY AND ACADEMIC ACHIEVEMENT
IN MATHEMATICS AMONG SECONDARY SCHOOL
STUDENTS OF MIZORAM AND MEGHALAYA**

**A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE
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PHILOSOPHY**

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**MATHEMATICS ANXIETY AND ACADEMIC ACHIEVEMENT IN
MATHEMATICS AMONG SECONDARY SCHOOL STUDENTS OF
MIZORAM AND MEGHALAYA**

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Submitted

**In partial fulfillment of the requirement of the Degree of Doctor of Philosophy in
Education of Mizoram University, Aizawl.**

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CERTIFICATE

This is to certify that the thesis entitled “*Mathematics Anxiety and Academic Achievement in Mathematics among Secondary School Students of Mizoram and Meghalaya*” submitted by C. Lalsangpuii, Regn. No. MZU/Ph.D./1855 of 29.08.2021 for the Degree of Doctor of Philosophy in Education of the Mizoram University, Aizawl, India embodies the record of original investigation carried out by her under my supervision.

She has been duly registered and the thesis presented is deemed worthy of consideration for the award of a Ph.D. degree. This research work has not been submitted for any degree at any other university.

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DECLARATION
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I **C. LALSANGPUII**, hereby declare that the subject matter of this thesis is the record of work done by me, that the contents of this thesis did not form basis of the award of any previous degree to me or to do the best of my knowledge to anybody else, and that the thesis has not been submitted by me for any research degree in any other University/Institute.

This is being submitted to the Mizoram University for the **Degree of Doctor of Philosophy in Education**.

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CHAPTER I

CONCEPTUAL FRAMEWORK

1.1 MATHEMATICS

Mathematics is a subject that occupies a central role, standing as one of the most essential subjects within the school curriculum. It spans a diverse range of disciplines and finds applications in all aspects of life. Mathematics in simple term refers to the science and area of study that deals with numbers, structure, pattern, space, logic, shapes and arrangement, and has been historically developed using abstraction and logical reasoning.

Ranging from the basic act of counting numbers to the complexity of its abstractness, mathematics plays a leading role in molding our understanding of the world. It is the building block for our everyday lives as we see the need for its use in all spheres. Mathematics is the craft of creating new knowledge from old, using deductive logic and abstraction and is the theory of formal patterns. It has also been spoke of as a precise conceptual apparatus and an ideal reality (Wilkinson, 2021).

Some of the famous definitions as highlighted by Barboianu (2021) are as follows-

Paul Dirac has defined mathematics as, “Mathematics is the tool especially suited for dealing with abstract concepts of any kind and there is no limit to its power in this field.”

According to **Bertrand Russell**, “Mathematics takes us still further from what is human, into the region of absolute necessity, to which not only the actual world, but every possible world, must conform.”

Richard Courant has also defined it as “Mathematics as an expression of the human mind reflects the active will, the contemplative reason, and the desire for aesthetic perfection. Its basic elements are logic and intuition, analysis and construction, generality and individuality.”

According to **Paul Lockhart**, “Mathematics is the music of reason.”

After a close analysis and study of the definitions provided by various prominent figures, Barboianu subsequently defined mathematics in a way that it reflects the amazing complexity of mathematics.

‘Mathematics is simultaneously a discipline, a method, and a language, applicable to other disciplines or methods of knowledge, but also to mathematics itself. It is a mode of organizing, validating, and communicating knowledge, which uses the principles of logic and gives it a field of manifestation and application that is “pure,” free from contingency, and free from the confusion of natural language, in which the truths of propositions are universally valid and do not depend on any interpretation. It is the only discipline entitled to investigate concepts of any nature and any degree of generality, but also to be self-referential and self-applicable, as is in fact human reason.’

The practice of mathematics involves reasoning, which stimulates and enhances the capacity of logical thinking, thereby sharpening reasoning abilities. Mathematics reasoning has been regarded to be based and built on the foundation of logic. All theorems, proofs and other mathematical conclusions have been derived from sets of logical rules. Mathematics exercises the mind; the greater the mathematics practice, the more tasks can be completed correctly (Cresswell, 2020). Thus, it can be stated that Mathematical reasoning helps individuals develop a discipline along with systematic approach to problem-solving which instigate a strong foundation for general reasoning. Mathematics promotes critical thinking and precision, helps in pattern recognition, accuracy, problem solving skills and generalization. This is achieved by the distinct nature and attributes of mathematics.

1.1.1 The development of mathematics

The origins of mathematics can be inferred to extend back to the very start of humanity. It has been believed that counting, a practice initiated by humanity nearly 40,000 years ago, forms the foundation upon which mathematics is built. The development of mathematics has been intricately linked with society and culture, shaping and influencing the course of history through its application in various fields of life. Its evolution to its current state has gone through fundamental changes in

different ways such as changes in concepts, scope, outlook, organization and practice.

According to Ebrahim (2010), seven periods of mathematics evolution can be identified, each with its distinct characteristics.

(1) Proto-Mathematics:

Even our earliest ancestors required fundamental mathematical understanding such as counting, timekeeping, recognizing shapes and symmetry and other pragmatic aspects of measurement and construction. This period covers the mists of ancient time through the archaeological evidence of 30,000 BCE to 2000 BCE. Archaeological evidence like bone artifacts were discovered from the Stone Age that has been believed to be used for reckoning time.

(2) Ancient Mathematics:

This period has been considered to be covering from 3000 BCE to 800 BCE. During this period, it was believed that the sciences of numbers (number) and geometry (figure) arose through abstraction from the existing empirical mathematics. The Babylonians and the Egyptians during their respective civilizations developed sophisticated science from these which reached spectacular heights. They are applied to astronomy, calculation of areas and volumes, logistics, the regulation of time, administration, planning, construction, surveying of land and the engineering of magnificent monuments. Around 3500 B.C.E., the Egyptians possessed a well-established numerical system which is capable of indefinite counting, where new symbols are occasionally introducing. Additionally, by 3000 B.C.E., the Babylonians had devised a writing system which were derived from pictographs that features a fully developed sexagesimal positional system and positional notation for sexagesimal fractions.

(3) Pre-Modern Mathematics

This period has been considered to be covering from 800 BCE to 1400 CE. The rise of axiomatic geometry (Greek), sophisticated geometry, highly sophisticated

abstraction in algebra as well as algorithmizing of arithmetic period was observed and encountered in India, Arab, Central Asia during this period.

Early Classical: The Greeks introduced a fundamental abstraction to mathematics: separating its proceedings from the empirical to the logical. They structured the principles of geometry into a hierarchy of statements which is firmly grounded in the acceptance of first principles or axioms.

Their view on mathematics was of a formal structure, unified by the principles of rational thinking. Results were systematically organized into a linear body of work, in which each proof depends on previously accepted or proven statements. There was a clear recognition and the need of first principles or axioms. The science of Geometry was well flourished among the Greeks, with applications to various fields such as mechanics, astronomy, machinery and engineering in both Greek and Roman contexts.

The Encountering of Paradox: In the development and early understanding of arithmetic and numbers, the Greeks encountered a challenge when their common notion of numbers (specifically, rational numbers), fell short in describing certain lengths. A simple length for instance, the diagonal of a square, could not be expressed adequately using their existing conventional idea of numbers.

This discovery eventually led to paradoxes in mathematical theory. The logical incongruence between the diagonal and side of a square was not the actual problem in reality but rather, with the mathematical theory itself. Since these lengths were logically incommensurable, the theory, which seamlessly blended arithmetic with geometry thus faced a dilemma. There is no (rational) number that can measure that length, regardless of how small the scale of measurement is.

This realization sparked inquiry in ancient Greece as scholars sought for intellectual identification of what the flaw in the mathematical theory was. It's crucial to understand that the issue lay in constructing the mathematical theory. But not in the real world, progress, science, or engineering. In practical, diagonals and all lengths could be measured without difficulty. But the Greeks found it dissatisfying to have a theory wherein not every length could be represented by a "number."

A clear division had now clearly occurred between concrete and abstract mathematics along with separation between practical science and engineering, and theoretical mathematics.

The Resolution of the Paradox of Number: The remedy for the problem of numbers was its expansion to include all (Cauchy) sequences of rational numbers. Real numbers came to existence, whose establishment and properties stems from fundamental analysis, which was an accomplishment finally completed in the 1800s by Cantor, Dedekind, and others. This new and significantly larger domain of numbers is no more a countable infinity of numbers, but an uncountable one as demonstrated by Cantor.

Late Classical Mathematics: The study of equations, known as Algebra, was well developed in Babylonian and Egyptian times. However, it saw significant growth during the Islamic era, particularly under the contributions of Arabic, Central Asian, and Indian mathematicians. It was during this period that the Arabic and Central Asian mathematicians developed systematic algorithms to solve algebraic expressions which is actually our modern approach. These developments found applications in various fields such as astronomy, engineering, optics, and commerce.

(4) Mercantile Mathematics

This period stems from 1400 CE to 1500 CE. During this period, improvements in numeration, symbolic development, symbolic shorthand arithmetic (Renaissance Europe), solution of equations (Italian wranglers) was seen.

Over a thousand years or so of Islamic rule, a flourishing trade and financial system emerged. This development first took place under Baghdad and Damascus caliphs, and then continued during the Mongol overlordship, and finally under the courts of Seljuk Turks. Practical mathematical concepts like computation, calculation, and the use of negative numbers were developed which flourished in Asia, India, Arab and China.

(5) Early modern mathematics

One could characterize early modern mathematics as extending roughly till the end of the 1600s (Fermat, Bernoulli, Leibniz, Newton), perhaps into the middle to late 1700s. Euler served as a transitional figure over the dividing line of early modern and modern mathematics during the early 1700s.

Negative numbers were still approached cautiously despite the familiarity brought about by trade and improved form of arithmetic algorithms. They were utilized hesitantly as computational tools for facilitating accurate results, even if one has to temporarily suspend the "meaning" of a specific step on the process. This perspective on numbers was then reinforced by encountering numbers in computations and solutions which lacked real-world significance in the actual "reality," such as negative numbers, roots, and imaginary numbers. For such a context, Euler's advancements along with his bold use of formal manipulation stand out and was considered ahead of his time.

(6) Modern abstract mathematics

This period covers from 1850 CE to 1950 CE, it is the period where modern abstract analysis, modern abstract algebra, modern logic - all freed mathematics from the paradoxes and problems encountered during the pre-modern and mercantile periods emerged.

The era of modern mathematics stood out for its comprehensive and systematic synthesis of mathematical knowledge. It uncovered deep structural phenomena, was remarkable for its generalization and synthesis of all of mathematics. Modern mathematics is modern algebra, such as Galois theory of algebraic equations, analysis, modern number theory, set theory, Fourier analysis, complex variables, etc., i.e., much of which are the content of advanced undergraduate and graduate level mathematics.

Modern mathematics, even though are more unified, abstract, and diverse as compared to the pre-modern mathematics, it is still not the mathematics of today.

Although this period uncovered the deeper structures of mathematical fields, they were not yet reflected in a standardized approach to various areas.

(7) Post-modern mathematics

This period covers from 1950 CE to the present. A dramatic expansion in scope and productivity in mathematics, which are based upon axiomatic methods are observed. This is accelerated by the growth in science, engineering, technology, statistics, and applications to all spheres of our lives. Contemporary mathematics is extremely vast.

Contrary to misconceptions, there exists a strong connection between mathematics and the actual world. The presentation may involve abstract definitions and axiomatized structures, but modern abstract mathematics very much aligns with the ongoing evolution of the subject along with its knowledge base. There is a great potential for applications in technology, and with greater efforts to address potential misunderstandings in education, much more exciting developments awaits.

1.1.2 Branches of mathematics

Branches of mathematics have been classified by many, depending on their nature and areas. Yadav (2017) has divided mathematics into four fields: Arithmetic, Algebra, Analysis and Geometry.

Arithmetic in the simplest form is an elementary branch of mathematics that deals with numerical operations like addition, subtraction, multiplication and division. Arithmetic deals with numbers and basic arithmetical operations. The word ‘Arithmetic’ is a Greek word that means numbers. Arithmetic is all around us, we apply it daily. For instance, if each room in the house has 3 windows and if there are 5 rooms, we will have to multiply 3 and 5 to find the total number of windows in the house.

Addition and subtraction are the most basic operations and are the building blocks of understanding operations on numbers. Addition means ‘putting together’ whereas subtraction means ‘to take away’. Multiplication and division form the other two arithmetic operations that can be applied to mathematics concept like

multiplying fractions, rational numbers, integers, etc., and to divide means to split a large group into smaller groups (Cuemath, n.d)

When arithmetic is applied to solving real life problems, equations are formed which leads to algebra. **Algebra** is a branch of mathematics dealing with symbols and the arithmetic operations across these symbols. These symbols do not have any fixed values and are named ‘variables. We see certain things that keeps changing in our actual world, there is a constant need to represent such changing values. These values here in algebra, are usually represented with symbols such as x, y, z, etc., which are called variables. These symbols are then manipulated through various arithmetic operations with the objective to find the values.

Algebra can be further divided into four branches which are Pre-algebra, Elementary algebra, Abstract algebra and Universal algebra.

Pre-algebra forms mathematical expression of a given problem in mathematics. It is a basic way of presenting unknown variables to help create a mathematical expression. It thus helps in transforming real-life problems into an algebraic expression.

Elementary algebra deals with solving the already formed algebraic expressions for a viable answer. Simple variables like x, y, z, etc. are represented in the form of an equation. Based on the degree of the variable, the equations can be divided into linear equations, quadratic equations and cubic equations. Linear equations are of the form: $ax + b = c$, $ax + by + c = 0$, $ax + by + cz + d = 0$. Elementary algebra, based on the degree of the variables then branches out into quadratic equations and then to polynomials. The general form of representation of a quadratic equation is $ax^2 + bx + c = 0$ and of a polynomial equation is $ax^n + bx^{n-1} + cx^{n-2} + \dots + k = 0$.

Abstract algebra is that branch that deals with the use of abstract concepts such as groups, vectors, rings, rather than using simple mathematical number systems. Rings are simple levels of abstraction which are found by writing the addition and multiplication properties together. Group theory and ring theory constitutes two important concepts of abstract algebra. Abstract algebra contributes

to numerous applications in computer sciences, physics, astronomy., etc. They used vector spaces to represent quantities.

All the other mathematical forms such as the ones involving trigonometry, calculus, coordinate geometry which involves algebraic expressions constitutes *Universal algebra*. All other branches of algebra can be considered the subset of universal algebra. Any real-life problems that are faced in our everyday lives can be classified into any one of the branches of mathematics and can then be solved, using abstract algebra.

Algebra can further be divided into numerous topics. Of which, the important topics of algebra are algebraic expressions and equations, exponents, logarithm, sequences and series, and sets.

When these properties of arithmetic and algebra fails, we are in need of another branch of mathematics, i.e., *Analysis*. Analysis is that branch of mathematics that deals with the study of continuous change and those processes that emerged out of the study of continuous change like limits, differentiation and integration. Calculus, differential equations and functional analysis are some of the important subfields of analysis. Real analysis that deals with real-values and complex analysis that deals with complex-valued functions are two broad subdivisions of analysis. Derbyshire (2004) describes it as “the study of limits” (Weisstein, n.d.).

Mathematical analysis is broad and involves a rigorous study that deals with concepts related to the above-mentioned topics involving continuous change and their applications. It can further be divided into different types-

Real Analysis studies analytic properties of real valued function. It focuses on real numbers with their properties. It may include the study of sequences, series, limits and involve the concepts of continuity and differentiability. *Complex Analysis* deals with complex numbers and functions. It involves the study of complex valued function while *Functional Analysis* involves the study of functions and operators. It emphasizes vector spaces of functions.

Numerical Analysis studies the properties of computer algorithms and is an iterative method for solving equations. It may include interpolation, integration and differentiation. *Fourier Analysis* studies functions that can be described by Fourier series while *Harmonic Analysis* studies functions and signals in terms of their respective frequency components. *Differential Equations* which deal with the study of equations involving derivatives may also be included as part of analysis.

Geometry is the branch of mathematics that deals with the study of shapes, sizes, dimensions as well as angles of objects, it explores the properties as well as relationships of shapes and spaces. Geometry is divided into two parts, namely, Plane (or Euclidean) Geometry and Spherical (Non-Euclidean) Geometry. Plane Geometry deals with flat shapes that we can usually draw on papers such as squares, circles, triangles, etc., whereas spherical geometry deals in three dimensional solid shapes such as cubes, spheres, cones, etc. Spherical geometry deals with the study of figures on the surface of spheres and is considered the three-dimensional version of the plane geometry.

Furthermore, geometry can be divided in terms of its different fields and areas as the following.

Euclidean geometry: Geometry in its classical meaning is actually Euclidean geometry, and is utilized in various scientific domains such as astronomy, mechanics, etc and in technical applications like engineering, architecture, aerodynamics, etc. Euclidean topics are immensely important and forms basic concept in mathematics and are included in majority of countries around the world in their respective school curricula. Such are points, lines, planes, angles, triangles, congruency, similarity, solid objects, circles, and analytic geometry.

Differential geometry: Differential geometry studies issues in geometry using techniques of calculus and linear algebra. It may be used in fields like physics, econometrics, and bioinformatics, etc. Owing to Albert Einstein's general relativity postulation saying that the cosmos is curved, differential geometry is peculiarly important in mathematical physics.

Non-Euclidean geometry: Non-Euclidean geometry does not conform to the traditional Euclidean axioms and it deals with objects that have non-flat surfaces, or are curved. There are two types of non-Euclidean geometries: hyperbolic geometry, which deals with objects that have a saddle shape and elliptic geometry, which deals with objects that have a spherical shape.

Topology: Topology is a branch of mathematics which studies the characteristics of continuous mappings and is an extension of Euclidean geometry. It deals with the study of properties of space that are preserved under continuous transformations, such as bending or stretching. It deals with concepts such as continuity, connectedness and compactness.

Algebraic geometry: Algebraic geometry can be "naively" defined as the study of solutions of algebraic equations. It had evolved from Cartesian coordinate geometry. Algebraic geometry deals with geometric objects connected with commutative rings: algebraic varieties and their different generalizations.

Complex geometry: Complex geometry studies the nature of geometric constructions modelled on or emerging from the complex plane. Complex geometry combines algebraic geometry, differential geometry and multivariable analysis. It is applied in string theory and mirror symmetry.

Discrete geometry: Discrete geometry relates closely with convex geometry. It mostly deals with relative positions of basic geometric objects: points, lines, and circles. Few examples are- The study of sphere packings, triangulations, and the Kneser-Poulsen conjecture. In methodology and principles, it shares a lot of commonness with combinatorics.

Computational geometry: Computational geometry deals with algorithms and their implementations for manipulating geometrical.

Convex geometry: Convex geometry frequently employs real analysis and discrete mathematics approaches to study convex forms in Euclidean space and its more abstract equivalents. It has a fundamental application in number theory and is closely linked to convex analysis, optimization, and functional analysis.

1.1.3 Mathematics as the language of the universe

Mathematics holds the key to unlocking secrets of the universe. Ranging from distant galaxies to microscopic particles, mathematics is indeed the universal language, that enable us to understand and navigate the intricacies of the world surrounding us (Rao, 2023). Mathematics is often said to be a language that transcends all cultures, continents and disciplines. Its elegance lies in its ability to convey universal truths and principles. This universality, thus holds the key to mathematics being a force that unifies scientific research, technological advancements and global communication.

Noyes (2023) stated, “For me Mathematics is the poetry of the universe. To put Mathematics in context with other disciplines: mathematics is the poetry of everything, or the language with which everything communicates with everything and how it relates to everything.”

Considering mathematics to be a language is evident in a number of research articles especially in the realm of Mathematics Education. As a language, mathematics is considered to have properties of internal logic which helps in describing and communicating. With such a property, it is considered that mathematics is ‘the international language’. It is universally understood across the globe, by its ways of symbols and operations.

If we consider the universe as a whole, we would normally imagine a story full of wondrous events such as strange occurrences with particles, stellar collapse, galactic collisions, etc. A visualization of the galaxies, the ever stretching of the breadth of time, starting from the Big Bang and landing this day, etc. On this note, we must understand that there is an additional side to this amazing natural occurrence which is oftentimes overlooked; unless sincere attempt is made to understand the what and the why of this existence. Behind all of those fantastic observations and eventually realizations, there is a mechanism at work that allows the discovery of them all and that allows to enjoy learning about. This mechanism is mathematics, and without it the universe would still be covered in darkness.

Lerman (1990) described mathematics as “the last bastion of absolutism” (Noyes, 2004) and is considered a mirror to the view that mathematical language is elevated to an almost divine status (e.g. “God is mathematics”). The reason for this is that when mathematics is considered as the language of the universe, it appears to be self-existent which is embodied in nature itself. There seems to be a strong sense of pre-existence.

It is often argued that mathematics is discovered revealing universal truths, rather than being invented like a language. Mathematics is seen as a distinct realm of its own. Thus, such a quality of mathematics being self-existent can be considered to be almost like a teacher on its own. The more the knowledge, the wider the exploration. It teaches clear and logical thinking. Mathematics is not merely a pre-existing language; rather, it seems to have the power to express itself. It serves as a tool for describing and interpreting the world around us.

Although the self-evident nature of mathematics has been spoken of, it is important to understand that it is both a natural occurrence as well as a human designed system. For instance, it would appear that the self-evident nature of mathematics grants us this ability to recognize patterns in the form of arithmetic, which we then systematically construct more complex mathematical systems that are not obvious in nature, but which do let us further communicate with nature.

Many more demonstrations which illustrate the importance of mathematics within our history, especially within astronomy and sciences can be shown. This demonstration depicts the universality of mathematics and how it can be used for interpreting natural and scientific phenomenon. For instance, Johannes Kepler used mathematics to model his observations of the planets where his idea of the universe is extremely motivating to understand more about mathematics.

Therefore, mathematics is much more than simply a set of vague equations and complex rules that requires memorization. It is the language of the universe. To be more precise, as of now, it is impossible to travel to the centre of the galaxy and observe the supermassive black hole to visually confirm its existence, or to venture out into a Dark Nebula to watch in real-time a star being born. But mathematics

allows us to understand how these things exist and work. When the mind is set to learn mathematics, it so happens that it not only expands the mind, but connects with the universe on a fundamental level.

“The grand story of the universe is written in mathematics, and our ability to translate those numbers into the events that we all love to learn about is nothing short of amazing. We are connected to the universe through mathematics” (Singh, 2022).

Rao (2023) explored the importance of mathematics in unravelling the mysteries of the universe and has presented practical examples to appreciate its significance. He divided the many cases of how Mathematics is a language.

Mathematics as the Language of Patterns: Mathematics, at its core, is the study of patterns, from star formations to atomic behaviors, which underlie the universe. Understanding, recognizing and interpreting these patterns helps to understand complex systems. Fibonacci sequence, seen in natural occurrences such as flower petals or seashell spirals, helps appreciate the beauty and practical relevance of mathematics in the world. Engaging in exploring these natural patterns fosters a deeper connection between mathematics and everyday experiences.

Mathematics as the Language of Relationships: Mathematics provides a structure for understanding the relationships between objects, phenomena, ideas, etc., Geometry, a branch of mathematics enhances this understanding through visualization, especially in fields like engineering and architecture.

Mathematics as the Language of Probability and Uncertainty: The universe is a complex system full of uncertainties. At such a condition, mathematics provides the tools to manage these uncertainties. Probability theory helps to make informed decisions, assess risks, and understand the likelihood of outcomes. Our data-driven world cannot do away with mathematical literacy for navigating challenges.

Embracing mathematics as a powerful tool unlocks the doors to innovation, scientific breakthroughs, and a much deeper understanding of the universe. Mathematics truly serves as a universal language as it empowers to unlock the secrets of the universe and shape a better future.

1.1.4 Relevance of mathematics

Mathematics aids as a strong instrument for worldwide knowledge and communication that helps organize our lives. It contributes to our understanding of the world in all spheres of life. Mathematics is a subject that develops logical reasoning, creative thinking, critical thinking, spatial thinking, problem-solving abilities, and even good communication skills.

Mathematics plays a role in all aspect of life. Reflecting its comprehensive application in just a few words and in a simple manner, Sharma (2021) explained that mathematics helps in the development of skills and explains how things function. He mentioned that it aids in the development of wisdom and accelerates intuitive processing. It contributes to the child's intelligence and allows youngsters to interact with the outside world. Sharma also stated that pursuing mathematics as a career can be financially rewarding.

The significance of mathematics can be demonstrated across various areas of life, some of which are outlined in the following:

Role of mathematics in the overall curriculum:

Mathematics has a cross-disciplinary nature. Historically, mathematics in the form of geometry and algebra were considered two of the seven liberal arts in Greek and medieval education systems. This historical role reflects the mental discipline that mathematics provides for other disciplines. Mathematics literacy is an attribute of individuals to live lives as a more constructive, concerned and reflective citizen.

Mathematics is required and applied in various fields and disciplines, i.e., mathematical concepts are used to solve problems in fields of science, engineering, economics, etc. The complexity of those problems often demands relatively sophisticated mathematical concepts and procedures. Because of which, in some curricula, mathematics is offered independently in order to support the study of other school subjects as an 'instrumental subject'. In other curricula, integrated courses that combines mathematics and other fields are offered (ICMI, n.d.).

Role of mathematics in Vocational Development:

The primary goal of education is to equip children with skills to earn a living and become self-reliant. Mathematics stands out as the most essential subject to achieve this goal. It prepares students for vocational fields where mathematics is applied, such as engineering, accountancy, banking, and business. Fields like agriculture, tailoring, carpentry, surveying, baking, fashion designing, music and dance, etc requires mathematical knowledge.

For instance, as mentioned, mathematics is important in the kitchen. Every component must be measured when it comes to baking and cooking, and in doing so, we must occasionally multiply or divide the precise amount of anything we need. Arithmetic is extremely crucial in both music and dancing as there is always mathematics involved in music, whether we write, listen or study a dance routine. Every song has a distinct pulse and every dance has its own beat. In fashion and designing, mathematics is used to measure sample cloth for fittings. Fashion designers utilise mathematical methods to assist construct designs, determine the amount and cost of fabric needed to carry any project.

Role of mathematics in Moral Development:

Morality seems complicated as it is associated with the cognitive domain, but this does not mean it is impossible to relate. The ‘moral’ is the knowledge to judge something whether it is right or wrong. Mathematics with its precised, accurate and exact nature helps cater to the development of establishing right and wrong in any decision making.

As a subject, mathematics adds to students’ moral development since mathematical knowledge is helpful in character and personality development. This can be well said and explained as students naturally become familiar with and has internalized the precision of mathematics subconsciously. This eventually leads to mathematics helping in moral development and character formation as there is no place for prejudiced feeling, biased outlook, doubts and half-truths, discrimination etc. in learning of the subject.

We can overall assume and see the qualities that may be brought by the influence of mathematics, which are- honesty, truthfulness, justice, dutifulness, punctuality, self-confidence. It also inculcates the nature of observing rules and belief in a systematic manner. These qualities definitely go towards developing good morals and a sound character.

Role of mathematics in achieving the aims of education

In education system, mathematics plays an important role in shaping the future probability of the youth. According to Mahatma Gandhi (n.d.), Education is the all-around drawing out of the best in child and man-body mind and spirit. To achieve this aim of education that Gandhiji has well described, it is important that a person has the right attitude and the required nature and qualities. These qualities are required to draw out the best in an individual. Such qualities may include critical thinking skills, discipline and perseverance, confidence, creativity, problem solving skills, etc.

Mathematics encourages logical reasoning and organized planning, as influenced by its nature in which calculation is always precised and systematized. By engaging with mathematical concepts and mathematical tasks, a person learns to analyze situations, evaluate options and make informed decisions. Since the process of solving mathematical problems requires patience and persistence, these are also eventually applied to real life. Mastering mathematical concepts boost a person's confidence not only in solving mathematical problems, but also in real life situations. It encourages individuals to tackle challenges head-on. Mathematics promotes creative thinking as it encourages individuals to approach problems from different angles and in developing innovative solutions.

Having such qualities that mathematics as a subject provides, we can definitely say that mathematics fosters a much skilful life. Such qualities will bring out the best in an individual and bring about holistic development, which is indeed the main aim of education.

Role of mathematics in social development:

Mathematics is deeply connected to the details of daily human life and its activities. People apply mathematical concepts in various forms, often unaware of it, whether in the kitchen, office, study, or even during leisure and entertainment. Mathematics brings order to human life, eliminating possible chaos and randomness. It enhances skills vital for the daily interactions and communication skills.

Human life relies deeply on social interaction, as humans are social beings. The need for interaction inevitably results in the necessity to work in groups or in society. Working in groups enhances social abilities like communication and cooperation which are crucial for functioning within a community. The ability to collaborate with others in the society develops various social skills, promoting teamwork and mutual understanding.

Mathematics plays a vital role in this social framework, as it is the key for managing the give-and-take processes in daily life. Business and industry also depend heavily on mathematical knowledge for growth. The modern conveniences which we enjoy today, such as advanced transportation systems, technological innovations, communication tools, etc are all products of mathematical progress. Therefore, mathematics plays a vital role in understanding and development of society. It not only facilitated societal change, but continues to be drive the evolution of human civilization.

Role of mathematics in the development of science and technology

Mathematics serves as the language of science and technology. (Mathnasium, 2023). Whether in physics, chemistry, computer science, or engineering, mathematics is a tool that comprehends the world and advance innovative technologies. Its significance extends much beyond theoretical understanding, but to multiple practical applications. Mathematics addresses real-world challenges, such as creating enhancing transportation systems, new medical treatments, and contributes to developing more efficient energy sources. Mathematics is crucial for scientific and technological progress with its importance never to be overstated.

The 'functional' aspect of mathematics arises from its important role as the language of science, technology, and engineering, and its contribution to their development. Without mathematics, there can be neither science nor engineering (Yadav, 2019). The involvement of mathematics in these applications is as old as mathematics itself. Today, adoption of mathematical methods in social, medical and physical sciences has been expanding and advancements have fired rapidly. This confirms that mathematics is an indispensable part of all school curricula and mathematical knowledge and application should be well-uplifted in higher studies as well. The progress of science and technology would be impossible without mathematics, as it serves as the basic foundation for their understanding and development.

1.2 MATHEMATICS AT SECONDARY LEVEL OF EDUCATION IN INDIA

Secondary education is a critical stage in the educational structure as it prepares students for higher education. It links the primary education and the higher education. The primary education aims in providing minimum requirements for survival while the secondary education prepares a person to be a full member of the challenging society.

The secondary stage of education in India is broken into two, two-year cycles, generally referred to as General/Lower Secondary School, and Higher/Senior Secondary School. Education continues to be free at government schools, although private education seems to be more common at the secondary level. In India, Classes IX and X constitute the Secondary stage and classes XI and XII are designated as the Higher Secondary stage. The normal age group of the children in secondary classes is 14 years upon entry and 16 years upon exit.

General objectives of teaching Mathematics at secondary level.

The following are the general objectives of teaching mathematics at secondary level (IGNOU, n.d.):

- Students will be able to acquire knowledge of facts, theories, concepts, laws, principles and proofs of Mathematics.

- Students will develop the ability to communicate mathematical ideas with precision and accuracy.
- Learners will develop interest and attain a positive attitude towards Mathematics.
- Students will be able to apply mathematical knowledge to solve real life problems.
- Mathematics will develop the skill to use algorithms in problems solving.
- Learners will appreciate the contributions of mathematicians.
- Students will develop mastery of algebraic skills, drawing skills, finding patterns, deducing interpretations, reasoning, critical thinking, making connections, analyse, organise data, etc.

These objectives are translated into different contents areas of mathematics and are studied in the secondary stage of schooling. In India, high school mathematics curriculum covers a range of topics that build on foundational concepts. Although the syllabus may vary slightly between different educational boards (like ICSE, CBSE, or State boards), but generally, it includes key topics such as Number Systems, Algebra, Geometry, Mensuration, Statistics, Probability, Coordinate geometry and Trigonometry.

According to Section 3.4 of National Curriculum Framework for School Education 2023 (NCERT, 2023), the learning standard of mathematics at the secondary stage emphasizes enhancing to justify claims and arguments through logical reasoning. At this level, students must gain confidence in handling abstract concepts and core mathematical techniques, including computational thinking. They will also be engaged in mathematical modelling of real-world phenomena and develop algorithms for solving complex problems.

1.3 ANXIETY

According to Cambridge dictionary, anxiety is an uncomfortable feeling of nervousness or worry about something that is happening, or might happen in the future (Cambridge dictionary, 2022). It is a psychological reaction to stress or unwanted situations that may affect the normal and proper functioning of a person.

Anxiety is actually a normal reaction to stress. A moderate level of anxiety can be beneficial, as it can aid as a motivating force that drives individuals to focus, perform efficiently and complete tasks. It can actually be a driving force that enhance productivity and encourage timely action. It can alert us to dangers and help us prepare and pay attention.

However, when anxiety begins to interfere with a person's ability to carry out routine activities and affects daily functioning, it becomes problematic. At this stage, it can eventually evolve into an anxiety disorder, which requires attention and management in order to prevent it from significantly diminishing the overall well-being of an individual. According to American Psychiatric Association (n.d.), anxiety disorders are the most common of mental disorders and they affect nearly 30% of adults at some point in their lives.

Such disorders may be evident in various ways, including persistent worry, difficulty concentrating or avoidance behaviors, etc. which disrupt personal, social, and professional life of an individual. It is important to recognize and understand this shift from a manageable level of anxiety to one that hinders functioning, as early intervention may help restore balance and well-being.

While anxiety disorders may vary based on symptoms and triggers, they can all interfere with daily activities. Understanding the different types can be beneficial. The four common types of anxiety disorders according to National Institute of Mental Health (2023) are:

Generalized anxiety disorder

Generalized anxiety disorder (GAD) is characterized by persistent and excessive worry about everyday matters. This ongoing anxiety, which may last for months or years, can lead to physical symptoms such as restlessness, difficulty concentrating, fatigue, muscle tension, and sleep disturbances. GAD often causes individuals to feel overwhelmed, focusing on minor issues and daily responsibilities such as job responsibilities, family health or minor matters, chores, car repairs, or appointments, etc.

Panic disorder

People with panic disorder often experience frequent and unexpected panic attacks. Panic attacks are sudden, intense feelings of fear or terror when no immediate danger is present. Physical symptoms of panic disorder include fast heartbeat, chest or stomach pain and difficulty in breathing. It comes with feeling of weakness or dizziness, sweating, chills, or numbness on the hands. People having this disorder may feel detached from reality and feel like they have no control over their body or thoughts and may even worry of having a heart attack. Some experience a sense of fear that something terrible is going to happen.

Phobia-related disorders

A phobia can be understood as an intense fear of specific objects or situations. This fear is disproportionate to the actual risk posed by the situation or object. For instance, a person may experience agoraphobia (fear of public places) or claustrophobia (fear of closed-in spaces). Many people experience having phobias of flying, heights, certain animals, needles, etc. People with a phobia experience immediate anxiety when faced with it and may even go out of their way to avoid their feared object or situation.

Social anxiety disorder

People with social anxiety disorder experience an intense fear of social situations. The symptoms include feeling self-conscious or being worried about embarrassment or being judged by others. This fear can interfere with daily activities like going to work, attending school, or participating in social gatherings, which pose a big problem for the individual.

1.4 MATHEMATICS ANXIETY

Mathematics anxiety can simply be explained as a negative reaction towards mathematics. It is a negative emotion that may interfere in solving mathematical problems of any kind. This could cause individuals to develop a dislike for mathematics, leading them to avoid mathematics classes and situations involving

mathematical concepts. A person may experience a stressful feeling when encountering any mathematics-related situation.

Richardson and Suinn defined mathematics anxiety as feelings that involves tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations (Richardson & Suinn, 1972, as cited in Suinn & Winston, 2003).

According to Nandini and Subramanian (2021), mathematics anxiety is a feeling of tension and anxiety which interferes with the manipulation of numbers and solving of mathematical problems both in ordinary life and as well as in academic situations.

Mathematics anxiety maybe exhibited in different ways and forms. An individual may experience panic or helplessness when encountering mathematics-related tasks, even something as simple as splitting a bill at a restaurant. A common misconception is that mathematics is inherently one of the most difficult subjects (Capuno et al., 2019, as cited in Kunwar et al., 2022). When a person is brought up in such a condition, it adversely affects his/her mindset and may even be said 'brainwashed' leading them to feel "programmed" to be weak in mathematics.

This notion of considering mathematics to be one of the most difficult subjects has been instilled in the society for generations. As a result, a person may develop a feeling of being 'mathematics-anxious,' and disclose a panic-type reaction which might eventually result in anxiety disorder. Such individuals may feel uneasy when asked to perform mathematical calculations, avoid mathematics classes, show physical symptoms of profound distress, may even faint, dread mathematics-related activities, etc.

1.5 EXPRESSIONS OF MATHEMATICS ANXIETY THROUGH DIFFERENT DOMAINS

According to Hoque (2017), the domains of learning can be categorized as cognitive domain (knowledge), psychomotor domain (skills) and affective domain (attitudes). This categorization is best explained by the Taxonomy of Learning

Domains which was formulated by a group of researchers led by Benjamin Bloom in 1956. This domain of learning is commonly known among educators as Bloom's Taxonomy.

Bloom's Taxonomy may serve as a comprehensive framework for anxiety studies as it covers the full range of learning, including cognitive, affective, and psychomotor domains. For the purpose of expressing mathematics anxiety, the psychomotor domain is interpreted as behavioral, enhancing clarity and making it more suitable as an indicator of mathematics anxiety. Thus, mathematics anxiety can be evident in cognitive, affective and behavioral expressions in the following ways:

1.5.1 Cognitive expression of mathematics anxiety:

Mathematics anxiety can profoundly affect cognitive functioning, which may lead to a negative attitude towards mathematics and a diminished performance. The following are cognitive expressions of mathematics anxiety-

Reduced Attention and Focus:

Mathematics anxiety hampers concentration and can cause individuals to become easily distracted during mathematics-related tasks. This inability to concentrate can worsen anxiety levels and have negative impact in mathematics performance.

Negative perspective towards mathematics:

Individuals with mathematics anxiety often experience negative thoughts and perspective towards mathematics. As a result of which, they have intrusive negative thoughts and often doubt their mathematics abilities which eventually affect their performance. Their worries and doubts results in lack of self-confidence often indicated in certain situations.

Impaired Working Memory:

Performing mathematical tasks can affect working memory. When students become anxious, they may struggle in manipulating numbers or formulas in their minds which will make it difficult to solve problems effectively.

Increased Cognitive Load:

As a person with mathematics anxiety must manage their anxiety alongside the demands of the mathematical task, it leads to higher cognitive load adding pressure on the person. This can overwhelm cognitive resources of the individual leading to poor performance.

1.5.2 Affective expression of mathematics anxiety:

Affective expression of mathematics anxiety may refer to the emotional responses an individual experience in relation to mathematics. This may be in the form of the following:

Emotional Responses:

Individuals with mathematics anxiety often experience intense negative emotions such as feelings of fear, frustration, embarrassment, or dread which can hinder their interest towards engaging in mathematical tasks. These frustrations may affect psychological ability and may be exhibited physically as well.

Lack of self-confidence:

Mathematics anxiety can often lead to decreased sense of self-worth and confidence in one's mathematical abilities. It may cause individuals to feel inadequate or inferior compared to peers.

Negative Attitudes Toward mathematics:

According to Singh & Jethwani (2023), Mathematics anxiety can have a negative impact on students' engagement as well as attitude towards mathematical tasks. It affects their ability to learn concepts on mathematics, solve problems, and acquire further knowledge.

Stress and Anxiety:

Mathematics anxiety can cause stress in a person as the person lives with ongoing fear of encountering any mathematical activity. This can make life difficult

as mathematics is all around us in our everyday life. It may trigger anxiety that makes it even more challenging to engage with mathematics.

1.5.3 Behavioral expression of mathematics anxiety:

Behavioral expression of mathematics anxiety indicative of individuals' physical responses and behaviors when engaging with mathematical tasks can be explained as:

Physical Symptoms:

Individuals experiencing mathematics anxiety may exhibit physical symptoms such as rapid heartbeat, sweating, trembling etc., when confronted with any mathematical activity or assessments. These physiological reactions affect their ability to focus and perform well.

Inconsistent Performance:

People with mathematics anxiety may exhibit inconsistent performance in mathematical tasks. Although they may be capable of understanding concepts, their anxiety can lead to impairment in their ability to perform tasks efficiently. Anxiety can affect fine motor skills necessary for tasks such as writing equations, drawing graphs, or performing calculations. They may even struggle with holding a pencil or writing legibly, especially under pressure.

Restlessness:

Students with mathematics anxiety may show signs of restlessness during mathematics classes or tests. This can be seen in the form of tapping fingers, continuous shaking of body or other physical movements that indicate discomfort and anxiety.

Avoidance Behavior:

Mathematics anxiety can lead to avoidance of mathematics related activities altogether. These are often expressed through behaviors like refusing to attend

mathematics classes, avoiding assignments, or avoiding situations that necessitate mathematics skills.

1.6 CONSTRUCTION AND STANDARDIZATION OF A SCALE

The construction and standardization of any scale, such as an educational or psychological scale, is a systematic process to ensure that the scale correctly and reliably measures the intended construct.

1.6.1 Scale construction:

Constructing a scale is a detailed and systematic process crucial for developing reliable research measurement tools. It commences with a precise definition of the construct to be measured, followed by a comprehensive literature review to understand both the theoretical and empirical aspects of the construct. This foundational knowledge informs the generation of items in the form of questions or statements, designed to align with the construct's dimensions. The format of the scale, whether a Likert scale, multiple-choice items, or another structure, are chosen based on the construct and research goals.

Subject matter experts play an important role in the content validation phase, rigorously reviewing the scale for ensuring that it thoroughly represents the construct. The scale then undergoes iterative revisions based on expert feedback for improving accuracy and clarity. After which a pilot test is usually conducted with a small participant sample to gather feedback and to make necessary adjustments. This iterative process then results in a reliable and valid measurement tool, which is essential for effective research and data collection (DeVellis & Thorpe, 2021, as cited in Lalrinmawii, 2024).

1.6.2 Scale standardization:

After constructing a scale, standardization is a critical step to ensure that it consistently yields reliable and valid results. The process involves a series of rigorous procedures for evaluating the scale's effectiveness. First, the scale is administered to a large, diverse sample representative of individuals of the target

population, ensuring that it allows the performance of the scale to be capable of generalizing to a broader context. Next, various statistical analyses are performed to assess reliability and validity. Reliability, or the consistency of results, can be evaluated through methods such as the test-retest reliability, in which the same participants complete the scale at two different times, and comparison is made between the two scores. A strong correlation between these two scores indicates the scale's reliability over time.

Construct validity, which is essential for determining whether the scale measures the intended construct, is assessed using techniques like factor analysis to examine the scale's underlying structure, or is assessed by correlating the scale's scores with other established measures which are theoretically related to the construct. During standardization, norms are also developed to serve as benchmarks for interpretation of individual or group scores, which provides a reference point to understand how a particular score compares to the broader population, aiding in meaningful interpretation.

1.6.3 Step for construction and standardization of a scale

It is an elaborate process to create a scale, such as a psychological or educational one, that involves the following steps: (Bai, 2013; Kaur & Singh, 2016; Balamurugan & Govindan, 2019; DeVellis & Thorpe, 2021; Gupta & Verma, 2022; Sarma & Gogoi, 2022; Vishwakarma et al., 2022; Ansary & Saha, 2023, as cited in Lalrinmawii, 2024).

1. Conceptualization:

At the initial stage of scale development, conceptualization involves defining the construct to be measured. Researchers conduct a thorough literature review to explore the construct's different dimensions seeking input from subject matter experts. This approach ensures a well-rounded understanding of the construct which forms a solid basis for the creation of the scale.

2. **Item writing:**

It is crucial to generate a robust pool of potential items. These items, which can be questions or statements, must accurately and precisely represent the construct to ensure that participants provide meaningful and reliable responses.

3. **Expert review:** After items are generated, experts in the field review these items. Expert input is very important to ensure that the items generated effectively represent the intended construct, thereby establishing content validity. Moreover, experts may provide their valuable insights for the enhancement of item wording or formatting.

4. **Pilot testing:** The initial version of the inventory must undergo pilot testing with a small sample. This phase contributes to assessing the comprehensibility of the items, completion time, and identifies any existing potential issues. It offers an opportunity to tune the instrument for a smoother and more effective data collection process.

5. **Item analysis:** Once the items are given out to certain number of samples and then collected back, responses to each item are subjected to rigorous analysis. Items that perform poorly in terms of discrimination or reliability need to be revised or eliminated, so as to enhance the scale's quality and precision.

6. **Finalization of the inventory:** Feedback from the pilot test and item analysis informs the needful to the finalization of the scale. Adjustments are made to ensure clarity and relevance and finally, overall effectiveness.

7. **Administration to a larger sample:** The finalized scale is then administered to a larger, representative sample. This step is essential for standardization, as this ensures that the instrument yields reliable and generalizable results.

8. **Reliability analysis:** To establish the consistency of responses across scale items, researchers typically employ measures like Cronbach's alpha or test-retest reliability. This analysis confirms that the scale produces dependable results.

9. **Validity analysis:** Researchers check if the scale accurately measures the intended construct. This often involves using methods like factor analysis or

correlational analysis with other relevant measures for establishing the scale's validity.

10. **Norming:** Norms or standard scores are established which are based on the responses of the larger sample. These norms serve as a benchmark for interpreting individual or group scores on the scale. This facilitates meaningful comparisons and insights into participants' performance.

To summarize, standardization is a meticulous process that ensures a scale's reliability, validity, and interpretability, thereby making it a valuable tool for research and assessment across various fields. Ethical considerations, guided by professional organizations must be taken into account, such as the American Psychological Association to maintain integrity and ethical standards (Kaur & Singh, 2016; Ansary & Saha, 2023, as cited in Lalrinmawii, 2024).

It is essential to construct and standardize a scale with watchful attention to its relevance suiting to the current context and the target population. During this process, various precautions must be considered to ensure that the scale is both accurate as well as ethical in its measurements.

Therefore, it is crucial to develop and standardize an appropriate tool, such as in the case of the current study, a Mathematics Anxiety Scale. Additionally, the scale's items should broadly cover all relevant dimensions—as the case demands, the constructed scale covers all the different domains of learning: cognitive, affective, and behavioral.

1.7 ACADEMIC ACHIEVEMENT IN MATHEMATICS

Academic achievement is the outcome of education and the extent to which a student, a teacher or an institution has achieved their various educational goals. Academic achievement is usually measured and taken from continuous assessment or results in examinations, although there is no strict agreement on how it should be measured or in deciding which aspects should be given most importance.

Furthermore, academic achievement refers to a person's excellent performance in a given academic field. It generally refers to how well a student

accomplishes his or her studies and tasks. The most well-known indicator is the student's 'score' in a specific period of studies such as the overall period of academic year, etc. (Paulpandi & Govindharaj, 2017). Academic achievement in mathematics therefore, refers to the achievement or accomplishment of students in mathematics subject. This may be measured from a specific period of time.

Numerous studies have been conducted over the past several decades to determine the various factors that influence mathematics achievement. Many literatures have stated the influence of different factors affecting mathematics achievement including teacher-student relationship, students' self-efficacy, attitude, student's perception of mathematics, etc. (Yunus & Awang, 2022). Of which, anxiety on mathematics has been noticed to be one of the major studies conducted over many years.

These studies have demonstrated the influence of various factors on mathematics achievement, with some showing significant effects while others do not. For instance, among the many findings, it has been shown that mathematics anxiety negatively affects students' mathematical performance (Zanabazar, et al., 2023). The findings of Marsh and Tapia (2002) indicate that students with low levels of mathematics anxiety feel more confident, more excited and highly motivated to learn mathematics as compared to students who have high anxiety levels. However, the research findings of Josiah and Adejoke (2023) found that the differences in achievement across mathematics anxiety groupings (low, medium and high) were all non-significant.

1.8 RATIONALE OF THE STUDY

Mathematics is regarded as a critical subject in secondary stage of education. The knowledge of mathematics is applied in various professions. Considering its importance and usefulness in every walk of life, failing to be comfortable with mathematics and experiencing mathematics anxiety will affect a person's life for the worse. It is known that anxiety disorders contribute to some of the most common mental health problems throughout the world (Habibah et al., 2023). Free of it for instance, a person who is good in mathematics are considered to be good in decision

making and critical thinking. Thus, it can be said that a person should have certain mathematical skills in life, to survive and to ease life itself.

Achieving this goal will be easier if the misconception that mathematics is only for ‘smart people’ is removed from students' minds. Many students approach mathematics having a preconceived notion that it is inherently difficult, even before making effort to study and understand the subject (Capuno et al., 2019, as cited in Kunwar et al., 2022). Therefore, examining mathematics anxiety is crucial, as it affects academic performance, mental health, and most importantly, future opportunities for students.

The secondary stage of education is a critical period during which students are at the age of making decisions about their future and the possible career paths they will pursue. They are at the age of adolescence where the brain has an astonishing ability to adapt and respond to new experiences and situations (National Institute of Mental Health, n.d.). This can be believed to play a significant role in shaping students’ perceptions of mathematics and in influencing their mindset towards the subject. Thus, knowledge on knowing the levels of mathematics anxiety secondary school students have will aid in taking steps to further understand how to tackle possible problems.

Comparative education is a field of education that assists in developing educational system of different regions. It deepens and broadens understanding for better possible outcome for developing education in the region studied. Furthermore, comparing education across different regions can rather be an intriguing endeavor. Analysing two regions that may seem to have a noticeable impact may be believed to help capture one’s attention which will probably result in having positive impact to be effective.

Meghalaya has always been reputable to be the hub for education and higher educational facilities that is exemplary (RUSA Meghalaya, n.d). The researcher has dug deep but found no studies that convey that the state has ever been subjected to comparison with other states in India, let alone any North-East states on account of mathematics anxiety among secondary school students. Additionally, enhancing both

convenience and educational advantage, Mizoram as a neighbouring state which ranks the third in literacy rate in the Country (Onmanorama, 2023), is one of the most suitable and intriguing state to compare with Meghalaya. The researcher feels a study such as mathematics anxiety among secondary school students between the two states will be an interesting educational study with the hope that it will open the minds for positive furtherance in several fields.

Furthermore, this research is expected to promote equity in education in a way that it is expected to identify and address disparities among students studying in the two states. The society in Mizoram follows a patriarchal society which is different from that of Meghalaya which follows a matriarchal society. No other study has been found that conducts a comparative study of mathematics anxiety of secondary students of different regions with such a societal situation over the past. So, the researcher felt the need to conduct the study to see if gender had an impact on the mathematics anxiety among secondary school students while taking into account the varying societal situations.

Various factors contribute to mathematical anxiety among students, including environmental influences, cognitive factors, inappropriate teaching methods, learner characteristics, parental factors, etc (Kour & Razaqi, 2024). Understanding and identifying these underlying reasons, will definitely contribute to implementing effective strategies to minimise mathematical anxiety and improve students' experiences in mathematics. Furthermore, a study examining the relation of mathematics anxiety with academic achievement in mathematics across the two states will enhance the understanding of where to focus efforts for improving mathematical instruction and support.

The researcher found that no comparative study on mathematics anxiety with reference to different aspect and variables among secondary school students in the states of Mizoram and Meghalaya has been conducted in the past. Therefore, the researcher recognized the necessity of conducting a comparative study between the two states, with anticipation that it would reveal the current perceptions of mathematics among secondary school students in the said region and possibly lead to

necessary actions for the advancement of mathematics subject in both the states, Mizoram and Meghalaya and potentially benefit others as well.

1.9 RESEARCH QUESTIONS

These factors serve as the reasons behind the proposal of the current study. The proposed study seeks to address the following research questions:

1. Would it be possible to find out the level of mathematics anxiety among secondary school students of Mizoram?
2. Would it be possible to know the level of mathematics anxiety among secondary school students of Meghalaya?
3. Will there be any significant difference with regards to the level of mathematics anxiety between secondary school students of Mizoram and Meghalaya?
4. Will there be any significant difference with regards to the level of mathematics anxiety between male and female secondary school students of Mizoram and Meghalaya?
5. Will there be any significant difference with regards to the level of mathematics anxiety between male secondary school students of Mizoram and Meghalaya?
6. Will there be any significant difference with regards to the level of mathematics anxiety between female secondary school students of Mizoram and Meghalaya?
7. Will there be any significant difference with regards to the level of mathematics anxiety between male and female secondary school students of Mizoram?
8. Will there be any significant difference with regards to the level of mathematics anxiety between male and female secondary school students of Meghalaya?
9. Will there be any significant difference with regards to the level of mathematics anxiety between secondary school students of rural and urban origin?
10. Will there be any significant difference with regards to the level of mathematics anxiety between rural and urban origin secondary school students of Mizoram?

11. Will there be any significant difference with regards to the level of mathematics anxiety between rural and urban origin secondary school students of Meghalaya?
12. Will there be any significant difference with regards to the level of mathematics anxiety between rural origin secondary school students of Mizoram and Meghalaya?
13. Will there be any significant difference with regards to the level of mathematics anxiety between urban origin secondary school students of Mizoram and Meghalaya?
14. What might be the reason or reasons for mathematics anxiety among secondary school students?
15. Does mathematics anxiety affect the performance of secondary school students in mathematics?
16. To what extent will mathematics anxiety predict academic achievement in mathematics among secondary school students?

1.10 STATEMENT OF THE PROBLEM

The problem addressed in this thesis is the lack of a standardized and validated Mathematics Anxiety Scale specific to secondary school students in Mizoram and Meghalaya, as well as a limited understanding of the relationship between mathematics anxiety and academic achievement in mathematics among this population. This knowledge gap hinders the effective assessment of mathematics subject and its perception on secondary school students in both the states. Therefore, there is a need to construct and standardize a reliable Mathematics Anxiety Scale tailored to the unique context of Mizoram and Meghalaya, and to investigate the relationship between mathematics anxiety and academic achievement in mathematics. The scale would definitely enhance better educational practices in promoting healthier perception on mathematics and aid in taking necessary actions for improving teaching and learning of mathematics subject. The problem proposed to be investigated reads as,

‘Mathematics Anxiety and Academic Achievement in Mathematics among Secondary School Students of Mizoram and Meghalaya.’

1.11 OBJECTIVES OF THE STUDY

1. To standardize a scale to measure the mathematics anxiety of secondary school students.
2. To find out the level of mathematics anxiety among secondary school students of Mizoram.
3. To study the level of mathematics anxiety among secondary school students of Meghalaya.
4. To compare the level of mathematics anxiety between secondary school students of Mizoram and Meghalaya.
5. To compare the level of mathematics anxiety between male and female secondary school students of Mizoram and Meghalaya.
6. To compare the level of mathematics anxiety between male secondary school students of Mizoram and Meghalaya.
7. To compare the level of mathematics anxiety between female secondary school students of Mizoram and Meghalaya.
8. To compare the level of mathematics anxiety between male and female secondary school students of Mizoram.
9. To compare the level of mathematics anxiety between male and female secondary school students of Meghalaya.
10. To compare the level of mathematics anxiety between secondary school students of rural and urban origin.
11. To compare the level of mathematics anxiety between rural and urban origin secondary school students of Mizoram.

12. To compare the level of mathematics anxiety between rural and urban origin secondary school students of Meghalaya.
13. To compare the level of mathematics anxiety between rural origin secondary school students of Mizoram and Meghalaya.
14. To compare the level of mathematics anxiety between urban origin secondary school students of Mizoram and Meghalaya.
15. To analyse the reason or reasons for mathematics anxiety among secondary school students.
16. To find out the relationship between mathematics anxiety and achievement in mathematics.
17. To examine the impact of mathematics anxiety on academic achievement in mathematics among secondary school students.

1.12 HYPOTHESES OF THE STUDY

1. There is significant difference in the level of mathematics anxiety among secondary school students of Mizoram and Meghalaya.
2. There is significant difference in the level of mathematics anxiety between male and female secondary school students of Mizoram and Meghalaya.
3. There is significant difference in the level of mathematics anxiety between male secondary school students of Mizoram and Meghalaya.
4. There is significant difference in the level of mathematics anxiety between female secondary school students of Mizoram and Meghalaya.
5. There is significant difference in the level of mathematics anxiety between male and female secondary school students of Mizoram.
6. There is significant difference in the level of mathematics anxiety between male and female secondary school students of Meghalaya.

7. There is significant difference in the level of mathematics anxiety between secondary school students of rural and urban origin.
8. There is significant difference in the level of mathematics anxiety between rural and urban origin secondary school students of Mizoram.
9. There is significant difference in the level of mathematics anxiety between rural and urban origin secondary school students of Meghalaya.
10. There is significant difference in the level of mathematics anxiety between rural origin secondary school students of Mizoram and Meghalaya.
11. There is significant difference in the level of mathematics anxiety between urban origin secondary school students of Mizoram and Meghalaya.
12. There is a significant relationship between mathematics anxiety and achievement in mathematics among secondary school students of Mizoram and Meghalaya.
13. Mathematics anxiety has an impact on the academic achievement in mathematics among secondary school students.

1.13 OPERATIONAL DEFINITIONS OF THE KEY TERMS USED

Mathematics: For the present study, mathematics refers to the subject studied by secondary school students.

Anxiety: It refers to a feeling of pressure and worries which affect a person's life.

Mathematics anxiety: For the present study, it is the negative reaction that secondary school students show when encountering any mathematics related situations.

Academic Achievement: For the present study, it is the mark obtained by secondary students in mathematics subject in their previous class, i.e., Class 9.

Secondary school students: Secondary school students in this present study includes students in 10th grade.

1.14 STRUCTURAL FRAMEWORK OF THE STUDY

The current investigation has been structured so as to align with the various objectives, allowing the researcher to present the findings with clarity and precision.

- Chapter-I: The First Chapter deals with the Introduction- The Development of mathematics, Branches of mathematics, Mathematics as the language of the universe, Relevance of mathematics, Mathematics at Secondary stage in India, Anxiety, Mathematics Anxiety, Expressions of mathematics anxiety through different domains, Academic achievement in mathematics, Rationale of the study, Statement of the problem, Research questions, Objectives, Hypotheses, Operational definitions of the key terms used and Structural framework of the study.
- Chapter-II: The Second Chapter- 'Review of Related Literature' deals with the related studies conducted with reference to various variables and also the relevance of the present study in the background of studies reviewed.
- Chapter-III: The Third Chapter- 'Methodology' deals with Introduction, Research approach, Population and sample, tools for data collection, tabulation of data, tabulation and procedures adopted for data analysis
- Chapter-IV: The Fourth Chapter is on Analysis and Interpretation of Data
- Chapter-V: The Fifth Chapter includes Major Findings, Discussions, Recommendations and Suggestions for further research.

CHAPTER II

REVIEW OF RELATED LITERATURE

This chapter focuses on analysing related literature of the present research. The objective is to understand the nature of previous studies conducted in the same area and to identify what has already been explored, which serves as the foundation for the current research.

Examining related literature and prior research not only establishes a conceptual framework for the proposed study, but also offers valuable guidance on appropriate methodologies, procedures, data sources, and statistical techniques for addressing the identified problem. This review enables the researcher to formulate hypotheses that are logically grounded in the context of the study. The process typically involves consulting a variety of sources, including books, dissertations, manuals, academic journals, articles, and theses.

2.1 INTRODUCTION

The literature reviewed is divided broadly into three categories – Studies on mathematics anxiety, studies on mathematics anxiety in relation to academic achievement in mathematics and studies on reasons of mathematics anxiety. A total of 85 literature were reviewed in this chapter, of which 55 studies were conducted abroad while the rest 30 studies were conducted in India. It covers studies conducted for a span of 67 years from 1957 to 2024.

A comprehensive overview of the range of years and studies conducted abroad and in India is summarized in the following table-

Table 2.1

Details of related studies reviewed

Sl. No.	Studies with respect to location	Span of Years	Total
1.	Studies on mathematics anxiety conducted abroad	2004-2024	14
2.	Studies on mathematics anxiety in relation to academic achievement in mathematics conducted abroad.	1957-2024	24
3.	Studies on reasons of mathematics anxiety conducted abroad	1999-2023	17
4.	Studies on mathematics anxiety conducted in India	2014-2024	10
5.	Studies on mathematics anxiety in relation to academic achievement in mathematics conducted in India	2009-2024	13
6.	Studies on reasons of mathematics anxiety conducted in India	2020-2022	7
Total			85

The table 2.1 summarizes review of literature for the present study across different locations and time spans. It encompasses a total of 85 studies conducted on mathematics anxiety, with a notable emphasis on various themes and geographic locations.

A total of 14 studies were conducted abroad on mathematics anxiety between 2004 and 2024. Studies examining the relationship between mathematics anxiety and academic achievement abroad totalled 24, conducted from 1957 to 2024.

Additionally, 17 studies focused on the causes of mathematics anxiety abroad, spanning from 1999 to 2023.

In India, 10 studies on mathematics anxiety were conducted between 2014 and 2024, while 13 studies explored the link between mathematics anxiety and academic achievement in India from 2009 to 2024. Furthermore, 7 studies were dedicated to understanding the causes of mathematics anxiety in India, conducted between 2020 and 2022.

The following table 2.2 shows the number of literatures reviewed with respect to the different variables in accordance with the objectives, i.e., gender, locale, academic achievement in mathematics and reasons of mathematics anxiety.

Table 2.2

Number of related literatures reviewed according to variables

Sl. No.	STUDIES	TOTAL
Studies on mathematics anxiety conducted abroad		
1.	Studies on mathematics anxiety with reference to gender	10
2.	Studies on mathematics anxiety with reference to locale	3
3.	Studies on mathematics anxiety in relation to academic achievement in mathematics	21
4.	Studies on reasons of mathematics anxiety	12
Studies on mathematics anxiety conducted in India		
1.	Studies on mathematics anxiety with reference to gender	19
2.	Studies on mathematics anxiety with reference to locale	7
3.	Studies on mathematics anxiety in relation to academic achievement in mathematics	14
4.	Studies on reasons of mathematics anxiety	12

2.2 STUDIES CONDUCTED ABROAD:

Studies conducted abroad were categorized into three distinct groups

1. Studies on mathematics anxiety conducted abroad
2. Studies on mathematics anxiety in relation to academic achievement in mathematics conducted abroad.
3. Studies on reasons of mathematics anxiety conducted abroad

2.2.1 Studies on mathematics anxiety conducted abroad

Tapia and Marsh (2004) explored “The Relationship of Mathematics Anxiety and Gender,” focusing on the impact of mathematics anxiety and gender on students' attitudes toward mathematics. A total of 134 students enrolled in mathematics classes at a state university responded the Attitudes Toward Mathematics Inventory (ATMI). Through multivariate factorial analysis, the study found that gender did not influence attitudes toward mathematics, nor did the interaction between gender and mathematics anxiety have any significant impact on attitudes. However, there was a notable significant effect of mathematics anxiety on self-confidence, enjoyment, and motivation, with a large effect size. Specifically, students without mathematics anxiety exhibited significantly higher enjoyment levels compared to those with high math anxiety.

Chinn (2009) investigated “Mathematics Anxiety in Secondary Students in England,” focusing on various aspects of mathematics that students identified as anxiety-inducing. A sample of over 2,000 students from both independent and mainstream schools in England completed a 20-item questionnaire assessing mathematics anxiety levels. This questionnaire was also administered to over 440 dyslexic males in specialized educational settings within the same age group. The results indicated that approximately 4% of students experienced high anxiety levels related to examinations and tests. Moreover, certain topics within the mathematics curriculum, particularly long division, were shown to provoke similar anxiety levels across different year groups in secondary education.

Abbasi et al. (2013) in their study, “Study of Mathematics anxiety in High School Students and its Relationship with Self-Esteem and Teachers’ Personality Characteristics,” examined the connections between mathematics anxiety, self-esteem, and the personality traits of mathematics teachers among high school students. Using categorical sampling, 480 students were selected, along with 60 mathematics teachers. Data were gathered using Cooper Smith’s Self-Esteem Questionnaire, a Mathematics anxiety Questionnaire, and the Neo Personality Questionnaire. Analysis of the data revealed the following key findings: a significant negative relationship exists between students’ Mathematics anxiety and their self-esteem; a significant association was found between students’ mathematics anxiety and their teachers’ personality characteristics. No significant relationship, however, was identified between mathematics anxiety and students’ academic levels. Lastly, a significant difference in mathematics anxiety was noted between male and female students, in which females were found to have higher anxiety as compared to males.

Keshavarzi and Ahmadi (2013) conducted a study titled “A Comparison of Mathematics Anxiety Among Students by Gender,” targeting high school science and mathematics students across four districts in Shiraz. Utilizing random-cluster sampling, the researchers employed Chiu and Henry’s “Mathematics anxiety Scale for Children” (MASC) to evaluate students’ anxiety levels. The results indicated that there was no statistically significant difference in mathematics anxiety between girls and boys overall. However, in the dimension of mathematics problem-solving and evaluation, girls scored higher on average, whereas boys reported higher anxiety levels stemming from teacher interactions, with these differences reaching statistical significance.

Mutodi and Ngirande (2014), in their study titled “Exploring Mathematics Anxiety: Mathematics Students’ Experiences,” aimed to assess mathematics anxiety levels among students at a selected South African tertiary institution. They examined variations in mathematics anxiety according to gender, age, and home language. This quantitative study involved 120 randomly selected respondents (84 male and 36 female), with mathematics anxiety levels measured using Jerran’s Maths Centre

instrument (2012). Findings indicated high levels of mathematics anxiety among respondents, especially among female students. A t-test analysis revealed a significant mean difference between male and female in mathematics anxiety on the basis of gender.

Amam et al. (2019), did a study titled “Math Anxiety Performance of the 8th Grade Students of Junior High School,” to assess the levels of mathematical anxiety among junior high school students. The research included all students from Class VIII across seven different classes, with 95 students selected via cluster random sampling. The data were analysed using descriptive statistics, a t-test, and the Kruskal-Wallis test. Key findings indicate that the overall level of mathematical anxiety among students falls within the low category. However, differences in mathematical anxiety levels were observed across class categories, while no significant difference was found in mean mathematical anxiety between male and female students.

Ambaranti and Retnowati (2019) conducted a study titled “Exploring Mathematics Anxiety Among Senior High School Students” to investigate differences in mathematics anxiety among students based on gender, grade level, and academic programs. Data were collected from a sample of 215 students across four Indonesian cities. Descriptive and inferential analyses showed that high school students generally experienced moderate levels of mathematics anxiety. Male students reported lower anxiety than female students, but this difference was not statistically significant. However, 12th-grade students displayed the highest levels of anxiety, followed by 10th and 11th graders, with a statistically significant mean difference between the 10th and 11th graders, suggesting that 11th-grade students demonstrated a more positive attitude towards mathematics.

Anugrah et al. (2019) examined “Mathematics Anxiety in Dealing Math Exams” among 17 students in a qualitative case study. The research utilized purposeful sampling, with data collected through observations, interviews, and a questionnaire. Findings indicated that students primarily experienced moderate levels of mathematics anxiety, with 29.4% of students reporting high anxiety, 41.2%

moderate, and 29.4% low levels. Teacher interviews revealed that students of both high and low academic achievement encountered light anxiety, indicating a general trend in student experiences.

Brown et al. (2020) explored cultural variations in mathematics anxiety in their study titled “Does Mathematical Anxiety Differ Cross-Culturally?” focusing on engineering students in the southeastern United States and Colombia. A sample of 108 engineering students completed the AMAS, with data analysed via factorial ANOVA. The results revealed a statistically significant difference in mathematics learning anxiety between the two cultural groups, indicating potential cultural influences on mathematics anxiety in educational contexts.

Delgado-Monge et al. (2020) in their paper “Comparative Study on Mathematical Anxiety Among Students from Costa Rica and Spain,” compared Mathematics anxiety among university students from the National University of Costa Rica and the University of Granada in Spain. The factorial design analysed mathematics anxiety as a dependent variable with nationality, sex, and degree program as factors. Results indicated similar levels of mathematics anxiety among students in both countries. However, students with extensive mathematics coursework reported significantly less anxiety across different contexts, including general mathematics anxiety and exam-related anxiety. Gender differences were not statistically significant, though female students in both countries generally reported higher anxiety levels across all measures.

Sarfo et al. (2020) conducted a study titled “Gender Differences in Mathematics Anxiety Across Cultures: A Univariate Analysis of Variance Among Samples from Twelve Countries,” to investigate gender-based differences in mathematics anxiety (MA) across cultural contexts using the Anxiety Towards Mathematics Scale (ATMS). Data were collected from 4,340 students across 12 countries. Univariate analysis of variance indicated that gender significantly affects MA, with females recording higher mean scores than males (71.816 vs. 68.118). Furthermore, significant gender-location interaction effects were found, with females showing higher MA scores across most locations, except in Egypt, Malaysia, and

Nigeria (Enugu State), where no significant gender difference was observed. Ranking by gender, the top-three locations with the highest female MA scores were Malaysia, Thailand (Bangkok), and Nigeria (Enugu State), while males ranked Malaysia, Nigeria (Enugu State), and Thailand (Bangkok) as the highest.

Nirmal et al. (2021) conducted a research study on “The Impact of Mathematics Anxiety and their Factors on Gender Basis,” to analyse mathematics anxiety (MA) levels at Mehran University of Engineering and Technology, focusing on cognitive, psychological, physical, and environmental factors across gender. The study employed descriptive statistics and regression analysis, analysed through SPSS, and found that the cognitive factor had the highest impact on MA levels, while the physical factor had the lowest. The findings further indicated that physical and environmental factors significantly influenced gender-based differences in MA.

Rahaman et al. (2023) examined “Gender and Mathematics Anxiety Among Senior High School Students” in the Sagnarigu Municipality of Ghana, using a quantitative cross-sectional design. Data from 385 students were analysed using descriptive and inferential statistics, including the Mann-Whitney U Test for gender comparisons. The findings showed high levels of mathematics anxiety among students, with gender exerting a significant influence; females exhibited notably higher levels of Mathematical Anxiety than males.

Souza et al. (2024) in their study “Mathematical anxiety is associated with the school context: correlational study between rural, urban and suburban schools” investigated the influence of school context on the prevalence of Mathematical Anxiety (MA) as well as on mathematical performance of school children, considering different educational contexts (rural, urban, and suburban) and gender of the participants (female & male). Self-reported scale of mathematical anxiety - Anxiety Rating Scale for Elementary Children- MARS-E- was used on totalling 312 students from the 5th and 6th year of elementary school. The results indicated that MA is related to the school context when it was associated with gender. In urban/suburban school contexts, girls of suburban group had higher MA than girls of urban group. For rural/suburban contexts, boys of rural area had higher MA

compared to their peers in the suburban group. No results of such were found associated with rural/urban contexts. Thus, the findings suggested that depending on the school context, MA seems to have an impact on gender differently. The result also showed that there exists social and environmental influence such as the school context on Mathematical Anxiety and mathematical performance when considering gender.

2.2.2 Studies on mathematics anxiety in relation to academic achievement in mathematics conducted abroad.

Dreger and Aiken (1957) conducted “The Identification of Number Anxiety in a College Population,” aiming to identify the presence of emotional reactions to arithmetic and mathematics, termed “Number Anxiety.” Involving 704 students enrolled in basic mathematics at Florida State University, the study demonstrated that number anxiety appears distinct from general anxiety. The study also found that individuals with high number anxiety tended to achieve lower mathematics grades.

Aiken et al. (1961) did research titled “The Effect of Attitudes on Performance in Mathematics,” to assess how mathematical attitudes influence achievement among freshman students. Using multiple aptitude tests and attitude scales, the study suggested that attitudes toward mathematics can predict achievement for females, but not for males. Modest correlations between mathematics experiences and attitudes supported the role of attitudes in influencing performance.

Degnan (1967) explored “General Anxiety and Attitudes Toward Mathematics in Achievers and Underachievers in Mathematics” by comparing high-achieving and underachieving 8th-grade students' general anxiety levels and attitudes toward mathematics. Results indicated achievers exhibited higher anxiety levels compared to underachievers, supporting the notion that negative attitudes correlate with lower mathematics achievement among students who excel in other subjects. This finding suggests that anxiety may positively influence learning in certain contexts.

Anttonen (1969) did a study titled “A Longitudinal Study in Mathematics Attitude,” to investigate the relationship between mathematics attitude and achievement over six years in a sample of 607 students. Results showed significant positive correlations between early and later mathematics attitudes, as well as between attitude and achievement measures, indicating a stable relationship between mathematics attitudes and achievement over time.

Adams and Holcomb (1986) analysed “The Relationship Between Anxiety About Mathematics and Performance” in a sample of 92 college statistics students. Canonical analysis revealed a significant “Mathematics Efficiency” factor linking mathematics anxiety and performance, with attitude and anxiety being major contributors. The study emphasizes that reducing anxiety and improving attitudes may effectively enhance mathematics performance.

Cooper and Robinson (1989) examined “The Influence of Gender and Anxiety on Mathematics Performance” with 298 male and 83 female engineering students. Results showed no significant gender differences in mathematics ability, anxiety, or performance. However, mathematics anxiety, especially the “worry” aspect of test anxiety, negatively affected performance beyond mathematics ability alone, accounting for 50% of the variance in advanced mathematics tasks.

Meece et al. (1990) investigated “Predictors of Mathematics Anxiety and Its Influence on Young Adolescents’ Course Enrolment Intentions and Performance” with 250 7th- to 9th-grade students. Findings showed that mathematics anxiety closely relate to self-perceived mathematics ability, performance expectancies, and value perceptions. While performance expectancies predicted mathematics grades, value perceptions influenced course enrolment intentions, suggesting that mathematics anxiety impacts perceptions but not grades or intentions directly. The patterns observed were consistent across genders.

Satake and Amato (1995) conducted “Mathematics Anxiety and Achievement Among Japanese Elementary School Students” to examine the prevalence, correlates, and impact of mathematics anxiety among Japanese children. Using a translated

version of the mathematics anxiety Rating Scale for Elementary School Students (MARS-E), the study involved 154 fifth- and sixth-grade students. Factor analysis identified four distinct dimensions of mathematics anxiety, and factor scores were calculated for each dimension. The comparison of these mean factor scores across low, middle, and high achievers showed significant differences in mathematics anxiety levels among the achievement groups, indicating that mathematics anxiety varies meaningfully with performance level.

Ho et al. (2000) conducted a study titled “The Affective and Cognitive Dimensions of Math Anxiety: A Cross-National Study,” which investigated mathematics anxiety by comparing its dimensions, levels, and relationship with mathematics achievement among sixth-grade students from China, Taiwan, and the United States. The findings revealed a significant negative correlation between the affective dimension of mathematics anxiety and mathematics achievement across the three national samples. The study also identified significant difference between boys and girls across the nations for both affective and cognitive dimensions of mathematics anxiety.

Mohamed and Tarmizi (2010) conducted a comparative study titled “Anxiety in Mathematics Learning Among Secondary School Learners: A Comparative Study Between Tanzania and Malaysia” to explore mathematics anxiety levels and its impacts on academic performance in Malaysia and Tanzania. Using the 24-item MARS-A scale (adapted from the original 98-item MARS-A), the study analysed responses from secondary school students. Findings revealed that Malaysian students exhibited higher test-related anxiety than Tanzanian students (mean scores: 2.56 vs. 2.33). Gender differences in mathematics anxiety were not significant in either country, but senior students showed more anxiety than juniors in both nations. A negative correlation was observed between anxiety levels and grades, suggesting an inverse relationship between mathematics anxiety and student performance.

Engelhard (2012) examined “Math Anxiety, Mother’s Education, and the Mathematics Performance of Adolescent Boys and Girls: Evidence from the United States and Thailand” to understand how these factors relate to mathematics

performance. Using nationally representative samples of 13-year-olds from the U.S. (N = 4,091) and Thailand (N = 3,613), the study employed ANOVA analyses to assess the influence of mathematics anxiety, mother's education, and gender on performance. Findings indicated an inverse relationship between mathematics anxiety and performance in both countries (U.S. $r = -0.24$; Thailand $r = -0.14$). Results also suggested a three-way interaction between mathematics anxiety, mother's education, and gender, particularly significant in Thailand.

Zakaria (2012) investigated "Mathematics Anxiety and Achievement Among Secondary School Students" in Selangor, Malaysia, focusing on gender differences and achievement levels based on anxiety. The study, which involved 195 students, used an adapted Fennema-Sherman Mathematics Attitudes Scale and analysed data with SPSS. Findings indicated significant levels of mathematics anxiety but no notable gender-based differences. However, one-way ANOVA results revealed significant differences in achievement based on anxiety level, confirming a connection between higher anxiety and lower mathematics performance.

Seng (2015) did a study titled "The Influence of Pre-University Students' Mathematics Test Anxiety and Numerical Anxiety on Mathematics Achievement," to analyse the relationship between test and numerical anxiety on mathematics achievement, along with gender-related differences. With 140 pre-university students, multiple regression analyses demonstrated significant impacts of anxiety on performance, with non-parametric tests confirming mathematics anxiety as a significant predictor of achievement, with positive coefficient of correlation.

Reali et al. (2016) examined the relationship between mathematics anxiety and performance in "Examining the Link Between Math Anxiety and Math Performance in Colombian Students." The study, which included 296 students aged 8–16, found a significant negative correlation between mathematics performance and mathematics anxiety, with the effect stronger in girls than boys. Given Colombia's lower mathematics scores on PISA reports, the study highlighted the impact of anxiety on performance.

Shishigu (2018) conducted a study titled “Mathematics Anxiety and Prevention Strategy: An Attempt to Support Students and Strengthen Mathematics Education” to assess the prevalence and impact of mathematics anxiety on student achievement in Ethiopia’s East Shoa Zone. Using the Math Anxiety Rating Scale (MARS) and achievement tests, structural modelling revealed a negative correlation between anxiety and performance. Gender differences were statistically significant, in which female shows higher anxiety compared to male.

Buratta et al. (2019), in their study titled “Mathematics Anxiety and Cognitive Performance in Adolescent Students,” aimed to explore the link between mathematics-specific anxiety and cognitive performance among a sample of 83 adolescent students, of whom 78.3% were male. The findings revealed that 38% of the students experienced a high level of mathematics anxiety. An independent t-test indicated that female students reported higher levels of both mathematics anxiety and general trait and state anxiety compared to their male counterparts, though no significant differences in mathematics performance were noted between genders. A multivariate linear regression analysis demonstrated that mathematics anxiety was influenced by trait anxiety and subsequently impacted higher-level mathematics performance, particularly in areas such as arithmetic facts.

Thi et al. (2021) investigated “An Investigation of Mathematics Anxiety and Academic Coping Strategies Among High School Students in Vietnam,” analysing the relationships between anxiety, gender, grade, career choices, and achievement among 1,548 students. This study used the Revised Version of the mathematics anxiety Rating Scale to survey 1,548 high school students. Results from MANOVA, Pearson correlation, and regression analysis indicated that grade, achievement, and career intentions significantly affect anxiety levels. The findings show a weak positive correlation significance between mathematics anxiety and gender as well as mathematics anxiety and average mathematics score.

Mutegi et al. (2021) conducted a study titled “Mathematics Anxiety, Attitude, and Performance Among Secondary School Students in Kenya,” aiming to analyse the relationship among mathematics anxiety, students’ attitudes towards

mathematics, and academic performance. Utilizing a correlational research design, data was gathered from 367 students, randomly selected from 55 secondary schools. Instruments included an adapted Mathematics anxiety Scale (MAS) and the Attitude Towards Mathematics Inventory (ATMI). The relationship was initially visualized with scatter plots and then analysed using Spearman's correlation coefficient. A significant positive linear relationship was found between mathematics anxiety and mathematics attitude ($r = 0.538$, $p < 0.05$), indicating that higher anxiety was associated with a more negative attitude. The study also found that a significant negative linear relationship was identified between mathematics anxiety and performance ($r = -0.723$, $p < 0.05$), suggesting that high anxiety is linked to poorer performance. These findings imply that students' attitudes towards mathematics correlate with anxiety, which subsequently affects performance.

Bashir et al. (2023) conducted a study on "Gender Difference in Student's Attitude Towards Mathematics and Their Academic Achievements at Secondary Level," to investigate differences in attitudes towards mathematics and academic achievement based on gender among secondary-level students. The researchers collected data from three secondary schools in Rawalakot and two in Muzaffarabad, selecting 200 students (100 boys and 100 girls) through random sampling. The study utilized a 39-item Attitude Scale towards Mathematics and a 65-item Academic Achievement Scale. Data analysis showed that there were no significant gender differences in students' enjoyment and motivation towards mathematics. However, significant gender differences emerged in terms of fear and anxiety, with female students exhibiting higher levels. Overall, there were no significant gender differences in academic achievement in mathematics.

Bornaa et al. (2023), in their paper "Mathematics Anxiety and Academic Performance of Senior High School Students in Sagnarigu Municipality, Ghana," examined the link between mathematical anxiety and academic achievement. Utilizing a quantitative approach and an analytical cross-sectional design, 385 students from two senior high schools were randomly selected. The Pearson product-moment correlation analysis revealed that mathematics anxiety was strongly

negatively associated with mathematics performance ($r = -0.85$), indicating that higher levels of anxiety were linked to lower academic achievement in mathematics.

Mweni et al. (2023) conducted a study titled “Relationship Between Student Anxiety and Achievement in Mathematics Among Secondary School Students in Ganze District, Kilifi County, Kenya,” to assess the connection between mathematics anxiety and achievement. Using a Descriptive Survey design, the researchers collected data from 250 students with a mathematics anxiety Rating Scale and a Mathematics Achievement Test. The findings indicated a statistically significant positive correlation ($r_{xy} = 0.38$) between anxiety and achievement, i.e., as anxiety levels increase, achievement tends to increase as well, though the relationship is not very strong.

Tawaldi et al. (2023), in their paper “Is Mathematics Anxiety Related to Mathematics Learning Outcome? A Meta-Analysis,” investigated the association between mathematics anxiety and learning outcomes, with an additional focus on the moderating effects of education level and demographic factors. This meta-analysis employed a random-effects model, alongside the Q Cochrane test and Z test, facilitated by the Comprehensive Meta-Analysis (CMA) software. The findings indicated a weak negative relationship between mathematics anxiety and learning outcomes ($r = -0.134$), suggesting that higher anxiety only marginally correlates with reduced performance. The study also found that neither education level nor demographic factors significantly moderated the relationship between mathematics anxiety and learning outcomes, highlighting the limited impact of these variables on academic outcomes in mathematics.

Malu et al. (2024) examined the “Relationship Between Mathematics Anxiety and Achievement of Senior Secondary School Students in Gombe State,” adopting a correlational research design. The study encompassed all 137 public senior secondary schools in Gombe State, with a sample of 395 students selected through a multistage cluster sampling technique. Data were collected using the Mathematics Achievement Test (MAT) and Mathematics anxiety Scale (MAS) and analysed with Pearson’s Product Moment Correlation (PPMC), multiple regression, and t-tests.

Results revealed no significant relationship between mathematics anxiety and academic achievement among senior secondary school students in Gombe State, suggesting that mathematics anxiety may not directly impact students' performance in this region.

Francis (2024) explored the “Impact of Anxiety on Mathematics Ability in Tanzanian Secondary School Students: A Case Study of Singida District,” focusing on the influence of Mathematics anxiety on academic performance. The study involved 1,150 students from 12 secondary schools in Singida district, who completed standardized questionnaires with closed-ended questions. Academic performance was also measured using students' terminal examination results in mathematics. Findings indicated a statistically significant effect ($p = 0.025$, two-tailed) of mathematics anxiety on academic performance, with a correlation coefficient of $r = 0.425$, suggesting a substantial positive relationship between anxiety and mathematics performance. Regression analysis further indicated that mathematics anxiety significantly impacts mathematical ability, showing the relevance of anxiety in shaping academic outcomes.

2.2.3 Studies on reasons of mathematics anxiety conducted abroad

Trujillo and Hadfield (1999) in their study “Tracing the Roots of Mathematics Anxiety through In-Depth Interviews with Preservice Elementary Teachers,” utilized the Revised Mathematics anxiety Rating Scale (R-MARS) to examine factors contributing to mathematics anxiety among 50 preservice teachers. Notable trends included negative experiences in school, insufficient family support, and a general predisposition to test anxiety among participants, providing insight into potential early influences on mathematics anxiety development.

Smith (2004) conducted a study “Math Anxiety: Causes, Effects, and Preventative Measures,” to explore the impact of teacher attitudes on student mathematics anxiety. Using the Mathematics Attitude Inventory, Smith assessed two different classes with different teachers, comparing students' attitudes towards mathematics with those of their teachers. Findings demonstrated that teachers'

attitudes significantly influence students' attitudes toward mathematics, indicating that teacher disposition may play a role in fostering or mitigating mathematics anxiety.

Finlayson (2014) conducted research titled "Addressing Math Anxiety in the Classroom," which examined the roots of mathematics anxiety and strategies preservice teachers might use to alleviate it. Data collected from surveys of 70 preservice teachers in Canada identified common causes of mathematics anxiety, including low self-confidence, fear of failure, certain teaching styles, ineffective learning practices, and lack of student engagement. These findings showed the need for supportive classroom practices to address mathematics anxiety.

Mollah (2017) in the study titled "Mathematics Anxiety Among the School Students," aimed to explore the causes, effects, and possible solutions for mathematics anxiety among school students. According to the study, mathematics anxiety manifests in psychological, physical, and behavioral expressions, which adversely impact students' performance, academic achievement, and social development. The research identified several key contributors to mathematics anxiety, including teachers' negative attitudes, unconstructive teaching methods, students' negative classroom experiences, unrealistic parental expectations, and high-stakes test pressure. Mollah emphasizes that failure to address mathematics anxiety could lead to serious consequences within the education system.

Leary et al. (2017) studied "Math Anxiety Is Related To Some, But Not All, Experiences With Math" in which Math anxiety has been defined as unpleasant feelings of tension and anxiety that hinder the ability to deal with numbers and mathematics in a variety of situations." The study employed a mixed-methods design and surveyed 131 undergraduate students on their experiences with mathematics through elementary school, junior high, and high school, as well as assess their mathematics anxiety, general anxiety, and test anxiety. Some reported experiences, such as support in high school and providing students with plenty of examples, were significantly associated with levels of mathematics anxiety, even after controlling for general and test anxiety. However, many other factors initially believed to be linked

to mathematics anxiety did not show a significant relationship in this study. Overall, this research fills a gap in the existing literature and offers insights into the types of past experiences that are related to mathematics anxiety, as well as those that are not.

Rubinsten et al. (2018) in their study “A Framework for Studying the Heterogeneity of Risk Factors in Math Anxiety,” proposed a comprehensive model for understanding mathematics anxiety. This model suggests that mathematics anxiety arises from a dynamic interaction between environmental factors (such as parenting and teaching styles) and intrinsic factors (including neuro-cognitive predispositions and genetic influences), predicting that this interplay shapes the diversity of symptoms and experiences associated with mathematics anxiety.

Ali and Hassan (2019) in their study “Mathematics Anxiety and Mathematics Motivation Among Students in the Faculty of Science of a Public University in Malaysia” aimed to examine gender differences in mathematics anxiety and motivation, as well as the relationship between the two, among undergraduate students in the Faculty of Science at a public university in Malaysia. The sample included 104 students (23 males, 81 females), and data were collected using the mathematics anxiety Rating Scale (MARS) and the Motivated Strategies for Learning Questionnaire (MSLQ). Results revealed a moderate, significant correlation between mathematics anxiety and motivation, as well as notable gender differences in both areas.

Garba et al. (2019) studied “Exploring Peer Effect on Mathematics Anxiety Among Secondary School Students of Sokoto State, Nigeria through Photovoice Approach” on finding the factors for mathematics anxiety and on peers’ contribution towards mathematics anxiety. The photovoice approach was applied to capture peers’ speech and behaviour. The findings revealed that peers’ behaviour, such as speech, using frightening and discouraging statements in the mathematics classroom, poor students causing trouble and intelligent students dominating the lesson, has a direct effect on intensifying mathematics anxiety. Although the findings also showed that peer behaviour, such as speech with positive advice, achievement of peers and group discussions also minimize mathematics anxiety among students. It concluded that

peers in their day-to-day interaction can have an effect in the anxiety of students in mathematics.

Mendoza et al. (2019) in their paper “Rasch Analysis in Understanding Mathematics Anxiety,” aimed to isolate specific factors contributing to mathematics anxiety among high school students. The study, which applied a dichotomous Rasch model to survey data, revealed several key strategies for reducing mathematics anxiety: promoting collective success over individual achievement, fostering teacher approachability, preparing students adequately for assessments, and ensuring appropriate, accurate assessment tools. Additional influential factors included gender, study time, preference for mathematics, and learning style.

Suren and Kandemir (2020) studied “The Effects of Mathematics Anxiety and Motivation on Students’ Mathematics Achievement”. In this research, anxiety and motivation levels of the students were examined together with variables like gender, pre-school education, support and training courses as well as private tutoring. The sample study consisted of 777 eighth-grade students in a province of Aegean region of Turkey. The tools used were Mathematical Motivation Scale (MMS) and mathematics anxiety Scale for Elementary School Students (MASESS). Descriptive analysis, independent samples t-test, correlation analysis, and structural equation modelling analysis were employed for data analysis. It was found that mathematics anxiety and motivation levels of middle school eighth-grade students were high. It was also determined that anxiety predicted achievement at a higher level which was followed by motivation. A positive and moderate relationship between mathematics anxiety and motivation towards mathematics was also found.

Li et al. (2021) studied “Relations Between Students’ Mathematics Anxiety and Motivation to Learn Mathematics: A Meta-Analysis.” The current meta-analysis examined the association between K-12 students’ motivation for learning mathematics and Mathematics anxiety, and explored the effects of possible moderating factors, including different motivation measures, dimensions of mathematics anxiety, students’ developmental stages, and cultural contexts. This meta-analysis was conducted with 73 articles (80 independent samples, total

$N = 95,872$) and a total of 142 effect sizes. It was found that a moderate, negative correlation between students' motivation for mathematics and mathematics anxiety ($r = -0.42$). It was also found that the strength of the correlation between students' mathematics anxiety with competence beliefs ($r = -0.48$) was stronger than the one with value beliefs ($r = -0.36$).

Szczygiel and Pieronkiewicz (2021) conducted research titled "Exploring the Nature of Math Anxiety in Young Children: Intensity, Prevalence, Reasons," focusing on first-grade students. Results indicated that mathematics anxiety was mild overall but most prevalent at the beginning of the school year. The leading causes of anxiety included concerns over failure, task difficulty, time pressure, and the fear of poor grades.

Vargas (2021) studied "A Literature Review on Math Anxiety and Learning Mathematics: A General Overview," to explore factors contributing to mathematics anxiety and potential interventions. Vargas highlighted that both internal factors (such as neurobiological elements and age) and external factors (such as gender and environment) are critical in the onset of mathematics anxiety. This study emphasized the importance of comprehensive approaches to diagnosing and managing mathematics anxiety.

Brewster and Miller (2023) in their work "Reflections on Mathematics Ability, Anxiety, and Interventions," reviewed existing research on mathematics anxiety, identifying missed opportunities to learn foundational mathematical skills as a significant, recently recognized cause of anxiety. This factor joins cognitive, affective, social, and genetic influences as an essential contributor to anxiety, stressing the importance of early mathematics skill acquisition.

Moyo (2023) in the study titled "Secondary School Students' Mathematics anxiety: A Zimbabwean Perspective," investigated the range of mathematics anxiety experienced by Zimbabwean students at the Ordinary level. The study employed a convenience sample of 91 students from Forms 3 and 4, comprising 41 males and 50 females, and utilized the Hopko-adapted amalgamated mathematics anxiety scale

(aMAS) (2003) for data collection. The findings revealed high levels of mathematics anxiety among participants, attributed to factors such as parental and societal pressure, teaching methods, and classroom environments. The study further noted that society places considerable pressure on students to succeed in mathematics, which contributes to anxiety. Some teachers' instructional styles and the classroom atmosphere were identified as sources of discomfort, particularly for students who struggle with mathematics.

Zanabazar et al. (2023) conducted a study titled “A Study of Factors Causing Math Anxiety Among Undergraduate Students,” focused on the mathematics anxiety of students from the National University of Mongolia and the Mongolian State University of Education. Analysing data with factor, correlation, and regression analysis, they found that teacher-related factors had the strongest negative correlation with mathematics anxiety ($\beta = -0.583$), while family-related factors ($\beta = -0.311$) and student-related factors ($\beta = -0.133$) exhibited weaker correlations. Explanations for these findings include inadequate teaching methods, poor teacher-student communication, and outdated educational resources.

Li et al. (2023) in their study, “Math Anxiety and Math Motivation in Online Learning During Stress: The Role of Fearful and Avoidance Temperament and Implications For STEM Education” examined how fearful or avoidant temperaments can contribute to mathematics anxiety and mathematics motivations for college students at the time of the COVID-19 pandemic. Ninety-six undergraduate students from a public university were assessed on temperamental fear, mathematics anxiety, and mathematics motivation in an online mathematics course. The findings showed that higher levels of temperamental fear are directly linked to higher levels of mathematics anxiety.

2.3 STUDIES CONDUCTED IN INDIA:

Studies conducted in India were sub-divided into two categories:

1. Studies on mathematics anxiety conducted in India

2. Studies on mathematics anxiety in relation to academic achievement in mathematics conducted in India
3. Studies on reasons of mathematics anxiety conducted in India.

2.3.1 Studies on mathematics anxiety conducted in India

Chowdhury (2014) conducted a study titled “A Study on Mathematics Anxiety Among the 9th and 10th Grade Secondary School Students of Tinsukia District in Assam, India,” to examine factors influencing Mathematics anxiety among 300 students using the Mathematics Anxiety Scale for Secondary School Students and a personal information form. The study found that female students exhibited significantly higher levels of mathematics anxiety compared to males, and students with higher mathematics performance reported lower anxiety levels. However, no significant difference was found in mathematics anxiety concerning students’ grade levels and school environments.

Srivastava et al. (2016) did a study on “Mathematics Anxiety Among Secondary School Students in Relation to Gender and Parental Education,” to analyse the impact of gender and parental education on mathematics anxiety among 1,000 students. Utilizing the mathematics anxiety Scale (MAS), results indicated that female students experienced higher levels of mathematics anxiety compared to their male counterparts. This outcome showed gender as a critical factor influencing mathematics anxiety.

Sadaphal and Bhandarl (2020) in “Mathematical Anxiety Among Adolescents and Its Relation with Logical Thinking: A Study,” explored the relationship between mathematics anxiety and logical thinking in 600 adolescents across four districts in Maharashtra. Findings revealed that urban and rural adolescents differed significantly in mathematics anxiety levels, with urban students exhibiting higher anxiety. Moreover, an inverse relationship between mathematics anxiety and logical thinking was observed, though this correlation did not hold for rural male students.

Kumar and Srivastava (2021) studied “Mathematics Anxiety of Secondary School Students,” to investigate the influence of various demographic factors, including gender, school board, and parental education, on mathematics anxiety among 195 students. Survey method was adapted and the tool used for the data collection was mathematics anxiety Scale (MAS) developed by Dr. (Mrs.) Sadia Mahmood and Dr. (Mrs.) Tahira Khatoon. Mean, standard deviation and ‘t’ test was used for statistical analysis. Analysis showed no significant differences in mathematics anxiety concerning gender, school board, or parental education, indicating that these factors may not be as influential as previously thought.

Mahato and Sen (2021) studied “Academic Stress, Self-Efficacy, and Anxiety: A Study on Mathematics of Higher Secondary Level Students in Purulia District of West Bengal, India,” focused on anxiety levels in mathematics among 11th and 12th graders. The results demonstrated that anxiety was significantly influenced by gender and academic stream (science vs. arts), with males and science students experiencing higher anxiety.

Siddiqui and Khanam (2021) conducted research titled “Mathematics Anxiety Among Secondary School Students in Relation to Their Self-Concept,” to investigate the connection between mathematics anxiety and self-concept in 160 students. Two tools- Abbreviated Mathematics anxiety Rating Scale (AMARS) and Self Concept Clarity Scale (SCCS) were used for collecting data. Findings revealed a moderately strong negative correlation between mathematics anxiety and self-concept, suggesting that lower self-concept is associated with higher mathematics anxiety levels, while demographic variables such as gender had no significant impact on anxiety.

Uniyal and Bhardwaj (2021) did a study titled “Anxiety and Self-Concept Towards Mathematics Amongst the University Students of North India,” to analyse mathematics anxiety and self-concept among 213 university commerce students from Uttarakhand. The study found that students generally exhibited a negative attitude towards mathematics, with no significant gender differences in mathematics anxiety.

However, self-concept differed significantly across age groups, indicating age-related variations in students' confidence toward mathematics.

Manikandan (2022) conducted research titled "Math Phobia Among School Students: A Comparative Design" to evaluate the prevalence of Math Phobia (Mathematical Anxiety) among high school students in selected Government and Private Schools in Kollam, Kerala. A total of 60 high school students were chosen using a convenience sampling technique, and a Descriptive Comparative design was employed for the study. The findings indicated that the level of Math Phobia/Mathematical Anxiety among Private High School students was significantly higher than that of Government High School students. (La sort lo)

Sangral and Kumar (2023), in their paper titled "Mathematical Anxiety Among Secondary School Students in Relation to Their Gender, Locality, and Types of Schools," investigated the impact of gender, school type, and locality on mathematical anxiety among secondary school students. The study concluded that there are no significant differences in mathematical test anxiety based on gender or school type. However, it identified a significant difference in mathematical anxiety related to the students' locality, indicating that environmental factors may influence students' experiences of anxiety in mathematics.

Kiso (2024) investigated "Mathematics Anxiety Among Secondary School Students in Kohima Town, Nagaland" to assess the level of mathematics anxiety in secondary school students concerning gender, type of management, and class level. The study included a sample of 380 secondary school students. The results indicated no significant difference in mathematics anxiety levels between male and female students, nor between private and government school students, or between students in class 9 and class 10. The majority of secondary school students exhibited an average level of mathematics anxiety.

2.3.2 Studies on mathematics anxiety in relation to academic achievement in mathematics conducted in India

Karmi and Venkatesan (2009) investigated “Mathematics Anxiety, Mathematics Performance, and Academic Hardiness in High School Students.” The study involved a sample of 284 tenth-grade high school students from Karnataka, comprising 144 males and 140 females. Data were analysed using Pearson correlation analysis and independent samples T-tests. The findings indicated that mathematics anxiety was significantly negatively correlated with mathematics performance, although no significant correlation was found with academic hardiness. The study also revealed that significant gender differences in mathematics anxiety were identified, while no significant differences were observed between boys and girls concerning mathematics performance or academic hardiness.

Khatoon and Mahmood (2010) conducted research titled “Mathematics Anxiety Among Secondary School Students in India and its Relationship to Achievement in Mathematics,” proposing and confirming independent variables (gender, school types, and mathematics achievement) related to mathematics anxiety. The study included a sample of 1,652 students from various school management types. Researchers developed a Mathematics anxiety Scale (MAS) and a Mathematics Achievement Test (MAT). The results revealed that nearly half of the secondary school students exhibited moderate levels of anxiety, with females displaying more anxiety toward mathematics than males. High levels of mathematics anxiety were observed in students from government and government-aided schools, while lower levels were found in students from AMU and Missionary schools. The findings also indicated a significant negative correlation (-0.48) between mathematics anxiety and mathematics achievement.

Chaman (2014) examined “Factors Influencing Mathematics Achievement of Secondary School Students in India,” focusing on how Mathematics anxiety, attitude toward mathematics, and parental involvement affected the mathematics achievement of Year 9 and Year 11 students and their parents from a private school in Kerala. A mixed-method approach was employed for data collection. The study

found no significant relationship between parental involvement and mathematics achievement, nor was there a significant correlation between student attitudes toward mathematics, mathematics anxiety, and mathematics achievement. It was also found that gender did not influence any of the variables.

Bhowmik and Roy (2015) conducted a co-relational study titled “Co-Relational Study on Anxiety and Achievement in Mathematics of Secondary School Students in Jangal-Mahal of West Bengal, India,” which included 394 secondary (class ten) students from six different high schools. The researchers developed and standardized a mathematics anxiety scale and a mathematics achievement questionnaire. Data were quantitatively analysed using independent samples t-tests and Pearson’s correlation coefficient with SPSS software. The findings showed no significant gender differences in students’ anxiety toward mathematics, although there was a significant negative correlation between anxiety and mathematics achievement.

Bhowmik (2017) investigated the “Correlation study on Xth Grade Students in Mathematics Achievement with Motivation and Mathematics Anxiety” among 94 students from Jangal-Mahal, West Bengal, focusing on the relationship between mathematics anxiety, motivation, and achievement. Anxiety and motivation were measured using a self-constructed Math Anxiety Scale (MAS) and the Effectiveness of Motivation Scale (EMS). ANOVA results indicated that mean achievement and motivation scores differed significantly among low, moderate, and high anxiety groups. A low ($r = -0.29$) but significant ($p < 0.05$) negative correlation was found between mathematics anxiety and achievement, along with a strong ($r = -0.69$) significant ($p < 0.05$) negative correlation between mathematics anxiety and motivation. A significant low positive correlation ($r = 0.31$) between motivation and achievement was identified.

Kundu and Kar (2018) studied “Mathematics Anxiety and Its Relationship with the Achievement of Secondary School Students” using a descriptive survey method. The sample included 310 tenth-grade students from Purulia district in West Bengal. The data were analysed using t-tests and Pearson correlation. The results

showed no significant differences in anxiety toward mathematics between boys and girls, but indicated that rural students exhibited significantly higher levels of mathematics anxiety than urban students. A significant negative relationship ($r = -0.667$) between mathematics anxiety and mathematics achievement was also identified.

Bhalla (2018) investigated “Effect of Mathematics Anxiety and Attitude Towards Mathematics on the Achievement of Adolescents” to explore the influence of these factors on adolescents’ mathematics achievement. Using random sampling, a sample of 120 secondary school students from District Ambala was selected. The findings revealed a significant difference in mathematics achievement between boys and girls, but no gender differences were found in mathematics anxiety or attitude toward mathematics. Students with high mathematics anxiety scored lower in achievement, establishing a significant negative relationship between mathematics anxiety and mathematics achievement.

Yadav and Singh (2018) conducted a study titled “A study on Mathematics Anxiety and Mathematics Achievement of Secondary School Students” to explore the relationship between mathematics achievement and anxiety among secondary school students. The study utilized a randomly selected sample of 374 students (302 males and 72 females) and employed self-constructed tools, including a mathematics anxiety Scale and Mathematics Performance Test. Results indicated a negative and significant relationship between achievement in mathematics and mathematics anxiety at the 0.05 level of significance, with significant differences in mathematics anxiety between high and low achievers. The study found no significant gender differences in mathematics anxiety.

Mandal (2020) examined “Mathematics Anxiety and Academic Achievement of Students at the Secondary Stage of Education,” focusing on the relationship between these variables in secondary school students. Participants were drawn from a sample of 300 students in classes IX and X from the West Bengal Board of Secondary Education in Kolkata. Both descriptive and inferential statistics were employed for analysis. Results revealed significant differences in mathematics

anxiety and achievement by gender, while indicating no significant differences in habitat (urban, semi-urban, and rural) concerning achievement. A significant relationship between mathematics anxiety and academic achievement was also established, with no significant differences in academic achievement based on gender.

Nandhini and Subramanian (2021) conducted a study titled “Mathematics Anxiety as a Predictor of Academic Achievement in Mathematics among Higher Secondary School Students” to examine the relationship between Mathematics anxiety and achievement in mathematics. Using simple random sampling, the study included 1,050 higher secondary school students from Chennai, employing a normative survey method. The Mathematics Anxiety Scale measured anxiety levels, and correlational analysis was the primary statistical technique used. The study revealed a negative correlation between mathematics anxiety and achievement in mathematics, indicating that higher levels of mathematics anxiety corresponded to lower academic achievement.

Bhan and Kumar (2023) conducted research titled “Study of Academic Achievement and Mathematical Anxiety among Secondary School Students,” comparing these variables among secondary school students in district Shimla. The sample comprised 180 tenth-grade students (90 males and 90 females) selected through random sampling. Statistical techniques such as mean, standard deviation, percentage analysis, and t-tests were used for data analysis. The findings indicated that the majority of male and female secondary school students experienced moderate levels of mathematical anxiety. It was also found that majority of male secondary school students had high academic achievement, while the majority of female students exhibited average academic achievement.

Dungdung and Bankira (2023) examined “Mathematics Anxiety and Academic Achievement of Secondary School Students in Relation to their Gender and Medium of School,” investigating the relationship between mathematics anxiety and academic achievement. The study employed a descriptive survey method with a sample of 140 students (70 boys and 70 girls). Data were collected using the

mathematics anxiety Scale (MAS) developed by Dr. Ayatollah Karimi and Prof. S. Venkatesan. The analysis employed mean, standard deviation, t-tests, and Pearson's Product Moment Correlation. The findings revealed a negative correlation between mathematics anxiety and academic achievement, with girls exhibiting higher levels of mathematics anxiety compared to boys. It was also noted that boys had better academic achievement than girls, and students from English medium schools performed better academically than those from Odia medium schools.

Rani and Rani (2024) studied "Examining Dependence of Mathematical Anxiety and Peer Pressure on Mathematical Achievement of Secondary School Students". Upon analysis, significant differences between male and female as well as between urban and rural secondary students in mathematical achievement, mathematical anxiety and peer pressure was observed. The analysis of F-ratios found that a particular combination of Gender and Demographic area, obtain a significant interaction effect on mathematical achievement, mathematical anxiety and peer pressure of secondary students.

2.3.3 Studies on reasons of mathematics anxiety conducted in India

Ameen et al. (2016) studied "Mathematics Anxiety between Male and Female Students at Secondary Level". A descriptive survey approach was used to conduct the research. The target population included all secondary-level students in public schools across Punjab. A sample of 300 male and female students was selected from the accessible population using simple random sampling. Statistical analyses, including mean, standard deviation, and independent samples t-test, were applied to analyze the data. The results revealed significant differences in MA between male and female students, as well as between students from rural and urban areas. It was concluded that female students experience higher levels of mathematics anxiety than male students, and rural students show more anxiety toward mathematics compared to urban students.

Das and Gupta (2020) in their research paper titled "Action Research on Mathematics Phobia Among Secondary School Students," sought to identify the

causes of mathematics anxiety in eleventh-grade students and propose potential solutions. The study involved a sample of 50 students, comprising 32 males and 18 females. The findings indicated that the underlying causes of mathematics phobia included flaws in the curriculum structure, students' low economic status, insufficient cognitive ability to grasp mathematical concepts, ineffective teaching practices, lack of technological resources, errors in the learning process, biased evaluation methods, students' disinterest in mathematics, inadequacies in lesson delivery, and an unsupportive learning environment.

Kunwar (2020) conducted a study titled "Mathematics Phobia: Causes, Symptoms, and Ways to Overcome," which aimed to examine the factors contributing to mathematics phobia. The research identified key causes such as curriculum design, inadequate school facilities, instructional methods, teachers' effectiveness, use of technological tools, and evaluation systems. The study highlighted the lack of proper incentives for mathematics teachers and the negative perceptions held by both students and teachers towards mathematics as significant contributors. The study affirmed the existence of mathematics phobia among students, characterized by negative attitudes towards mathematics influenced by tests and examinations, individual perceptions, teachers, parents, peers, and the inherent nature of the subject.

Kathuria (2021) in the paper titled "Exploring Students' Anxiety Level in Relation to Mathematics Learning," investigated the levels of mathematics anxiety and the underlying reasons for this anxiety among students. Utilizing a small survey and the mathematics anxiety Scale on a sample of 200 students, along with qualitative interviews, the study found that mathematics anxiety was significantly higher among secondary school students compared to their upper primary counterparts. Gender analysis revealed that female students exhibited higher mathematical anxiety levels than males, and a school-based comparison indicated that students from government schools reported greater anxiety than those from private institutions. The exploration of anxiety causes highlighted factors such as the reliance on rote learning, challenges in addressing diverse learning styles, inadequate

teacher-designed positive experiences, negative classroom dynamics, excessive emphasis on justification and explanation, glorification of mathematics, a non-conducive learning environment, abstract nature of mathematics, high scoring pressure, lack of humour in teaching, and a focus on procedural knowledge over conceptual understanding.

Kaushal et al. (2022) in their systematic review titled “Exploration of the Factors of Mathematics anxiety and Its Impact on the Achievement of Students in Mathematics,” aimed to examine the various factors contributing to mathematics anxiety and its effects on students’ mathematical achievement. The review analysed 10 to 15 research papers relevant to each objective and concluded that numerous factors contribute to mathematics anxiety, including students, parents, teachers, academic conditions, curriculum, cognitive processes, environmental influences, societal factors, behaviors, and gender, all of which equally impact anxiety levels. The researchers noted that while some theories posit a connection between mathematics anxiety and performance, others argue there is no relationship, suggesting that a student’s poor mathematical ability could lead to increased anxiety.

Arya and Ansari (2022) in their paper “A Study on the Mathematics Anxiety on Secondary School Students,” focused on mathematics anxiety factors among 60 secondary students in Mumbai. The study found that gender do not have much effect on mathematical anxiety. It also found that environmental factors had the lowest mean scores, suggesting students’ reluctance to seek help due to fear of negative judgment from peers. This finding emphasizes the crucial role of environmental support in managing math anxiety in academic contexts.

Singh (2022) investigated “Mathematics anxiety: A Mixed Method Approach to Understanding Secondary Students’ Avoidance of Mathematics Impacting Secondary Mathematics Enrolments.” This study employed a concurrent mixed-methods approach with a triangulation design, involving participants from four private schools, including 16 eleventh-grade students and four secondary mathematics teachers. Quantitative data were gathered through an online questionnaire (RMARS), while qualitative data were collected via semi-structured

interviews with both students and teachers. The results indicated that students associated their anxiety with mathematics examinations at the secondary level. Qualitative insights revealed that participants attributed mathematics anxiety to several factors, including low self-efficacy, poor time management skills, large class sizes, and insufficient understanding of mathematical concepts.

2.4 OVERVIEW OF RELATED LITERATURE REVIEWED

2.4.1 In relation to levels of anxiety:

Of the 85-literature reviewed, 8 mentioned the levels of Mathematics anxiety students experienced. Khatoon and Mahmood (2010), Ameen (2016), Anugrah et al. (2019), Ambaranti and Retnowati (2019), Bhan and Kumar (2023) and Kiso (2024), in their studies among secondary students found an average anxiety in mathematics. However, in contrast to this findings, Mutodi and Ngirande (2014) and Moyo (2023) found a high anxiety among secondary students while Szczygiel and Pieronkiewicz (2021) found a mild level of anxiety among the respondents studied for mathematics anxiety.

2.4.2 In relation to gender:

Several studies were conducted on Mathematics anxiety in relation to gender. Of which, 10 studies were reviewed abroad while 19 were reviewed on studies conducted in India. Significant differences were tested in several studies of which some have found a significant difference between males and females on their mathematics anxiety while some did not find any significance.

Majority of the research conducted found anxiety to be higher among females over males. Khatoon and Mahmood (2010), Abbasi et al. (2013), Chowdhury (2014), Srivastava et al. (2016), Ambaranti and Retnowati (2019), Kathuria (2021), Rahaman et al. (2023), Dungdung and Bankira (2023); in their study of mathematics anxiety among secondary school students, established females to have higher anxiety compared to male counterparts. However, Mandal (2020) and Mahato and Sen (2021) also found a significant difference between male and female secondary

students but found that males have higher anxiety compared to females. Apart from the study on secondary students, few studies conducted at tertiary level were also reviewed- Ho et al. (2000), Mutodi and Ngirande (2014), Sarfo et al. (2020) and Nirmal et al. (2021) found significant differences between male and females in their conducted study.

In contrast with the findings of the above mentioned, Karmi and Venkatesan (2009), Mohamed and Tarmizi (2010), Chaman (2014), Bhowmik and Roy (2015), Bhalla (2018), Kundu and Kar (2018), Yadav and Singh (2018), Buratta et al. (2019), Siddiqui and Khanam (2021), Kumar and Srivastava (2021), Uniyal and Bhardwaj (2021), Bashir et al. (2023), Sangral and Kumar (2023), Kiso (2024); in their studies found no significant difference between male and female secondary students on mathematics anxiety.

2.4.3 In relation to locale:

Several studies were conducted on mathematics anxiety in which comparison was made on the basis of locale, i.e., rural and urban origin students. Significant difference in mathematics anxiety between rural and urban students were found by Brown et al. (2020), who studied mathematics anxiety across culture from two different regions, Delgado-Monge et al. (2020) who found same level of anxiety between two countries. Also, Kundu and Kar (2018), Ameen et al. (2016) and Sangral and Kumar (2023), Rani and Rani (2024) found that rural students have higher anxiety than urban students; Sadaphal and Bhandarl (2020) found that urban students are more anxious than students in rural areas.

But these finding negates the findings of Mandal (2020) and Souza et al. (2024), who in their study of mathematics anxiety found no significant difference between students of rural and urban areas.

2.4.4 In relation to finding reasons of mathematics anxiety:

For the present study, 12 literatures each from studies conducted abroad and India were reviewed. These studies have given various reasons and causes of

mathematics anxiety among students. Brewster and Miller (2023) found that missed opportunities to learn foundational mathematical skills affect the anxiety of students at a later stage while Singh (2022) in his research have found that insufficient understanding of mathematical concepts was a key contributor to mathematics anxiety. Rubinsten et al. (2018) found intrinsic factors such as including neuro-cognitive predispositions and genetic influences to be one of the reasons for mathematics anxiety; Das and Gupta (2020) included insufficient cognitive ability to grasp mathematical concepts and students' disinterest in mathematics while Kaushal et al. (2022) and Kunwar (2020) identified cognitive processes and negative perceptions held by students to be reasons for mathematics anxiety.

This finding of Trujillo and Hadfield (1999) included insufficient family support as a contributor for the cause of mathematics anxiety. Kaushal et al. (2022) also found parents as one of the factors for anxiety in students. (Beilock et al., 2010, as cited in Leary et al., 2017) reported having a parent who is mathematics anxious also affect the anxiety of students. Abbasi et al. (2013) found teachers' personality characteristics responsible for mathematics anxiety. Rubinsten et al. (2018), Mollah (2017) and Smith (2024), found that negative attitude of teachers and their disposition, as well as their teaching styles contributes to mathematics anxiety.

This finding is however in contrast to many researchers such as Mollah (2017) and Kunwar (2020), who found unconstructive teaching methods in mathematics class contributes to anxiety in mathematics. Kathuria (2021) also found that reliance on rote learning, inadequate teacher-designed positive experiences and lack of humour in teaching mathematics resulted in anxiety.

Das and Gupta (2020) and Kaushal et al. (2022) included flaws in curriculum structure and an unsupportive learning environment key contributor to mathematics anxiety. Furthermore, Kathuria (2021) and Vargas (2021) found a non-conducive learning environment a critical factor in the onset of mathematics anxiety. The study of Das and Gupta (2020), Kunwar (2020) and Zanabazar et al. (2023) in their research found that reasons for anxiety in mathematics included lack of technological resources and school facilities, outdated educational resources, an unsupportive learning environment and inadequate use of technological tools. Brewster and Miller

(2023) in their research found that missed opportunities to learn foundational mathematical skills affects the anxiety of students in mathematics. Furthermore, Singh (2022) also found that insufficient understanding of mathematical concepts is one of the reasons for the cause of mathematics anxiety.

Finlayson (2014), Das and Gupta (2020), Moyo (2023) and Zanabazar et al. (2023) found that certain teaching styles, inadequate teaching methods with error in lesson delivery, ineffective learning practices and lack of student engagement in the process of transacting lessons in mathematics cause anxiety in students. Kathuria (2021) found that inadequate teacher-designed positive experiences, negative classroom dynamics, a non-conducive learning environment and a focus on procedural knowledge over conceptual understanding caused anxiety in mathematics. Finlayson (2014) also found that self-confidence and fear of failure is one of the key contributors to anxiety in mathematics. Szczygiel and Pieronkiewicz (2021) also found that concerns over failure, task difficulty, time pressure along with the fear of poor grades are also reasons for anxiety.

Arya and Ansari (2022) reported that students' reluctance to seek help due to fear of negative judgment from peers had caused anxiety in students and is a very important issue. Singh (2022) also found low self-efficacy in students to be a cause for mathematic anxiety. Li et al. (2023) also showed that higher levels of temperamental fear are directly linked to higher levels of mathematics anxiety. The findings of Garba (2019) reported that peers' behaviour, such as intelligent students dominating the lesson has a direct effect on intensifying mathematics anxiety. Trujillo and Hadfield (1999), Mollah (2017) and Moyo (2023) observed notable trends for the cause of anxiety to include negative experiences of students in classrooms and in schools.

Suren and Kandemir (2020) and Ali and Hassan (2019), revealed a moderate, significant correlation between mathematics anxiety and motivation. Li et al. (2021) also found that there is a moderate negative correlation between students' motivation for mathematics and mathematics anxiety. Kathuria (2021) found the cause of anxiety in mathematics to be contributed through glorification of mathematics and also with high scoring pressure. Arya and Ansari (2022) found that students are reluctant to seek help due to fear of negative judgment from peers. Moyo (2023)

reported factors such as parental and societal pressure contributing to the cause of difficulty in succeeding in mathematics.

It is evident from numerous studies on the causes of mathematics anxiety that the present research holds significant value. The extensive body of literature on mathematics anxiety, compiled over many years by various researchers, highlights the importance of this topic. While there has been little to no gap in research over the years, with each study contributing valuable insights, this particular study shall have its own niche in this area of research by being the first of its kind within the chosen locations, filling a number of research gaps for future researchers.

CHAPTER III

METHODOLOGY

Research methodology is a crucial component of any research outlining the guidelines and the systematic processes that the researcher has to follow throughout the study. A sound methodology is essential to ensure that the research findings are both valid as well as reliable, so as to fulfil the intended purpose of the study. Research methodology must be detailed showing the various steps that the researcher follows during the research, including aspects such as research design, the methods and tools employed for data collection, target population and selection of samples, collection and administration of data, its organization, and the statistical methods used for data analysis. Hence, the present chapter on methodology covers the following sections:

- 3.1 Research approach
- 3.2 Population, sample and sampling design
- 3.3 Tools/Techniques used for data collection
- 3.4 Administration of tools and collection of data
- 3.5 Tabulation of data
- 3.6 Procedures adopted for data analysis

3.1 RESEARCH APPROACH

The present research was descriptive in nature. A mixed research approach in which both qualitative and quantitative approaches were employed. Furthermore, explanatory sequential design was adopted for the qualitative part of research. Data was collected from two main sources by the researcher -

Primary sources: Secondary school students from Mizoram and Meghalaya made up the primary sources for the present study.

Secondary sources: In order to realize the research objectives, data from School Education Department of the two states, Government records, research reports from within the country and outside, books, articles from journals and records about the two states on education were considered as secondary sources.

3.2 POPULATION, SAMPLE AND SAMPLING DESIGN

The population for the present study consisted of all secondary school students in Mizoram and Meghalaya. However, to meet different objectives, samples were categorised into three groups. The first samples were taken from the general population using the most appropriate sampling method. The other two samples emerged from this bigger sample to meet the requirement of specific objectives.

i) In order to find out the level of Mathematics anxiety among secondary students from each state, a total of 900 students, 450 from each state were considered as samples using stratified systematic random sampling method. As shown in table No. 3.1, five districts, representing the four directions i.e., north, east, west, south and the centre were selected from Mizoram, where 90 students each were randomly selected as sample from the selected districts to get a total of 450 students.

From the three main hills of Meghalaya, i.e., Khasi hills, Garo hills and Jaintia hills, one district each, was randomly selected and out of each district, a sample of 150 students were selected so as to obtain the desired sample of 450 secondary school students. Furthermore, as reflected in Table No. 3.2, the selected samples were categorised in terms of gender and origin.

Table No. 3.1

No. of selected samples

STATE	Districts	No. of samples taken	Total no. of samples in each state	Total no. of samples
MEGHALAYA	Khasi Hills	150	450	900
	Jaintia Hills	150		
	Garo Hills	150		
MIZORAM	Aizawl	90	450	
	Lunglei	90		
	Champhai	90		
	Mamit	90		
	Kolasib	90		

Table No. 3.2

Sample students to find out the mathematics anxiety level among secondary school students of Mizoram and Meghalaya

STATE	No. of male students	No. of female students	Students of urban origin	Students of rural origin
MIZORAM	203	247	343	107
MEGHALAYA	208	242	281	169
A				
TOTAL	411	489	624	276

ii) To analyse the reason(s) for mathematics anxiety among secondary school students, the sample of 266 secondary students were selected purposively from sample students with average or higher levels of anxiety, as indicated by their mathematics anxiety scores. The sample students were then divided into male and female groups as presented in Table 3.3.

Table No. 3.3

No. of students with average or higher-level mathematics anxiety

No. of male students	No. of female students
143	123
Total: 266	

iii) For the *focus group discussion*, a sample of 10 students from Mizoram and Meghalaya who exhibited average and above average levels of mathematics anxiety were selected by means of purposive stratified sampling method. However, as depicted in Table 3.4, only 8 students turned up for the discussion.

Table No. 3.4
Detailed nature of sample students for Focus group discussion

STATE	No. of male students	No. of female students
MIZORAM	2	3
MEGHALAYA	1	2
TOTAL	3	5

3.3 TOOLS/TECHNIQUES USED FOR DATA COLLECTION

The following tools were used for the present study:

- 1) Mathematics Anxiety Scale (2024) developed by the researcher.
- 2) Mathematics Anxiety Scale for Secondary and Senior Secondary School Students (2012) developed by Sadia Mahmood & Dr. Tahira Khatoon
- 3) Opinionnaire developed by the researcher.
- 4) Focus Group discussion.

3.3.1 Mathematics Anxiety Scale (2024):

The researcher developed Mathematics Anxiety Scale using Likert's Method. This scale consisted of 38 items which were all framed as negative statements; thus, the pattern of scoring was consistent across all items. The scale was organized into three major dimensions by which mathematics anxiety is expressed: *Cognitive dimension*, *Emotional dimension* and *Behavioral dimension*, with the 38 items distributed across these categories. It used a five-point rating system, which included Strongly Agree, Agree, Undecided, Disagree, and Strongly Disagree. The reliability and the validity were established as explained in the following. Additionally, norms for the scale were established and presented in the form of z-scores.

Reliability

Reliability of Mathematics Anxiety Scale developed by the researcher was calculated by using the scores of 103 subjects on 38 items on the final form. The

reliability of the Mathematics Anxiety Scale was assessed, with a reliability coefficient of 0.84 using the Pearson's Product Moment Correlation method.

Validity

Validity of the Mathematics Anxiety Scale was assessed by content validity which was ensured through logical analysis by experts. Concurrent validity of the developed scale was also established by comparing it with the Mathematics Anxiety Scale created by Sadia Mahmood and Dr. Tahira Khatoun. A correlation coefficient of 0.82 was found using Pearson's Product Moment Correlation method.

3.3.2 Mathematics Anxiety Scale for Secondary and Senior Secondary School Students (2012):

The Mathematics Anxiety Scale for Secondary and Senior Secondary School Students had 14 statements. It was bi-dimensional and a shorter instrument in which among the items, 7 were worded positively and the remaining 7 items worded negatively. It is a 5-point Likert type instrument assessing positive and negative dimensions of mathematics anxiety. Both reliability and validity were established as explained in the following.

Reliability

The reliability of the Mathematics Anxiety Scale for Secondary and Senior Secondary School Students was calculated by using the scores of 250 subjects on the 14 items in the final form of the test. Reliability coefficient of 0.81 was found by using split-half method, in which correlation was calculated between the participants' scores on the even-numbered items with their scores on the odd-numbered items. The resulting correlation coefficient increased to 0.90 after applying the Spearman-Brown Prophecy Formula.

Additionally, Cronbach's alpha, which assesses the internal consistency of the entire scale, was also found to be 0.87, indicating a high level of internal consistency suitable for group analysis (Anastasi & Urbina, 1998, as cited in Mahmood & Khatoun, 2011).

Validity

The method used to establish the validity of the MAS relied on teachers' judgment method. Mathematics teachers from the schools whose students participated in the study were asked to review the descriptions of both high and low anxiety behaviors towards mathematics. They were then asked, to identify students from their schools whose anxiety behaviors matched either description. Thus, this process resulted in two groups of students: ones exhibiting higher anxiety and others exhibiting lower anxiety towards mathematics.

A t-test was applied to test the hypothesis that the mean scores of the high-anxiety group was significantly higher than those of the low-anxiety group. A one-tailed test was used to calculate the t-value. This validation process yielded a t-value of 14.50 which was significant at 0.01 level of significance. The concurrent validity was also tested by comparing it with the Fennema-Sherman Attitude Scale (1976), in which a negative relationship was found i.e., -0.41 which means that students with favourable attitude towards mathematics experienced less mathematics anxiety.

3.3.3 Opinionnaire:

In order to find the reason(s) why secondary school students face mathematics anxiety, the researcher prepared an opinionnaire. The opinionnaire included three multiple-choice questions aimed at assessing the students' level of anxiety, the level of education when they first encountered mathematics anxiety, and how they coped with the anxiety.

Additionally, the opinionnaire also included a multiple-choice question structured as a Yes/No inquiry. It consisted of 26 questions which were organized into eight categories: Personal experiences, family issues, teacher related factors, classroom interactions, economic concerns, misconceptions, syllabus, and infrastructure.

3.3.4. Focus Group Discussion

A Focus Group Discussion (FGD) was conducted in which a sample of 10 students were randomly selected from each state among students who exhibited average or higher levels of mathematics anxiety, as determined by their scores on the Mathematics Anxiety Scale developed by the researcher. However, only 8 students consisting of three males and five females turned up for the discussion. All participants were 15 to 16-year-old students from Class 10. To ensure confidentiality, participants were coded as B1, B2, B3, G1, G2, G3, G4 and G5 where 'B' represents 'Boy' and 'G' represents 'Girl.' The purpose of FGD was to provide the researcher with a more comprehensive understanding of the issue at hand, complementing the quantitatively gathered data. This discussion allowed for a deeper exploration of the topic from the participants' perspectives.

3.4 ADMINISTRATION OF TOOLS AND COLLECTION OF DATA

The Mathematics Anxiety Scale and the opinionnaire developed by the researcher were administered to more than 900 secondary school students, so as to achieve the goal of having a sample of 900. Primary data from both the states, Mizoram and Meghalaya were collected by the researcher. When the data were collected, a minor data cleaning was conducted in order to filter out the responses which were not complete. Each response was assigned a number and the first 900 responses emerged as the final sample.

The objectives and guidelines of the study for marking the chosen responses of students in the Mathematics Anxiety Scale and Opinionnaire were effectively communicated to all the participants. Participants were provided ample time to reflect on the statements to ensure genuine responses. They were assured that their answers would be kept confidential and solely utilized for research purposes. Great care was taken during the administration of the tools and conduct of the discussion meeting to ensure that all questions and required personal information were properly addressed.

Both the opinionnaire and Focus Group discussion (FGD) was employed for qualitative assessment. Since the opinionnaire aimed to identify the causes of mathematics anxiety, only the responses from students performing average and above level of anxiety (as per the established norm) were analysed.

The FGD was held online via Zoom Meet since the participants were located in different regions. The meeting was recorded for analysis. The researcher, who also served as the moderator of the focus group discussion carefully presented the questions and discussion topics to the participants.

3.5 TABULATION OF DATA

The information collected from 900 secondary school students were carefully examined, categorized, and evaluated using established protocols. Following the evaluation of responses from the Mathematics Anxiety Scale as well as the opinionnaire, a tabulation process was conducted. The obtained scores were recorded in an Excel spreadsheet and subjected to statistical analysis using the specified statistical methods for the analysis. SPSS was also used for tabulation. Furthermore, data from the focus group discussion were analysed and thoroughly examined to address the specific objectives of the study.

3.6 PROCEDURES ADOPTED FOR DATA ANALYSIS

3.6.1 Quantitative data analysis

Analytical and graphical test for normality was conducted in which, test of skewness and kurtosis was employed for analytical while histogram with a curve showing the data distribution was plotted for graphical test.

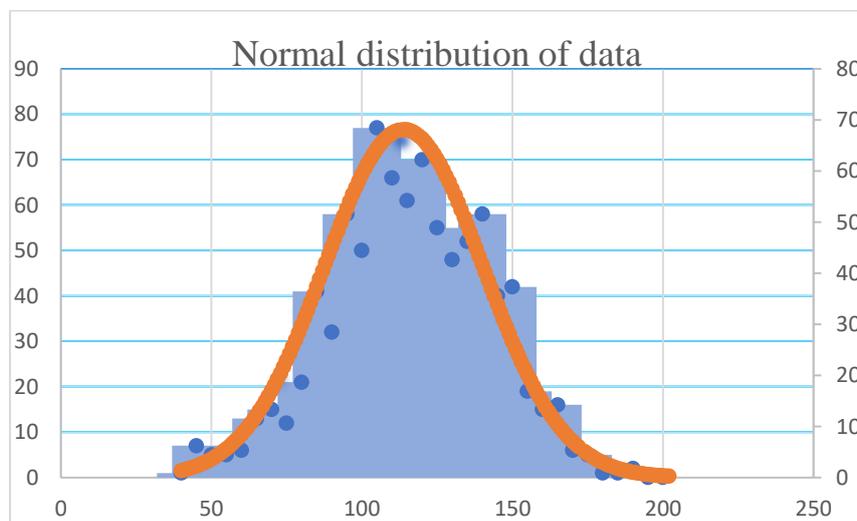
Normality test is necessary so as to decide the kind of test to be used for data analysis, whether parametric or non-parametric. The data in the present study showed a skewness of **-0.14** and a kurtosis of **-0.13**, indicating that normality assumptions were met and the data was normally distributed (Orcan, 2020). To further validate this normality, the data was presented by a histogram, and a normal distribution curve (bell-shaped) was plotted to visually represent the data's normal distribution.

Therefore, with normality established, further steps were taken using parametric tests.

Fig 3.1

Bell curve showing normal distribution of data for the present study

Mean=113.9, Standard deviation=26.36



Considering the nature of the data which has established normality, and in accordance with the objectives, the researcher employed the following statistical methods for data analysis:

1. *Descriptive statistics measures:* Various measures of central tendency, standard deviation which is a measure of variability, percentage and z-scores, were employed to understand the distribution of scores and to classify students into different categories based on the nature of their scores.
2. *Inferential statistics:*
 - A t-test was applied to determine the significance of differences in mean scores between different groups categorized by gender (male and female) and by origin (urban and rural).

- The Pearson's Product Moment Correlation was used to investigate the relationship between mathematics anxiety and academic achievement in mathematics.
- Regression analysis was used for predicting the impact of mathematics anxiety on academic achievement in mathematics.

In summary, these statistical techniques were selected based on the characteristics of the data and the specific research objectives. Each technique was carefully chosen to address key variables, interpret relationships within the data, test hypotheses, and eventually contributing to the overall rigor and reliability of the findings in the present study.

3.6.2 Qualitative data Analysis

The researcher adopted an explanatory sequential design in which qualitative data was collected by a *focus group discussion* based on the quantitative data already collected and analysed (Cresswell & Cresswell, 2018, as cited in Gonzaga University Library, 2023).

Therefore, methodological triangulation was applied by using quantitatively analysed data from the Mathematics Anxiety Scale and qualitatively analysed data from the focus group discussion. The method of triangulation aimed to enhance the credibility and validity of the findings in the present research.

CHAPTER IV

ANALYSIS AND INTERPRETATION

This chapter focuses on analysing and interpreting the collected data. As has been mentioned in the initial chapter, the primary aim of this study is to find the level of mathematics anxiety among secondary school students in Mizoram and Meghalaya.

Furthermore, it seeks to assess and compare mathematics anxiety across different groups based on factors such as gender, origin and academic achievement in mathematics. The study gathered data from secondary school students of Mizoram and Meghalaya through the utilization of assessment tools such as, the Mathematics Anxiety Scale and an Opinionnaire, designed and developed by the researcher.

The participants' responses were evaluated according to standard scoring guidelines. These scores were then organized, tabulated, and systematically analysed using conventional statistical methods, with the analysis aligned to meet the objectives of the study. In order to gather qualitative findings, a focus group discussion was held. The results of these were interpreted in a meaningful way. Both quantitative and qualitative findings supported each other. This chapter presents the research findings in accordance with the objectives outlined in the first chapter.

1. To standardize a scale to measure the mathematics anxiety of secondary school students.
2. To find out the level of mathematics anxiety among secondary school students of Mizoram.
3. To study the level of mathematics anxiety among secondary school students of Meghalaya.
4. To compare the level of mathematics anxiety between secondary school students of Mizoram and Meghalaya.

5. To compare the level of mathematics anxiety between male and female secondary school students of Mizoram and Meghalaya.
6. To compare the level of mathematics anxiety between male secondary school students of Mizoram and Meghalaya.
7. To compare the level of mathematics anxiety between female secondary school students of Mizoram and Meghalaya.
8. To compare the level of mathematics anxiety between male and female secondary school students of Mizoram.
9. To compare the level of mathematics anxiety between male and female secondary school students of Meghalaya.
10. To compare the level of mathematics anxiety between secondary school students of rural and urban origin.
11. To compare the level of mathematics anxiety between rural and urban origin secondary school students of Mizoram.
12. To compare the level of mathematics anxiety between rural and urban origin secondary school students of Meghalaya.
13. To compare the level of mathematics anxiety between rural origin secondary school students of Mizoram and Meghalaya.
14. To compare the level of mathematics anxiety between urban origin secondary school students of Mizoram and Meghalaya.
15. To analyse the reason or reasons for mathematics anxiety among secondary school students.
16. To find out the relationship between mathematics anxiety and achievement in mathematics.
17. To examine the impact of mathematics anxiety on academic achievement in mathematics among secondary school students.

4.1 Objective No. 1: To standardise a scale to measure the mathematics anxiety of secondary school students.

The researcher opted to develop a new Mathematics Anxiety Scale specifically for secondary school students, despite the availability of several existing scales. This decision was based on the recognition that as the demographics and characteristics of a population evolve or change, it is important to use an up-to-date tool that accurately reflects the specific attributes of the population being studied. This new tool would allow for establishing its reliability and validity for the population, as well as updating the norms for the tool. To ensure precision, the researcher developed and standardised a Likert-style Mathematics Anxiety Scale tailored for secondary school students, updating its norms according to the sample. The process employed for its creation and standardization is detailed below.

4.1.1 Selection of items

To develop the necessary statements for assessing the mathematics anxiety of secondary school students, the researcher reviewed various standardised tools researchers have used over the past and broadly consulted relevant literature and books. Following an in-depth analysis of these sources, a preliminary draft of 50 statements for the mathematics anxiety scale was carefully constructed. This comprehensive process aimed to ensure that the statements accurately reflect the mathematics anxiety faced by secondary school students. The items were designed to encompass a varied range of dimensions such as Mathematics learning Anxiety, Perception of difficulty in mathematics and Anticipatory anxiety.

4.1.2 Content validity:

Validity refers to the degree to which an instrument effectively and accurately measures what it is designed to measure and functions as intended. Content validity of the draft statements was evaluated by a panel of twelve experts, consisting of professionals in education. These experts gave a thorough review and assessed the draft statements, ensuring their accuracy and relevance in measuring the content validity.

Below is a list of the experts who were consulted for ensuring the content validity of the Mathematics Anxiety Scale:

- (1) Prof. Lalhmasai Chuaungo, Department of Education, Mizoram University
- (2) Prof. H. Malsawmi, Department of Education, Mizoram University
- (3) Prof. Lokanath Mishra, Department of Education, Mizoram University
- (4) Prof. Lalbiakdiki Hnamte, Department of Education, Mizoram University
- (5) Dr Sweta Dvivedi, Department of Education, Mizoram University
- (6) Dr. Mary L. Renthlei, Government Aizawl College
- (7) Prof. Lallianzuali Fanai, Institute of Advanced Studies in Education
- (8) Dr. Donna Lalnunfeli, Institute of Advanced Studies in Education
- (9) Dr. Zairemmawia, Institute of Advanced Studies in Education

Based on the valuable feedback from the experts, adjustments and modifications were made in the classification or categorization as well as in the items of the draft anxiety scale. Some statements were removed, new ones were added, and others were revised according to recommendations of the experts. Consequently, the items were reorganized and categorized into three dimensions—Cognitive, Affective, and Behavioral—which aligns with the Taxonomy of Learning Domains for expressing mathematics anxiety. Ultimately, 41 statements were retained.

4.1.3 Pretesting of the preliminary draft

After the Mathematics Anxiety Scale was finalised by the researcher, a simple trial was conducted with 20 secondary school students, 10 from Meghalaya and 10 from Mizoram. The purpose was to assess whether the scale would be suitable and easily understood by the target population. It was found that while students from Meghalaya had no issues responding to the scale, students from Mizoram struggled to comprehend the language. As a result, it was deemed necessary to translate the items into the local language of Mizoram i.e., Mizo. The researcher translated each item as accurately as possible. The translations were then reviewed by three language experts:

- (1) Dr. Zothanliana (Assistant Professor, Mizoram University)
- (2) Ms. Lalremsangi (Assistant Professor, Mizoram University)

(3) Ms. Liantluangpuii Sailo (Assistant Professor, Institute of Advanced Studies in Education).

4.1.4 Try out

The Mathematics Anxiety Scale, consisting of 41 items, was prepared for the final try-out. It was then administered to 100 randomly selected secondary students. The front cover of the scale included clear and self-explanatory instructions, making additional guidance unnecessary. Respondents were asked to provide honest and truthful answers. Following the administration of the scale to the secondary school students, an item analysis was conducted by calculating the discrimination value for each item.

4.1.5 Item discrimination

After the tool was administered to 100 secondary school students, the Likert scoring method was applied. The scores were arranged in ascending order. The top 27% and bottom 27% were set aside for item analysis and discrimination purposes. The Mathematics Anxiety Scale underwent a thorough analysis process. First, the mean and standard deviation were calculated separately for the top and bottom groups. Then, t-values were computed to determine the significance of the differences in scores between these groups across all 41 items. Items with t-values of 2.68 or higher, signifying significance at 0.05 confidence level, were retained for the final scale while those with lower t-values were rejected. Thus, after this item discrimination process, three additional items were further eliminated. The final version of the tool used consisted of 38 statements.

4.1.6 Establishment of reliability

Reliability refers to the stability and consistency of results obtained from an assessment tool. A reliable test yields consistent scores when administered multiple times to the same individual and this is essential for ensuring the validity of the test. To determine the reliability of the newly developed Mathematics Anxiety Scale, the researcher employed the Test-Retest Method.

The scale was administered twice over a two-week period. Test-Retest was conducted among 103 secondary school students. In the first test, 107 students participated, and two weeks later, the same group was tested again. However, due to student absences, only 103 students took the second test thus completing the test. The responses of these 103 students were meticulously scored and recorded, while the data of students who did not complete both tests were excepted from the analysis. In order to assess the reliability of the Mathematics Anxiety Scale, Pearson's Product Moment Correlation method was used for calculation in finding the coefficient of reliability. The resulting coefficient was found to be 0.84. This indicates a reliable measure for the Mathematics Anxiety Scale.

4.1.7 Establishment of validity

Validity means the effectiveness of a tool in measuring what it is intended to measure. It is crucial for a tool to possess sufficient validity so as to ensure its accuracy and precision. In the case of the Mathematics Anxiety Scale, content validity was confirmed through assessment by experts.

For establishing concurrent validity, the researcher administered the newly developed Mathematics Anxiety Scale along with another standardised tool, 'Mathematics Anxiety Scale for Secondary and Senior Secondary School Students' developed by Sadia Mahmood & Dr. Tahira Khatoon. This scale comprised of 14 statements. It is bi-dimensional in which among the items, 7 items were worded positively and the remaining 7 items were worded negatively. It is a 5-point Likert type instrument assessing both the positive and negative dimensions of mathematics anxiety. These tools were administered to 50 secondary school students.

After scoring was done, correlation coefficient between the two tests was calculated using Pearson's Product Moment Correlation method, and the correlation coefficient was found to be 0.82. This correlation coefficient indicates that the newly constructed Mathematics Anxiety Scale sufficiently captured the aspects of mathematics anxiety of secondary school students. This way, the anxiety scale was validated by means of concurrent validity.

4.1.8 Scoring procedure of items

The scoring method used for the current Mathematics Anxiety Scale follows the Likert Scale. Respondents were asked to express their opinions on each item using a five-point scale with options such as Strongly Agree, Agree, Undecided, Disagree, and Strongly Disagree. Each of these statements were scored 5, 4, 3, 2, 1 respectively. Since the scale consists of 41 statements, the maximum possible score is 205 (41×5), and the minimum is 38 (38×1).

4.1.9 Norms and interpretation of Mathematics Anxiety Scale

Norms are the basis for interpreting test scores and help reduce interpretive errors in a measuring tool. To establish norms for the Mathematics Anxiety Scale, the researcher administered the newly developed anxiety scale to 900 secondary school students of Mizoram and Meghalaya. The responses were then scored in accordance with the stated procedure. The researcher then developed norms based on z-scores to interpret the anxiety levels of secondary school students.

Z-score norms: The raw scores of all 900 secondary school students were transformed into z-scores. Based on the range of z-score given in the following, mathematics anxiety levels were classified into 5 levels and each level was given a grade A, B, C, D and E for high anxiety, above average anxiety, average anxiety, below average anxiety and low anxiety respectively. The detail is shown in the following table:

Table 4.1.1

Norms for interpretation of the levels of mathematics anxiety based on z-scores

Sl. No.	Range of z-score	Grade	Levels of Mathematics Anxiety
1	(+1.51 and above)	A	High anxiety
2	(+0.51 to 1.50)	B	Above average anxiety
3	(-0.50 to +0.50)	C	Average anxiety
4	(-1.50 to -0.51)	D	Below average anxiety
5	(-1.51 and below)	E	Low anxiety

4.2 Objective No. 2: To find out the level of mathematics anxiety among secondary school students of Mizoram

In order to find out the level of mathematics anxiety among secondary school students of Mizoram, Mathematics Anxiety Scale developed by the researcher was used. After calculating the mean and standard deviation, respondents were classified into different levels of mathematics anxiety based on their z-scores. The statistical result is presented in Table 4.2.1 and the different levels of anxiety is shown in Table 4.2.2. Figure 4.1 presents a visual representation of the data.

Table 4.2.1

Statistical results of mathematics anxiety among secondary school students of Mizoram

No of students	Mean	Standard deviation
450	114.24	25.32

Table 4.2.2

Level of mathematics anxiety among secondary school students of Mizoram

Sl. No.	Range of z-score	Grade	Levels of mathematics anxiety	No. of students in each anxiety level	Percentage of students in each anxiety level (%)
1	(+1.51 and above)	A	High anxiety	32	7.11
2	(+0.51 to 1.50)	B	Above average anxiety	102	22.67
3	(-0.50 to +0.50)	C	Average anxiety	178	39.56
4	(-1.50 to -0.51)	D	Below average anxiety	114	25.33
5	(-1.51 and below)	E	Low anxiety	24	5.33
Total				450	100

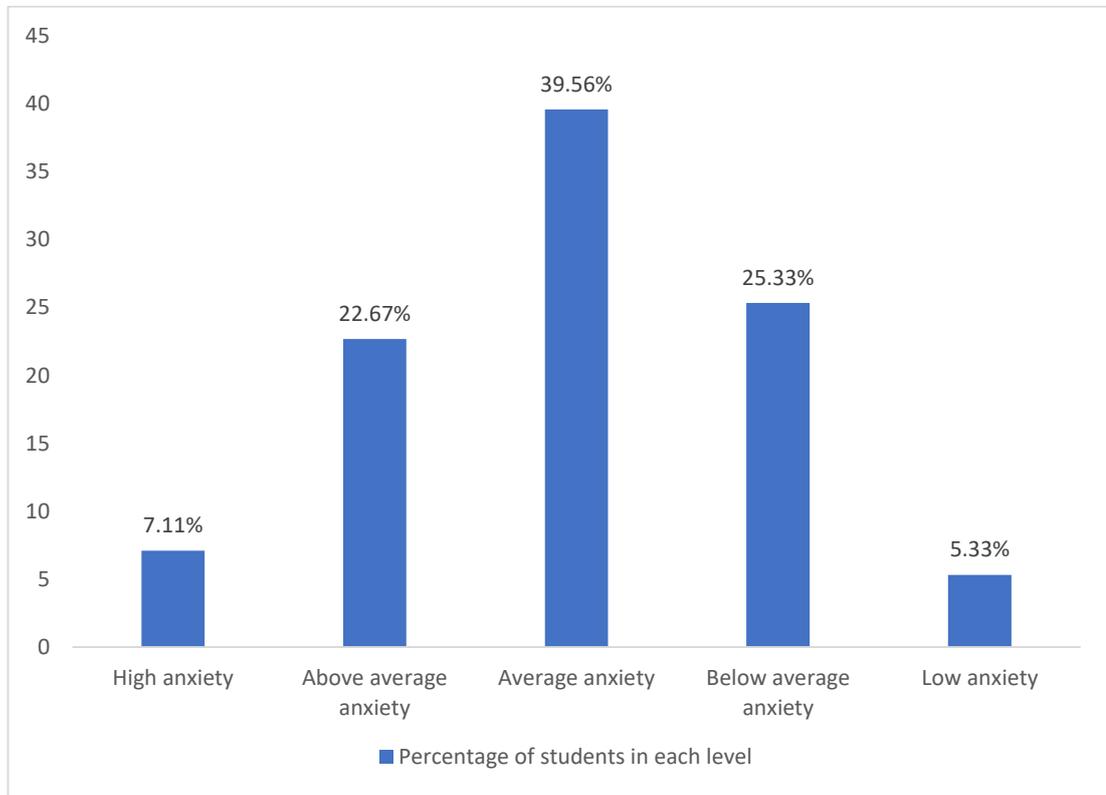
Table 4.2.1 depicts the statistical result of mathematics anxiety of secondary school students of Mizoram. The mean score of the 450 students was found to be 114.24 and the standard deviation was 25.32.

Table 4.2.2 shows the division of students into five levels of mathematics anxiety which was based on their z-scores. 32 students (7.11%) fall in grade A at the level of 'High anxiety' indicating significantly high levels of mathematics anxiety. The table also shows that 102 students (22.67%) exhibit above-average anxiety and are placed in grade B. The largest group comprising of 178 (39.56%) respondents falls within the average anxiety range at grade C. 114 students (25.33%) are classified as having below-average anxiety and 24 students (5.33%) have low levels of mathematics anxiety, placed in grade D & E respectively.

Thus, it can be observed that the highest percentage of the respondents (39.56%) experience average levels of anxiety. Low anxiety level has the least number of students, i.e., 5.33% and a notable portion (7.11%) have high anxiety in mathematics.

Figure 4.2.1

Mathematics anxiety among secondary school students of Mizoram



The bar graph in figure 4.2.1 visually highlights the distribution of secondary school students in Mizoram across the different levels of anxiety. The height of each bar provides a clear comparison of how the respondents fall into each of the category.

The X-axis represents the different levels of mathematics anxiety while the Y-axis represents the percentage of students. The bar represents the number of students in each level of mathematics anxiety.

The bar graph reveals that the highest percentage of students (39.56%) experience average levels of anxiety. Following this, 25.33% of students exhibit below-average anxiety while 22.67% of students experience above-average anxiety. At the higher end, 7.11% of students show high levels of anxiety and to constitute the least percentage, the last bar shows 5.33% of students reporting low anxiety.

Focus group discussion:

Students from Mizoram who participated in the discussion expressed and shared their thoughts. One student shared during the conversation, stating:

“...My parents expect so much from me and think I should get good marks in mathematics is very stressful, makes me more nervous...”

Another student mentioned:

“...I used to talk to my friends for discussion and help only when before exam or test. Most of the time, I avoid studying mathematics...”

One student expressed hope for improvement:

“...I feel if there are more solved examples to guide us, it will give me the security I would need to solve mathematics...”

Another student described:

“...If the student-teacher ratio is a bit smaller than what we have in our school right now, students and teachers will have a closer relationship and teachers will be able to care for students better...”

The data gathered from the discussion with Mizoram students clearly showed no participant is completely free from mathematics anxiety. Every student demonstrated a degree of anxiety at least to some extent, which explains why 'average anxiety' category constitutes the highest percentage 39.56% of students.

4.3 Objective No. 3: To study the level of mathematics anxiety among secondary school students of Meghalaya.

To determine the level of mathematics anxiety among secondary school students of Meghalaya, Mathematics Anxiety Scale developed by the researcher was employed. After the calculation of the mean score and the standard deviation, respondents were categorised into various levels of mathematics anxiety which was based on their z-scores. The statistical results are shown in Table 4.3.1, while the

different anxiety levels are outlined in Table 4.3.2. Figure 4.3.1 provides a visual representation of the data.

Table 4.3.1

Statistical results of mathematics anxiety among secondary school students of Meghalaya

No of students	Mean	Standard deviation
450	113.57	27.38

Table 4.3.2

Level of mathematics anxiety among secondary school students of Meghalaya

Sl. No.	Range of z-score	Grade	Levels of Mathematics Anxiety	No. of students	Percentage (%)
1	(+1.51 and above)	A	High anxiety	21	4.67
2	(+0.51 to 1.50)	B	Above average anxiety	126	28
3	(-0.50 to +0.50)	C	Average anxiety	175	38.89
4	(-1.50 to -0.51)	D	Below average anxiety	92	20.44
5	(-1.51 and below)	E	Low anxiety	36	8
Total				450	100

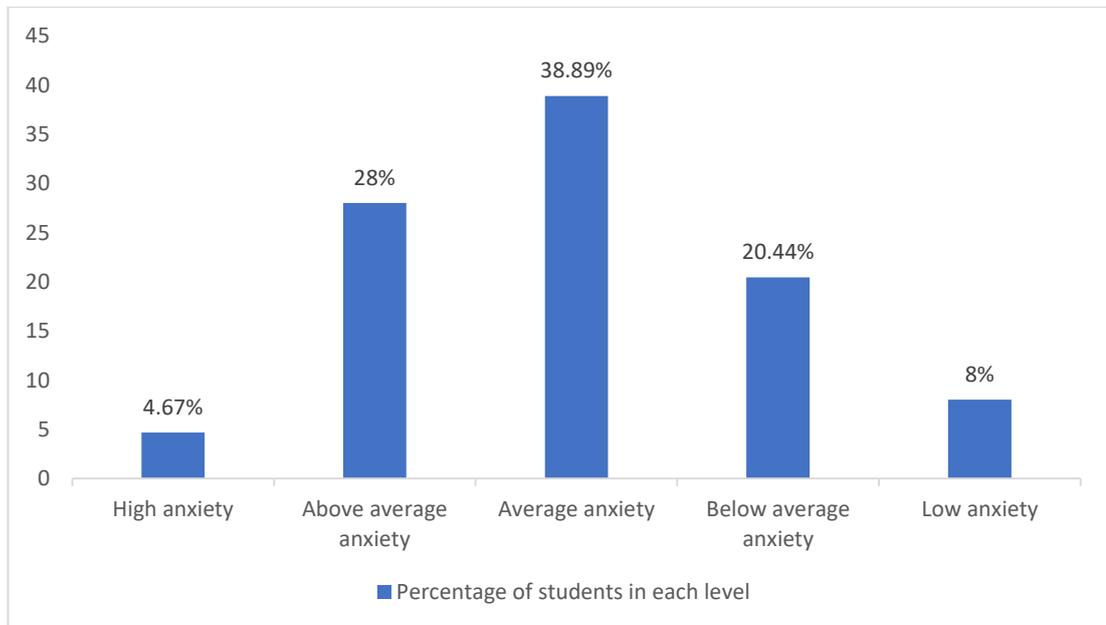
Table 4.3.1 presents the statistical results on the mathematics anxiety of secondary school students in Meghalaya. The mean score for the 450 students was 113.57, with a standard deviation of 27.38.

Table 4.3.2 illustrates the distribution of students into five different levels of mathematics anxiety, based on their z-scores. A total of 21 students (4.67%) falls in the category "High Anxiety" at grade A. Additionally, 126 students (28%) show above-average anxiety and are placed in grade B, while the largest group, consisting of 175 students (38.89%), falls within the average anxiety range (grade C). It is also found that 92 students (20.44%) are categorized as having below-average anxiety while 36 students (8%) exhibit low levels of anxiety, each placed in grade D and E respectively.

Thus, the highest percentage of secondary school students in Meghalaya (38.89%) experience average levels of anxiety, while a significant portion (28%) shows above-average anxiety, potentially impacting their academic performance. A small percentage (4.67%) suffer from high anxiety, and 8% demonstrate low levels of anxiety.

Figure 4.3.1

Mathematics anxiety among secondary school students of Meghalaya



The bar graph in Figure 4.3.1 provides a visual representation of the distribution of secondary school students in Meghalaya across different levels of mathematics anxiety. Each bar represents the number of respondents who fall into each

category, allowing for a straightforward identification of which levels of anxiety are most or least common.

The X-axis represents the various levels of mathematics anxiety and the Y-axis represents the percentage of students. Each bar shows the percentage of students at a particular anxiety level.

It can be observed that the largest portion of students have average level of mathematics anxiety constituting the highest percentage, i.e., 38.89%. This is followed by students in above-average anxiety category (28%) and students in below average anxiety in mathematics (20.44%). At both extremes, students with low

mathematics anxiety constitutes 8% while only 4.67% of students exhibit high level of mathematics anxiety.

Focus group discussion:

One of the students expressed his feelings as follows:

“...I used to be very nervous in the class and scared that my teacher will ask me questions in class. I’m afraid to make mistakes...”

The same boy lamented:

“...My teacher never motivates us in the class, he only says if we don’t study, we will fail...”

Another student said:

“...The solved problems in the textbooks are too less and sometimes very different from the questions...”

From the above information gathered from the group, it can be observed that participants of the discussion expressed their feelings towards mathematics, in which negative statements made by students from Meghalaya reveals mathematics anxiety among the students. This explains why majority (38.89%) are in average mathematics anxiety level.

4.4 Objective No. 4: To compare the level of mathematics anxiety between secondary school students of Mizoram and Meghalaya.

In order to compare the levels of mathematics anxiety among secondary school students of Mizoram and Meghalaya, a comparison table (Table 4.4.1) was prepared, showing the number of respondents from each state at each level of anxiety. The comparison is also illustrated visually in a bar graph (Figure 4.4.1). A t-test was conducted to assess the significance of the difference between the two groups.

4.4.1 Comparison based on levels of mathematics anxiety

Table 4.4.1 shows the comparison of mathematics anxiety of secondary school students of Mizoram and Meghalaya.

Table 4.4.1
Comparison of mathematics anxiety between secondary school students
of Mizoram and Meghalaya

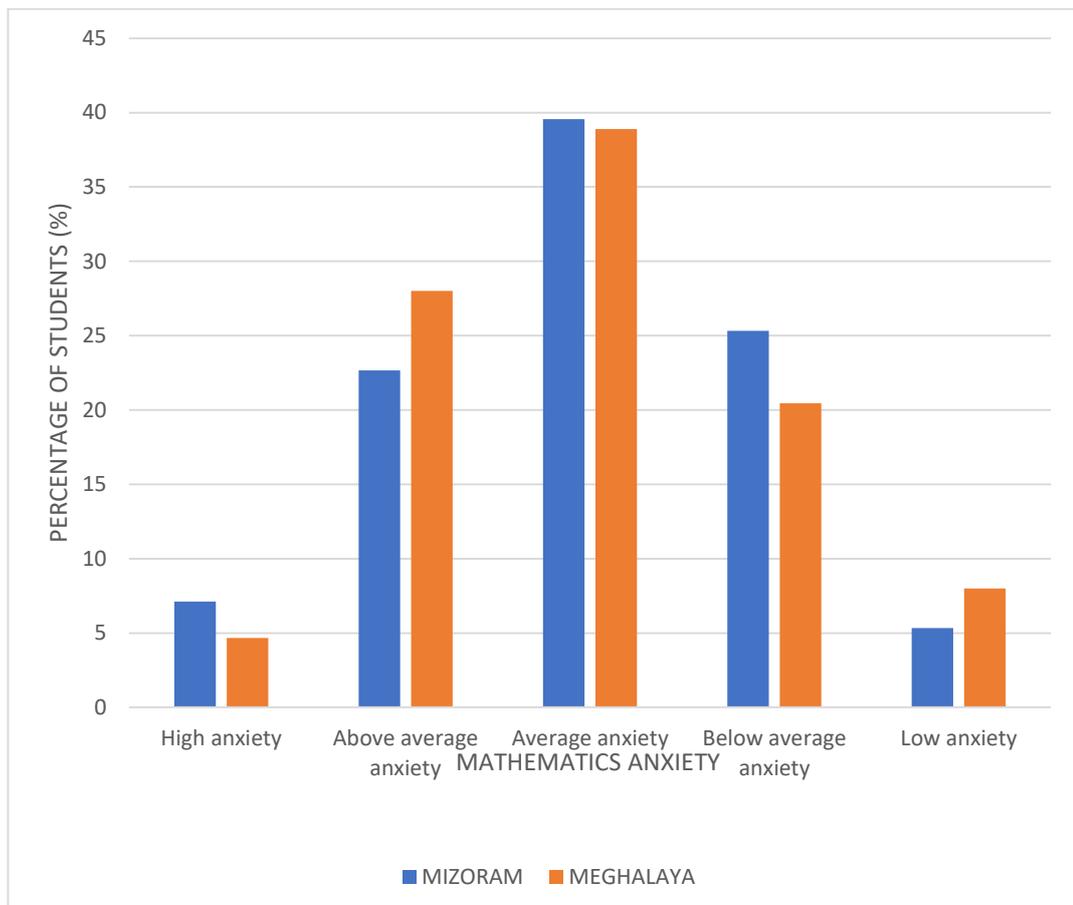
Sl. No.	Range of z-score	Grade	Levels of Mathematics Anxiety	No. of students in Mizoram		No. of students in Meghalaya	
				N	%	N	%
1	(+1.51 and above)	A	High anxiety	32	7.11	21	4.67
2	(+0.51 to 1.50)	B	Above average anxiety	102	22.67	126	28
3	(-0.50 to +0.50)	C	Average anxiety	178	39.56	175	38.89
4	(-1.50 to -0.51)	D	Below average anxiety	114	25.33	92	20.44
5	(-1.51 and below)	E	Low anxiety	24	5.33	36	8
Total				450	100	450	100

Table 4.4.1 shows the comparison of mathematics anxiety between secondary school students of Mizoram and Meghalaya. In both states, the largest group of students reports average anxiety (grade C) and the proportions are very similar. In Mizoram, 39.56% students fall into this category while 38.89% of students reports average anxiety in Meghalaya. 7.11% of students from Mizoram and 4.67% of

students from Meghalaya are with high anxiety (grade A) while 22.67% and 28% of students are at above average anxiety level (grade B) in Mizoram and Meghalaya respectively. The table also reveals that 25.33% of students in Mizoram and 20.44% of students in Meghalaya have below-average anxiety (grade D). At the low level of anxiety (grade E), 8% of students in Meghalaya and 5.33% of students in Mizoram reports low anxiety.

Figure 4.4.1

Bar graph showing the comparison of mathematics anxiety between secondary school students of Mizoram and Meghalaya



The bar graph in Figure 4.4.1 presents a visual representation of the comparison of mathematics anxiety between secondary school students of Mizoram and Meghalaya. The blue bar represents Mizoram while the orange bar represents Meghalaya. It can be observed that each level of mathematics anxiety has almost similar number of students, although they differ in few numbers at each level.

At the average anxiety level, the blue bar representing scores of respondents in Mizoram is slightly higher than of Meghalaya. Furthermore, the level of ‘High anxiety’ and ‘Below average anxiety’, respondents in Mizoram are slightly more in number as indicated by taller blue bars in both the cases. However, we can see those respondents in ‘Above average’ and ‘Low anxiety’ level of mathematics anxiety has more respondents from Meghalaya as compared to Mizoram.

4.4.2 Comparison by test of significance

To compare the mathematics anxiety of secondary school students between Mizoram and Meghalaya, the hypothesis which stated that ‘There is a significant difference in the level of mathematics anxiety between secondary school students of Mizoram and Meghalaya’ was converted into a null hypothesis which stated that, ‘There is no significant difference in the level of mathematics anxiety between secondary school students of Mizoram and Meghalaya’.

In order to test the null hypothesis, the mean and the standard deviation of the scores were calculated, a t-test was conducted and comparison was made between mean scores of the students in Mizoram and Meghalaya, the details are presented in the following table, Table 4.4.2.

Table 4.4.2

Comparison of mathematics anxiety between secondary school students of Mizoram and Meghalaya by test of significance

State	No. of students	Mean	Standard Deviation	SED	t-value	df	Significance level
Mizoram	450	114.25	25.32				
				1.79	0.38	893	Not Significant
Meghalaya	450	113.57	27.38				

Table 4.4.2 shows the comparison of mathematics anxiety between secondary school students of Mizoram and Meghalaya by testing their mean difference. The degree of freedom was found to be 893 and the calculated t-value was found to be 0.38, which is smaller than the critical value at the required level of significance.

The null hypothesis, 'There is no significant difference in the level of mathematics anxiety between secondary school students of Mizoram and Meghalaya ' is accepted.

Thus, there is no significant difference in the level of mathematics anxiety between secondary school students of Mizoram and Meghalaya.

Focus group discussion

When discussion with a focus group of students was carried out, it was clear that students from both states clearly had issues with mathematics.

One student confessed:

“...I believe that I will never fully grasp certain mathematical concepts. I am overwhelmed when presented with complex mathematical tasks and my mind gets jumbled when trying to understand word problems in mathematics...”

Another student from Meghalaya also said:

“...I think I am not smart enough to study mathematics. I find it hard to remember mathematical formulas. I know my abilities in mathematics to be inferior to others. Besides this, I simply do not like the subject...”

Another student admitted asserted that:

“... Mathematics is not taught in a practical manner; it is also taught in English which I am not comfortable with. Therefore, my major problems are with the language and the teachers...”

To sum it up, none of the students really enjoyed mathematics. However, some students did express fewer negative words than others, although they did face problems too. One student stated that:

“...I feel uncomfortable when asked to solve mathematical problems in front of others. Since difficult problems are there, it would be good if teachers would make students solve only lighter problems in front of the class...”

Another said of mathematics as follows:

“...I rush through mathematics homework just to get them over with quickly. And when I face difficult problems in mathematics, I tend to work on simpler tasks and wait for the last moment to finish the difficult problems.”

Comments like the above two are evidence that not all the students have a very deep anxiety about mathematics, only a slight anxiety with the more difficult problems. Therefore, the reason why there are more students with mathematics anxiety is explained with the qualitative discussion.

4.5 Objective No. 5: To compare the level of mathematics anxiety between male and female secondary school students of Mizoram and Meghalaya.

To compare the mathematics anxiety levels of male and female (i.e., based on gender) secondary school students of Mizoram and Meghalaya, a comparison table (Table 4.5.1) was created, outlining the number of respondents from each state across different anxiety levels. This comparison is also visually represented in a bar graph

(Figure 4.5.1). A t-test was also performed to determine the significance of the difference between the two groups.

4.5.1 Comparison based on levels of mathematics anxiety

Table 4.5.1 presents the comparison of mathematics anxiety of male and female secondary school students from both the states

Table 4.5.1

Comparison of mathematics anxiety between male and female secondary school students of Mizoram and Meghalaya

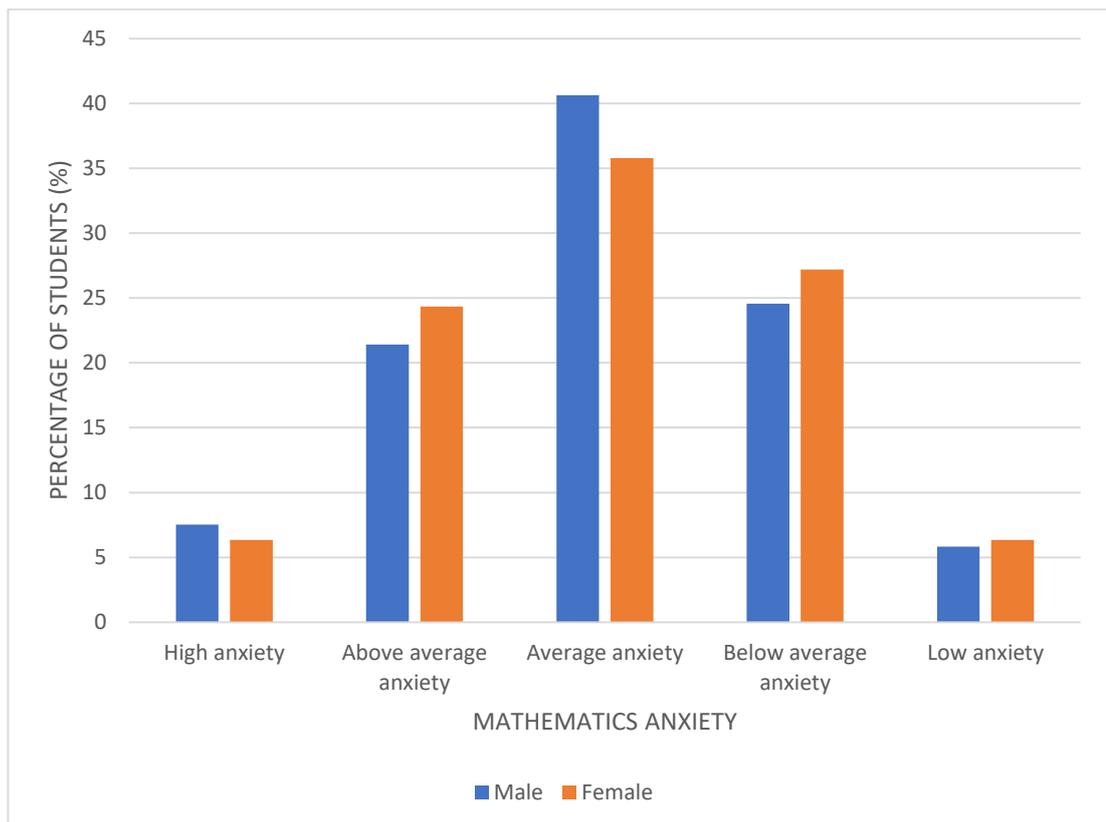
Sl. No.	Range of z-score	Grade	Levels of Mathematics Anxiety	Male		Female	
				N	%	N	%
1	(+1.51 and above)	A	High anxiety	31	7.54	31	6.34
2	(+0.51 to 1.50)	B	Above average anxiety	88	21.41	119	24.34
3	(-0.50 to +0.50)	C	Average anxiety	167	40.63	175	35.79
4	(-1.50 to -0.51)	D	Below average anxiety	101	24.57	133	27.20
5	(-1.51 and below)	E	Low anxiety	24	5.84	31	6.34
Total				411	100	489	100

An analysis of the data in Table 4.5.1 compares the mathematics anxiety levels of secondary students by examining the number as well as percentage of students in each anxiety category. The table shows that in both male and female

groups, the largest number of students fall within the "Average anxiety" category (grade C), with males constituting higher percentage (40.63%) compared to females (35.79%). Female respondents outnumber males in the "Above average" and "Below average" anxiety categories, placed in grade B and grade C respectively. Interestingly, the number of male and female students with high mathematics anxiety in grade A is identical in number, constituting 7.54% and 6.34% for male and female groups respectively.

Figure 4.5.1

Bar graph showing the comparison of mathematics anxiety between male and female secondary school students of Mizoram and Meghalaya



The bar graph in Figure 4.5.1 visually compares mathematics anxiety between male and female secondary school students from Mizoram and Meghalaya. The blue bar represents male, while the orange bar represents female. The graph shows that for most anxiety levels, the orange bar is slightly higher, indicating

female have higher anxiety across the different levels except for high anxiety level where there are equal number of males and females.

4.5.2 Comparison by test of significance

In order to compare the mathematics anxiety of between male and female secondary school students of Mizoram and Meghalaya, the hypothesis which stated that ‘There is significant difference in the level of mathematics anxiety between male and female secondary school students of Mizoram and Meghalaya’ was converted to a null hypothesis which stated that, ‘There is no significant difference in the level of mathematics anxiety between male and female secondary school students of Mizoram and Meghalaya’. The mean and the standard deviation of the scores were calculated to test the null hypothesis. A t-test was also conducted in which comparison was made between the mean score of male and female secondary school students in Mizoram and Meghalaya. The following table, Table 4.5.2 shows the detail of the calculation.

Table 4.5.2

Comparison of mathematics anxiety between male and female secondary school students of Mizoram and Meghalaya by test of significance

Gender	No. of students	Mean	Standard Deviation	SED	t-value	df	Significance level
Male	411	108.71	25.70				
				1.73	5.53	898	Significant at 0.01
Female	489	118.27	26.14				

The comparison of mathematics anxiety between male and female secondary school students of Mizoram and Meghalaya is shown in Table 4.5.2. It is observed that the degree of freedom was 898 and the calculated t-value was found to be 5.53, which is greater than the critical value at the required level of significance.

Thus, the null hypothesis, 'There is no significant difference in the level of mathematics anxiety between male and female secondary school students of Mizoram and Meghalaya' is rejected.

Hence, there is a significant difference in the level of mathematics anxiety between male and female secondary school students of Mizoram and Meghalaya.

Focus group discussion

In the focus group discussion, where discussion was made only after clear assurance that students' anonymity would be protected, the students came forward with eye opening comments that were carefully recorded by the researcher. One of the students, upon being asked about her mathematical abilities answered:

"... The need to learn mathematics stresses me out and frankly, I take whatever excuse I can to escape from learning mathematics. I look at the numbers and am just confused from the start..."

A male student responded in the following way:

"...I used to ask my friends for help because I'm nervous to deal with mathematical tasks on my own..."

Another male student also said:

"...For me, my parents also suggested so I took tuition in mathematics, I think I became a little comfortable after that..."

Among the students that had mathematics anxiety, the quantitative study shows that female students are with higher level of mathematics anxiety compared with male students. The qualitative research reveals that male students were willing to seek help from others, which is a positive strategy to deal with any problem. While many of the female students are just stressed out with mathematics problems and opt to run away, male students, although they too are anxious about the subject, are willing to take help from others and are also ready to complete the mathematics tasks quickly (thus finishing the work given) rather than not do the task. Therefore, the quantitative as well as qualitative findings strongly support and explain each other.

The qualitative findings also indicate the efficacy of certain measures to decrease the level of mathematics anxiety.

4.6 Objective No. 6: To compare the level of mathematics anxiety between male secondary school students of Mizoram and Meghalaya.

A comparison table (Table 4.6.1) was prepared to examine the mathematics anxiety levels of male secondary school students in Mizoram and Meghalaya. This table presents details of the students at various anxiety levels. The comparison is also visually shown in a bar graph (Figure 4.6.1). Additionally, a t-test was conducted to assess the significance of the differences between the two groups, i.e., between male secondary school students of Mizoram and male secondary students of Meghalaya.

4.6.1 Comparison based on levels of mathematics anxiety

The following table shows the comparison of male secondary students of Mizoram and Meghalaya.

Table 4.6.1

**Comparison of mathematics anxiety between male
secondary school students of Mizoram and Meghalaya**

Sl. No	Range of z-score	Grade	Levels of Mathematics Anxiety	Male students of Mizoram		Male students of Meghalaya	
				N	%	N	%
1	(+1.51 and above)	A	High anxiety	14	6.90	13	6.25
2	(+0.51 to 1.50)	B	Above average anxiety	49	24.14	53	25.48
3	(-0.50 to +0.50)	C	Average anxiety	79	38.92	84	40.38
4	(-1.50 to -0.51)	D	Below average anxiety	49	24.14	42	20.19
5	(-1.51 and below)	E	Low anxiety	12	5.91	16	7.69
Total				203	100	208	100

Figure 4.6.1

Bar graph showing the comparison of mathematics anxiety between male secondary school students of Mizoram and Meghalaya

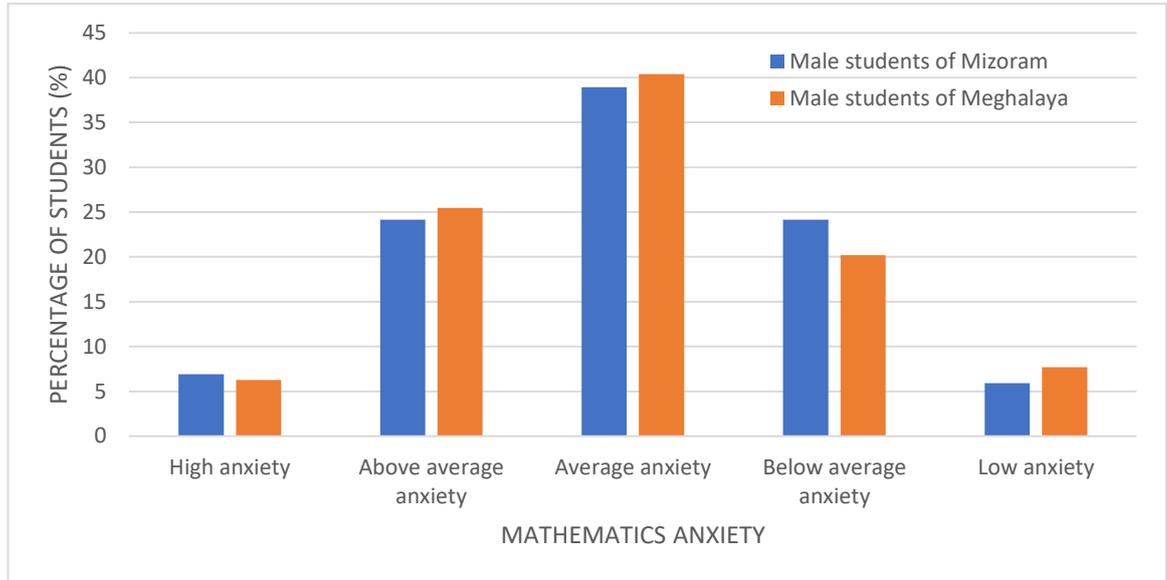


Figure 4.6.1 depicts the comparison of mathematics anxiety between male secondary school students of Mizoram and Meghalaya, through the given bar graph. The blue bar and the orange bar represent male students of Mizoram and Meghalaya respectively. It can be observed that the percentage difference of the groups compared is not as significant as shown by the bar at each level.

4.6.2 Comparison by test of significance

For comparison of mathematics anxiety between male secondary school students of Mizoram and Meghalaya, the hypothesis which stated that ‘There is significant difference in the level of mathematics anxiety between male secondary school students of Mizoram and Meghalaya’ was converted to a null hypothesis which stated that, ‘There is no significant difference in the level of mathematics anxiety between male secondary school students of Mizoram and Meghalaya.’

A t-test was done to test the significance of difference in the mean scores between the two groups. Table 4.6.2 shows the comparison of mathematics anxiety between male secondary school students of Mizoram and Meghalaya.

Table 4.6.2

Comparison of mathematics anxiety between male secondary school students of Mizoram and Meghalaya by test of significance

Gender	No. of students	Mean	Standard Deviation	SED	t-value	df	Significance level
Male students in Mizoram	203	110.69	23.98				
Male students in Meghalaya	208	106.77	27.19	2.53	1.55	409	Not significant

Table 4.6.2 shows that the mean score of male students in Mizoram is 110.69, with a standard deviation of 23.98. Meanwhile, the mean score of male students in Meghalaya is 106.77, with a standard deviation of 27.19. The t-value for the comparison between groups is 1.55, which indicates that the difference is not statistically significant at the chosen significance level.

Consequently, the null hypothesis, ‘There is no significant difference in the level of mathematics anxiety between male secondary school students of Mizoram and Meghalaya’ is accepted.

Thus, there is significant difference in the level of mathematics anxiety between male secondary school students of Mizoram and Meghalaya.

Focus group discussion

In the discussion, male students from Mizoram expressed their views on mathematics as well as how they feel about their class:

"...I often rush through my mathematics homework, just so I can finish it fast and do something else. I don't really like the subject but since I have to do it, I just do it fast without much concentration..."

"...If the student-teacher ratio is a bit smaller than what we have in our school right now, students and teachers will have a closer relationship and teachers will be able to care for students better..."

A male student from Meghalaya also shared:

"...For me, my parents also suggested so I took tuition in mathematics, I think I became a little comfortable after that..."

"...I feel when our teacher explains in the class, it easily becomes boring. I don't understand what he says..."

The quantitative study shows that there is no significant difference in mathematics anxiety among male secondary students in both states. Additionally, the qualitative research, gathered through focus group discussions, shows that male students who shared their anxiety-related issues reported similar levels of degree in their negative experiences with mathematics.

4.7 Objective No. 7: To compare the level of mathematics anxiety between female secondary school students of Mizoram and Meghalaya.

For comparing the level of mathematics anxiety between female secondary school students of Mizoram and Meghalaya, a comparison table (Table 4.7.1) was prepared to examine the mathematics anxiety levels of female secondary students in Mizoram and Meghalaya. This table presents details of the respondents at various mathematics anxiety levels. The comparison is also visually given in a bar graph (Figure 4.7.1). Moreover, a t-test was conducted to assess the significance of the differences between the two groups, i.e., between female secondary school students of Mizoram and female secondary students of Meghalaya.

4.7.1 Comparison based on levels of mathematics anxiety

The following table shows the comparison of female secondary students of Mizoram and Meghalaya.

Table 4.7.1
Comparison of mathematics anxiety between female
secondary school students of Mizoram and Meghalaya

Sl. No.	Range of z-score	Grade	Levels of Mathematics Anxiety	Female students of Mizoram		Male students of Meghalaya	
				N	%	N	%
				1	(+1.51 and above)	A	High anxiety
2	(+0.51 to 1.50)	B	Above average anxiety	43	17.41	76	31.40
3	(-0.50 to +0.50)	C	Average anxiety	92	37.25	82	33.88
4	(-1.50 to -0.51)	D	Below average anxiety	69	27.94	57	23.55
5	(-1.51 and below)	E	Low anxiety	11	4.45	20	8.26
Total				247	100	242	100

Figure 4.7.1

Bar graph showing the comparison of mathematics anxiety between female secondary school students of Mizoram and Meghalaya

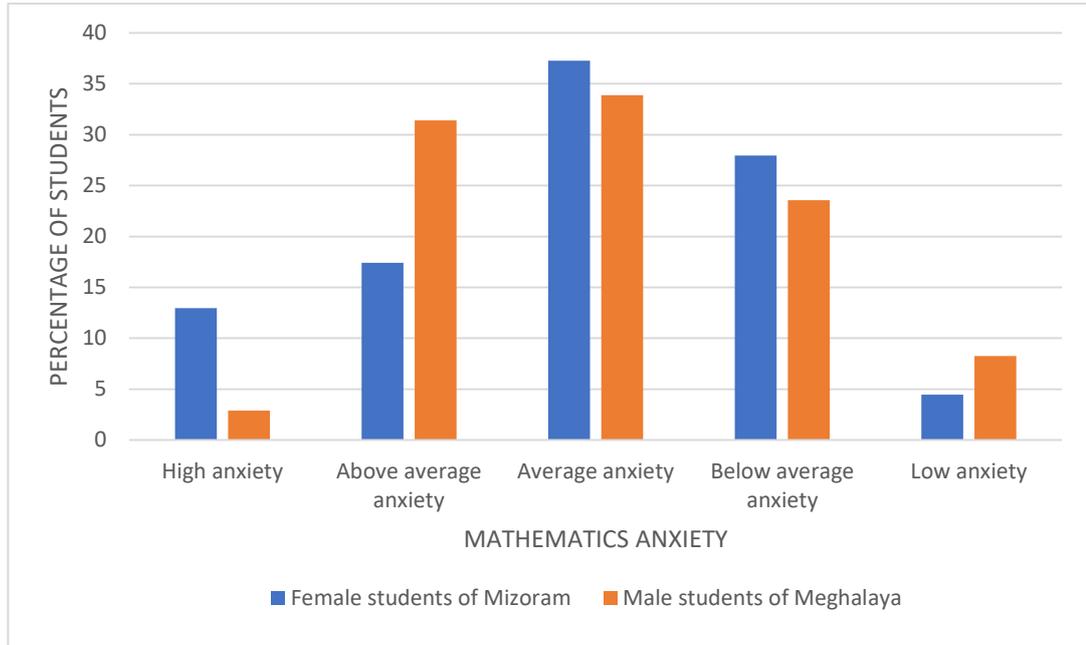


Figure 4.7.1 depicts the comparison of mathematics anxiety between female secondary school students of Mizoram and Meghalaya, through a bar graph. The blue bar and the orange bar represent female students of Mizoram and Meghalaya respectively. The greatest percentage difference is observed in the high anxiety category, where female students from Mizoram show a higher bar. There is also a notable difference in both the above average anxiety and low anxiety categories. Overall, the average anxiety category has the highest concentration of female students.

4.7.2 Comparison by test of significance

For comparison of mathematics anxiety between female secondary school students of Mizoram and Meghalaya, the hypothesis which stated that ‘There is significant difference in the level of mathematics anxiety between female secondary school students of Mizoram and Meghalaya’ was converted to a null hypothesis

which stated that, ‘There is no significant difference in the level of mathematics anxiety between female secondary school students of Mizoram and Meghalaya.’

A t-test was conducted to test the significance of difference in the mean scores between the two groups. Table 4.7.2 shows the comparison of mathematics anxiety between female secondary students of Mizoram and Meghalaya.

Table 4.7.2

Comparison of mathematics anxiety between female secondary school students of Mizoram and Meghalaya by test of significance

Gender	No. of students	Mean	Standard Deviation	SED	t-value	df	Significance level
Female students of Mizoram	247	117.15	26.06				
Female students of Meghalaya	242	119.41	26.22	5.59	2.11	487	Significant at 0.05

Upon examining the findings presented in table no. 4.7.2, it is evident that the 't' value, which assesses the significance of the difference in mathematics anxiety between female secondary school students of Mizoram and Meghalaya, is recorded as 2.11. Given that this calculated 't' value is greater than the critical value at the required level of significance, it is reasonably concluded that a significant difference exists in the mathematics anxiety between the two groups at 0.05 level.

Consequently, the null hypothesis, ‘There is no significant difference in the level of mathematics anxiety between female secondary school students of Mizoram and Meghalaya’ is rejected.

An analysis of their mean scores further confirms the significant difference as female students of Meghalaya exhibit higher mean scores compared to female students of Mizoram.

Focus group discussion

Female students from Mizoram shared:

“...I used to talk to my friends for discussion and also try to study problems on my own with the help of solved examples from text books and very often through YouTube videos...”

“... Mathematics is not taught in a practical manner; it is also taught in English which I am not comfortable with. Therefore, my major problems are with the language and the teachers...”

Female students of Meghalaya also expressed:

“...Everyone, my teachers, parents and all tells me to study mathematics and work very hard, this makes me nervous...”

“...Whenever I solve sums or problems in mathematics, I get confused on multiplications, divisions and other process and tend to make mistakes...”

The comments of students in the focus group discussion concur with the quantitative findings in which female students of Meghalaya have higher anxiety in mathematics as compared to female secondary students of Mizoram. The students of Meghalaya expressed feeling nervous with the encouragement of their teachers and parents which is indicative of their negative perception towards mathematics and could be the reason why they have higher mean score of mathematics anxiety. Struggles with basic mathematical operations would definitely result in anxiety as well. However, the comments by female students from Mizoram shows they resist assistance as their anxiety seems to be manageable.

4.8 Objective No. 8: To compare the level of mathematics anxiety between male and female secondary school students of Mizoram.

A comparison table (Table 4.8.1) was prepared to examine the mathematics anxiety levels of male and female secondary school students in Mizoram. This table details the number of students at various anxiety levels. The comparison is also visually depicted in a bar graph (Figure 4.8.1). Furthermore, a t-test was conducted to assess the significance of the differences between the two groups, i.e., between male and female secondary school students of Mizoram.

4.8.1 Comparison based on levels of mathematics anxiety

The following table shows the comparison of male and female secondary students on Mizoram on their mathematics anxiety.

Table 4.8.1
Comparison of mathematics anxiety between male and female
secondary school students of Mizoram

Sl. No	Range of z-score	Grade	Levels of Mathematics Anxiety	Male		Female	
				N	%	N	%
1	(+1.51 and above)	A	High anxiety	11	5.42	11	4.45
2	(+0.51 to 1.50)	B	Above average anxiety	50	24.63	69	27.94
3	(-0.50 to +0.50)	C	Average anxiety	82	40.39	92	37.25
4	(-1.50 to -0.51)	D	Below average anxiety	51	25.12	52	21.05
5	(-1.51 and below)	E	Low anxiety	9	4.43	23	9.31
Total				203	100	247	100

Table 4.8.1 provides data on the levels of mathematics anxiety among male and female secondary students of Mizoram, where both the number and percentage of students in each anxiety category is shown. Both male and female students report

high anxiety (grade A), with 5.42% of male students and 4.45% of female students. Female students report a slightly higher percentage of above average anxiety (27.94%) compared to male students (24.63%) placed in grade B. Majority of students fall in average anxiety level (grade C) in both groups where male students make up 40.39% while female students make up 37.25%. Male students report a higher percentage of below-average anxiety (25.12%) compared to female students (21.05%) placed in grade D. In the ‘Low anxiety’ category in grade E, a larger percentage of females (9.31%) have lower anxiety compared to males (4.43%), suggesting that a larger proportion of female students feel less anxious about mathematics.

Figure 4.8.1

Bar graph showing the comparison of mathematics anxiety between male and female secondary school students of Mizoram

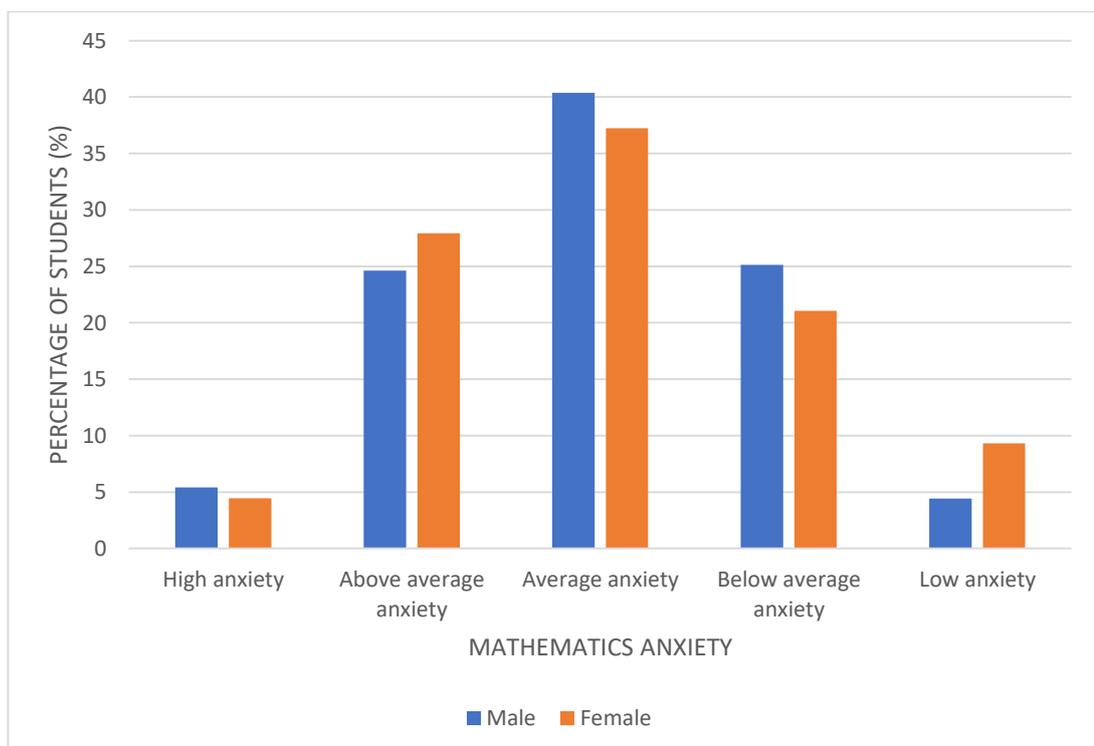


Figure 4.8.1 depicts the comparison of mathematics anxiety between male and female secondary school students of Mizoram, through a bar graph. The blue bar

and the orange bar represent male students and female students respectively. High anxiety exhibits equal bar height representing equal number of respondents. ‘Below average’ anxiety level shows almost equal number as well. In the other three levels of anxiety, i.e., Above average, Average and Low anxiety levels all show more female respondents as compared to males.

4.8.2 Comparison by test of significance

For comparison of mathematics anxiety between male and female secondary school students of Mizoram, the hypothesis which stated that ‘There is significant difference in the level of mathematics anxiety between male and female secondary school students of Mizoram’ was converted to a null hypothesis which stated that, ‘There is no significant difference in the level of mathematics anxiety between male and female secondary school students of Mizoram’.

A t-test was performed to test the significance of difference in the mean scores between the two groups. The following table, Table 4.8.2 shows the comparison of mathematics anxiety between male and female secondary school students of Mizoram.

Table 4.8.2

**Comparison of mathematics anxiety between male and female
secondary school students of Mizoram by test of significance**

Gender	No. of students	Mean	Standard Deviation	SED	t-value	df	Significance level
Male	203	110.69	23.98				Significant at 0.01
Female	247	117.15	26.06	2.36	2.74	448	

Upon examining the findings presented in table no. 4.8.2, it is evident that the 't' value, which assesses the significance of the difference in mathematics anxiety between male and female secondary school students of Mizoram, is recorded as 2.74. Given that this calculated 't' value is less than the established criterion 't' value, it is reasonably concluded that a significant difference exists in the mathematics anxiety between the two groups at 0.01 level of significance.

Consequently, the null hypothesis, 'There is no significant difference in the level of mathematics anxiety between male and female secondary school students of Mizoram' is rejected.

An analysis of their mean scores further confirms this distinction, as female students exhibit higher mean scores compared to their male counterparts. The outcome suggests that, in the context of Mizoram, female secondary school students have more mathematics anxiety as compared to male.

Focus group discussion

Students felt at ease and openly discussed their issues in a relaxed environment when asked to share challenges they face with mathematics, one male student described:

"...I often rush through my mathematics homework, just so I can finish it fast and do something else. I don't really like the subject but since I have to do it, I just do it fast without much concentration..."

A female student shared:

"...I never choose to play games related to calculations or which requires deep thoughts. I avoid participating in mathematics competitions or any games which would require mathematics. It just seems too intimidating..."

"... Just the thought of doing my mathematics homework makes me nervous and anxious..."

A student joined in as she mentioned:

"...I always feel like I'm not as good as my friends or classmates in mathematics. I know all my friends are better than me in mathematics..."

Among the students having mathematics anxiety, the quantitative study shows that female students have higher anxiety level in mathematics as compared to male students. The qualitative research reveals that female students who spoke of their issues related to their anxiety tend to describe their experiences with mathematics with more emotional intensity, highlighting a sense of intimidation against the subject thus showing greater anxiety. They expressed feelings of fear, nervousness, and comparison more strongly. On the other hand, the male students' response reflects a more detached, perhaps submissive attitude on having to do the works anyway instead of avoiding it completely. The focus is on completing the task as quick as possible rather than dealing with emotional or cognitive challenges. This difference in how they talk about their experiences have indicated a deeper sense of unease and self-doubt among females, which could reflect higher anxiety as compared to the males.

4.9 Objective No. 9: To compare the level of mathematics anxiety between male and female secondary school students of Meghalaya.

The level of mathematics anxiety between male and female secondary school students of Meghalaya is compared by the number of respondents in each level of anxiety from the two groups. This is presented in the comparison table, Table 4.9.1. The anxiety level between the two groups is also compared through a visual depiction of a bar graph shown in Figure 4.9.1. Furthermore, a t-test is conducted to test the mean scores of male and female secondary school students to test the significant difference.

4.9.1 Comparison based on levels of mathematics anxiety

The table below outlines the various anxiety levels in which respondents based on their scores are categorized.

Table 4.9.1

**Comparison of mathematics anxiety between male and female
secondary school students of Meghalaya**

Sl. No.	Range of z-score	Grade	Levels of Mathematics Anxiety	Male		Female	
				N	%	N	%
1	(+1.51 and above)	A	High anxiety	16	7.69	20	8.26
2	(+0.51 to 1.50)	B	Above average anxiety	42	20.19	57	23.55
3	(-0.50 to +0.50)	C	Average anxiety	84	40.38	82	33.88
4	(-1.50 to -0.51)	D	Below average anxiety	53	25.48	76	31.40
5	(-1.51 and below)	E	Low anxiety	13	6.25	7	2.89
Total				208	100	242	100

Table 4.9.1 reveals a comparison of mathematics anxiety levels between male and female secondary school students of Meghalaya across various levels of anxiety. Female respondents are more in both high and above average anxiety (grade A & B) compared to males, with female constituting 8.26% versus male constituting 7.69% at high anxiety level, while female constituted 23.55% and males constituted 20.19% at above average anxiety level. The highest percentage of students from both genders fall within the average anxiety level (grade C) with 40.38% of male students and 33.88% of females. In the below average anxiety level (grade B), female students

report a higher percentage (31.40%) compared to male students (25.48%). Male students outnumber females in the low anxiety category (grade E), with 6.25% males and 2.89% females.

Figure 4.9.1

Bar graph showing the comparison of mathematics anxiety between male and female secondary school students of Meghalaya

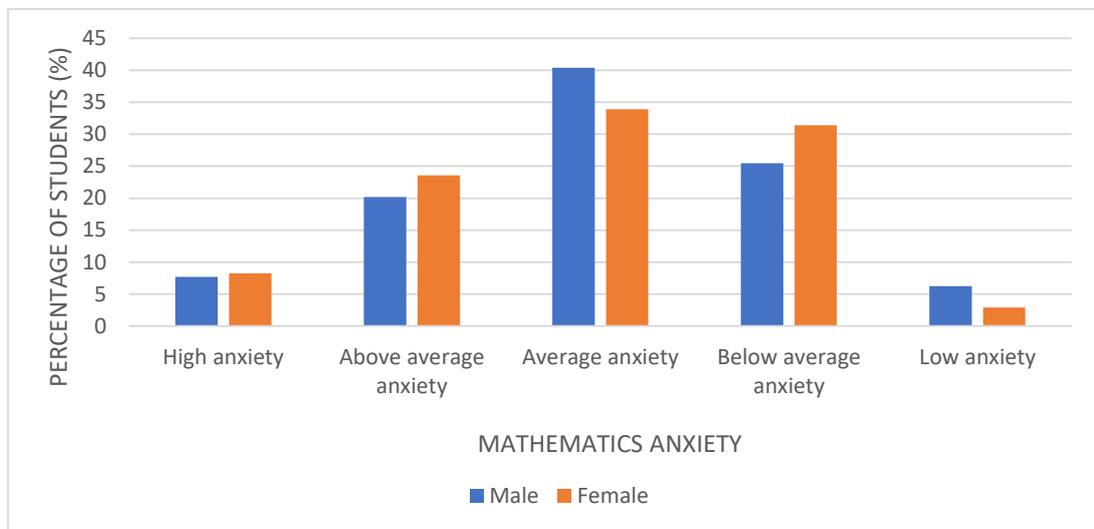


Figure 4.9.1 reveals the number of respondents in each level of anxiety and comparison is made between male and female secondary school students of Meghalaya. The blue and the orange bar represents male and female respectively. The comparison is evident through the visual representation of the bar graph.

At the average anxiety level, the height of both the bars are almost similar though a slight height difference is observed, showing a greater number of males have average anxiety in mathematics as compared to female. Furthermore, the level of ‘High anxiety’ Above average anxiety’ and ‘Below average anxiety’, has more female respondents than males. However, a greater number of males have low anxiety in mathematics.

4.9.2 Comparison by testing significant difference

For comparing the mathematics anxiety between male and female secondary school students of Meghalaya, the hypothesis which stated that ‘There is significant

difference in the level of mathematics anxiety between male and female secondary school students of Meghalaya' was converted to a null hypothesis which stated that, 'There is no significant difference in the level of mathematics anxiety between male and female secondary school students of Meghalaya'. To test the significance of difference in the mean scores between the two groups, a t-test was performed. The details of the test along with the mean, the standard deviation, the degree of freedom, the standard error difference and the t value is shown in the following table, Table 4.9.2.

Table 4.9.2

Comparison of mathematics anxiety between male and female secondary school students of Meghalaya by test of significance

Gender	No. of students	Mean	Standard Deviation	SED	t-value	df	Significance level
Male	203	106.77	27.19	2.53	5	448	Significant at 0.01
Female	247	119.41	26.22				

Upon the analysis of Table 4.9.2, it is clear that the 't' value, which measures the significance of the difference in mathematics anxiety between male and female secondary school students of Meghalaya, is 5. Since this calculated 't' value exceeds the critical 't' value, a significant difference exists between the two groups at the 0.01 level of significance.

As a result, the null hypothesis, which stated that 'There is no significant difference in the level of mathematics anxiety between male and female secondary school students of Meghalaya,' is rejected.

Analysis of the mean scores supports this conclusion. As female students display higher mean scores than their male counterparts, it can be concluded that female secondary school students in Meghalaya experience greater mathematics anxiety compared to males.

A male student stated:

"...I always feel anxious and nervous when I see others very good in mathematics while I know I'm very bad in the subject..."

A female student stated:

"...I don't think I will be able to understand mathematics concept anymore even if I study because I feel I have been lost since a long time, from middle schools. I look forward to higher classes where I wouldn't need to study mathematics subject..."

Another female joined in the discussion and shared:

"...Sometimes, I think I'm just not smart enough for mathematics. No matter how much I study, I can't seem to be interested..."

One of the female students also confessed:

"...I find myself always questioning my mathematics skills. I never feel confident in solving mathematics problems on my own. I know I'll make mistakes and I feel I lack the knowledge I need to have to solve problems..."

The quantitative study reveals that female students of Meghalaya have higher anxiety as compared to male students. This finding is in line with the data obtained by qualitative analysis through the focus group discussion. The statement obtained from a male student with regard to his experience in mathematics reflects a typical sense of comparison and frustration. However, it does not express deep, long-term doubt about his ability to understand mathematics.

On the other hand, female students express a deeper sense of hopelessness and self-doubt. Their statement reveals a sense of permanent struggle with a desire to escape from mathematics entirely. While the male student expresses anxiety in relation to external comparisons, female students tend to describe deeper feelings of inadequacy, fear of failure, and lack of confidence in their mathematical abilities. These emotional barriers seem to contribute to a stronger sense of anxiety which is reflected in their avoidance and pessimism about the subject.

4.10 Objective No. 10: To compare the level of mathematics anxiety between secondary school students of rural and urban origin.

The number of students from urban and rural origin in each level of anxiety is presented through a comparison table (Table 4.10.1). The bar graph in Figure 4.8.1 also shows the comparison of mathematics anxiety between the two groups. Each level of anxiety in the graph shows corresponding bars representing the number of respondents. Additionally, a t-test was conducted to test the significance of the differences between the two groups, i.e., between secondary school students of urban and rural origin.

4.10.1 Comparison based on levels of mathematics anxiety

The following table depicts the comparison of mathematics anxiety between secondary students of rural and urban origin

Table 4.10.1

Comparison of mathematics anxiety between secondary school students of rural and urban origin

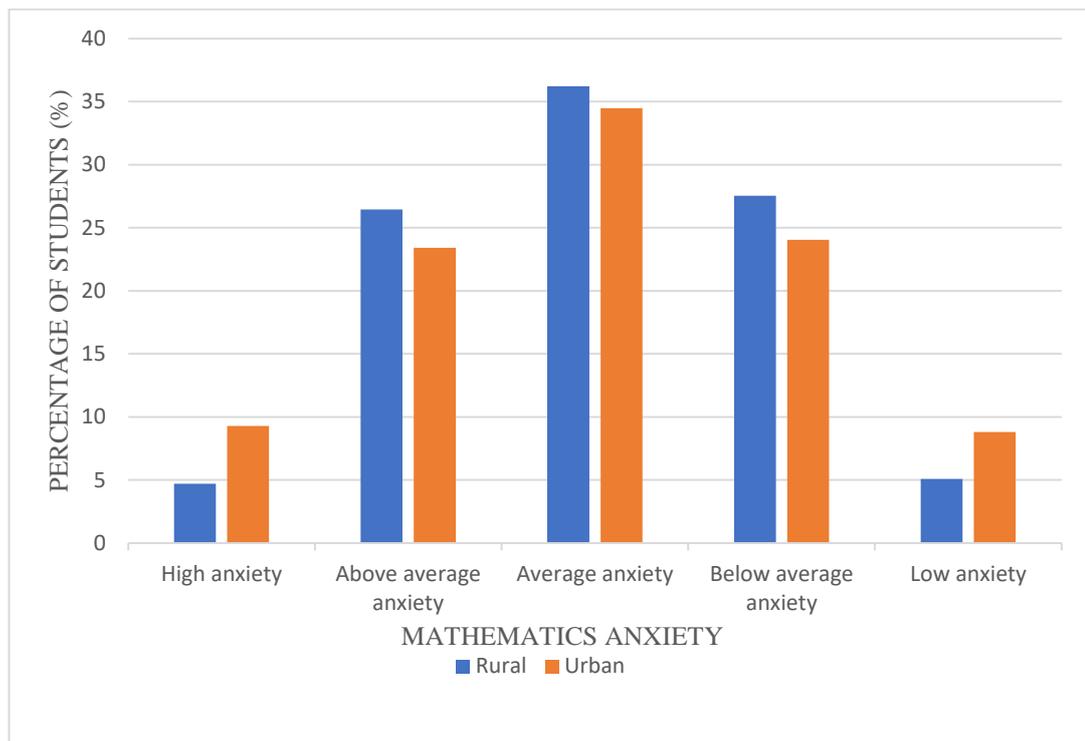
Sl. No	Range of z-score	Grade	Levels of Mathematics Anxiety	Rural		Urban	
				N	%	N	%
1	(+1.51 and above)	A	High anxiety	13	4.71	58	9.29
2	(+0.51 to 1.50)	B	Above average anxiety	73	26.45	146	23.40
3	(-0.50 to +0.50)	C	Average anxiety	100	36.23	215	34.46
4	(-1.50 to -0.51)	D	Below average anxiety	76	27.54	150	24.04
5	(-1.51 and below)	E	Low anxiety	14	5.07	55	8.81
Total				276	100	624	100

In the high anxiety category, urban origin students significantly outnumber rural origin students, with 9.29% to 4.71%. The percentage of students with above-

average anxiety is higher in students of rural origin (26.45%) compared to students of urban origin (23.40%). Here, the largest concentration of students is in the ‘average anxiety’ category where rural origin students report a higher percentage (36.23%) compared to urban origin students (34.46%). The percentage of students with below-average anxiety is higher among rural origin students (27.54%) compared to urban (24.04%). While at the low anxiety level, urban origin students constituted 8.81% which is higher than of rural which constituted 5.07%.

Figure 4.10.1

Bar graph showing the comparison of mathematics anxiety between secondary school students of rural and urban origin



It can be clearly observed from Figure 4.10.1 that urban origin students (orange bar) tend to experience higher levels of mathematics anxiety compared to their rural counterparts (blue bar) at the high anxiety and low anxiety level of anxiety. However, across the levels of above average, average and below average level, rural origin students show higher mathematics anxiety as compared to urban origin secondary students.

4.10.2 Comparison by test of significance

For comparison of mathematics anxiety between secondary school students of rural and urban origin, the hypothesis which stated that ‘There is significant difference in the level of mathematics anxiety between secondary school students of rural and urban origin’ was converted to a null hypothesis which stated that, ‘There is no significant difference in the level of mathematics anxiety between secondary school students of rural and urban origin’. The significant difference of the mean scores between the two groups, i.e., were tested using t-test. The detail is highlighted in the following.

Table 4.10.2

Comparison of mathematics anxiety between secondary school students of rural and urban origin by test of significance

Origin	No. of students	Mean	Standard Deviation	SED	t-value	df	Significance level
Urban	624	111.50	27.16	1.79	4.38	898	Significant at 0.01
Rural	276	119.34	23.60				

Table 4.10.2 compares the mathematics anxiety between urban and rural origin students, showing the number of students, mean anxiety scores, standard deviations, standard error difference and the results of the t-test conducted. The t-value is 4.38, with 898 degrees of freedom and the result is significant at the 0.01 level. Urban students have a mean score of 111.50, which is lower than the rural students' mean of 119.34. Also, standard deviation indicates more variability in the scores for urban students compared to rural students.

Consequently, the null hypothesis, ‘There is no significant difference in the level of mathematics anxiety between secondary school students of rural and urban origin’ is rejected.

An analysis of their mean scores further suggest that rural origin students generally report higher levels of mathematics anxiety as compared to students with urban origin.

4.11 Objective No. 11: To compare the level of mathematics anxiety between rural and urban origin secondary school students of Mizoram

The number of students from rural and urban origin in each level of anxiety is presented through a comparison table (Table 4.11.1). The bar graph in Figure 4.11.1 also shows the comparison of mathematics anxiety between the two groups. Each level of anxiety corresponds to the bars in the figure. Additionally, a t-test was conducted to test the significance of the differences between the two groups, i.e., between rural and urban origin secondary school students of Mizoram

4.11.1 Comparison based on levels of mathematics anxiety

The following table depicts the comparison of mathematics anxiety between rural and urban origin secondary school students of Mizoram.

Table 4.11.1

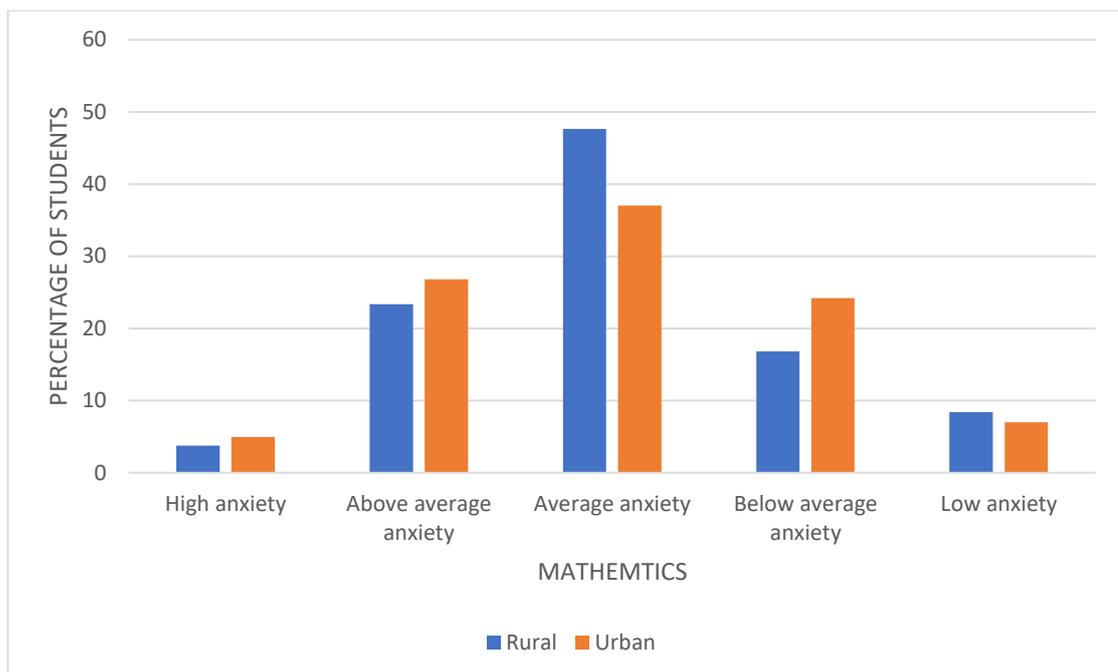
Comparison of mathematics anxiety between rural and urban origin secondary school students of Mizoram

Sl. No	Range of z-score	Grade	Levels of Mathematics Anxiety	Rural		Urban	
				N	%	N	%
1	(+1.51 and above)	A	High anxiety	4	3.74	17	4.96
2	(+0.51 to 1.50)	B	Above average anxiety	25	23.36	92	26.82
3	(-0.50 to +0.50)	C	Average anxiety	51	47.66	127	37.03
4	(-1.50 to -0.51)	D	Below average anxiety	18	16.82	83	24.20
5	(-1.51 and below)	E	Low anxiety	9	8.41	24	7
Total				276	100	624	100

The data shows that a higher percentage of urban origin students (4.96%) compared to rural students (3.74%) experience high anxiety in the high anxiety category. Similarly, urban origin students (26.82%) have a slightly higher percentage than rural students (23.36%) in the above average anxiety category. The average anxiety category has the largest percentage of rural origin students (47.66%) compared to urban origin students (37.03%). In the below average anxiety category, urban students (24.20%) show a higher percentage than rural students (16.82%). Finally, in the low anxiety category, rural origin students (8.41%) have a slightly higher percentage than urban origin students (7%).

Figure 4.11.1

Bar graph showing the comparison of mathematics anxiety between rural and urban origin secondary school students of Mizoram



It can be clearly observed from Figure 4.11.1 that rural origin students (blue bar) tend to experience higher levels of mathematics anxiety compared to their urban counterparts (orange bar) at the average anxiety and low anxiety category. However, across the levels of the high anxiety, above and below average level, urban origin

students show higher mathematics anxiety as compared to urban origin secondary students.

4.11.2 Comparison by test of significance

For comparison of mathematics anxiety between secondary school students of rural and urban origin in Mizoram, the hypothesis which stated that ‘There is significant difference in the level of mathematics anxiety between rural and urban origin secondary school students of Mizoram’ was converted to a null hypothesis which stated that, ‘There is no significant difference in the level of mathematics anxiety between rural and urban origin secondary school students of Mizoram’. The significant difference of the mean scores between the two groups, i.e., were tested using t-test. The detail is highlighted in the following.

Table 4.11.2

Comparison of mathematics anxiety between rural and urban origin secondary school students of Mizoram by test of significance

Origin	No. of students	Mean	Standard Deviation	SED	t-value	df	Significance level
Urban	342	114.42	25.31				
Rural	106	114.98	23.80	7.21	0.21	446	Significant at 0.05

The mean score of urban students is 114.42, while rural students have a slightly higher mean score of 114.98. As the t-value of 0.21 suggests that the difference between the two groups is significant at 0.05 level, rural origin students have slightly higher anxiety as compared to urban origin students of Mizoram.

Consequently, the null hypothesis, ‘There is no significant difference in the level of mathematics anxiety between rural and urban origin secondary school students of Mizoram’ is rejected. Thus, there is significant difference in the level of

mathematics anxiety between rural and urban origin secondary school students of Mizoram.

4.12 Objective No. 12: To compare the level of mathematics anxiety between rural and urban origin secondary school students of Meghalaya.

The number of students from rural and urban origin in each level of anxiety is depicted through a comparison table (Table 4.12.1). The bar graph in Figure 4.12.1 also shows the comparison of mathematics anxiety between the two groups of students. The levels of anxiety correspond to each bar in the figure. Moreover, a t-test was conducted to test the significance of the differences between the two groups, i.e., between rural and urban origin secondary school students of Meghalaya.

4.12.1 Comparison based on levels of mathematics anxiety

The following table depicts the comparison of mathematics anxiety between rural and urban origin secondary school students of Meghalaya.

Table 4.12.1

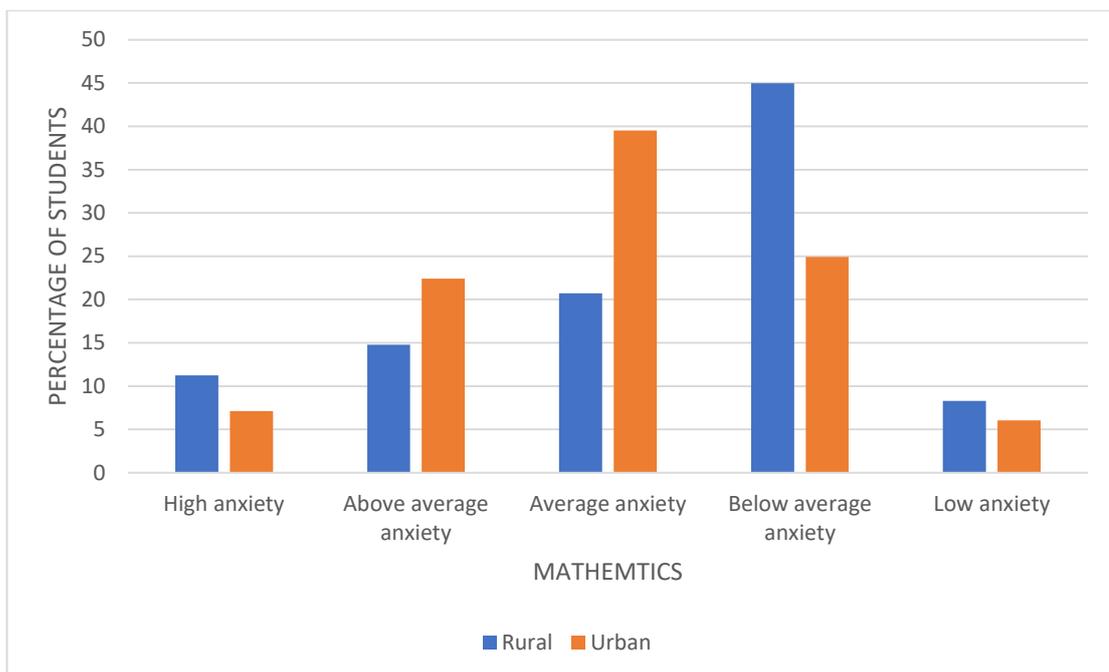
Comparison of mathematics anxiety between rural and urban origin secondary school students of Meghalaya

Sl. No	Range of z-score	Grade	Levels of Mathematics Anxiety	Rural		Urban	
				N	%	N	%
1	(+1.51 and above)	A	High anxiety	19	11.24	20	7.12
2	(+0.51 to 1.50)	B	Above average anxiety	25	14.79	63	22.42
3	(-0.50 to +0.50)	C	Average anxiety	35	20.71	111	39.50
4	(-1.50 to -0.51)	D	Below average anxiety	76	44.97	70	24.91
5	(-1.51 and below)	E	Low anxiety	14	8.28	17	6.05
Total				169	100	281	100

Table 4.12.1 shows that rural origin students have a higher percentage of high anxiety (11.24%) and below average anxiety (44.97%) compared to urban origin students, who report lower percentages in these categories (7.12% for high anxiety and 24.91% for below average anxiety). In contrast, urban origin students have a higher percentage of above average anxiety (22.42%) and average anxiety (39.50%) than rural origin students, who report 14.79% for above average anxiety and 20.71% for average anxiety. Rural and urban origin students show almost similar percentages in the low anxiety category, with rural origin students at 8.28% and urban origin students at 6.05%.

Figure 4.12.1

Bar graph showing the comparison of mathematics anxiety between rural and urban origin secondary school students of Meghalaya



It can be clearly observed from Figure 4.12.1 that urban origin students (orange bar) experience higher levels of mathematics anxiety compared to their rural counterparts (blue bar) at the above average and average level of anxiety. However, across the levels of high anxiety, below average and low anxiety level, rural origin

students show higher mathematics anxiety as compared to urban origin secondary students.

4.12.2 Comparison by test of significance

For comparison of mathematics anxiety between rural and urban origin secondary school students of Meghalaya, the hypothesis which stated that ‘There is significant difference in the level of mathematics anxiety between rural and urban origin secondary school students of Meghalaya’ was converted to a null hypothesis which stated that, ‘There is no significant difference in the level of mathematics anxiety between rural and urban origin secondary school students of Meghalaya’. The significant difference of the mean scores between the two groups, i.e., were tested using t-test as highlighted in the following.

Table 4.12.2

Comparison of mathematics anxiety between rural and urban origin secondary school students of Meghalaya by test of significance

Origin	No. of students	Mean	Standard Deviation	SED	t-value	df	Significance level
Urban	280	107.71	28.60				
Rural	168	122.99	22.16	5.84	6.32	418	Significant at 0.01

Table 4.12.2 compares the mathematics anxiety between urban and rural origin students of Meghalaya. The t-value is 6.32 which is greater than the critical value indicating a significant difference between the two groups at the 0.01 level. Rural origin students with a larger value of mean shows higher anxiety as compared to urban origin secondary students.

Consequently, the null hypothesis, ‘There is no significant difference in the level of mathematics anxiety between rural and urban origin secondary school students of Meghalaya’ is rejected.

Focus group discussion: The quantitative analysis of the data in Objectives 10, 11 and 12 has revealed similar findings in which there is significant difference between rural and urban origin students in which, students of rural origin have higher anxiety than students of urban origin. This finding concurs with the qualitative findings obtained by the focus group discussion, which adds to the credibility of the result obtained. Among the many statements shared by students, some of which are mentioned for the qualitative analysis as the following-

Two students of urban origin stated:

"...I get so frustrated whenever I know I have to do mathematics homework, and that is almost every day. The thought of starting it stresses me out, and I don't even know where to begin..."

"...Whenever I get stuck on some questions, instead of working through them, I just move on to the next one without completing it..."

Some of the statements made by students of rural origin:

"...I used to be afraid that teachers would ask me formulas or ask me to solve problems on the board in front of everyone. That is why I am never comfortable in mathematics class; I always have a sense of fear..."

"...I get scared when I see numbers or equations, or the thought of people asking me to solve them..."

"...Even when someone just mentions mathematics, I get stressed out. I often avoid such conversations..."

The rural-origin students express a deeper sense of stress, fear and avoidance towards mathematics, particularly in social or performance situations, such as anxiety about being asked to solve problems in front of others, whereas the urban-origin students tend to describe frustration, confusion of where to start and a lack of focus, which is not at the same level of emotional distress as compared to how rural origin students feel. This reflects the higher level of anxiety in mathematics that rural students experience as compared to urban origin secondary students.

4.13 Objective No. 13: To compare the level of mathematics anxiety between rural origin secondary school students of Mizoram and Meghalaya

The number of students of rural origin from Mizoram and Meghalaya in each level of anxiety is presented through a comparison table (Table 4.13.1). The bar graph in Figure 4.13.1 also shows the comparison of mathematics anxiety between the two groups. Each level of anxiety corresponds to each bar in the figure. A t-test was conducted to test the significance of the differences between the two groups, i.e., between secondary school students of rural origin in Mizoram and secondary school students of rural origin in Meghalaya.

4.13.1 Comparison based on levels of mathematics anxiety

The following table depicts the comparison of mathematics anxiety between secondary students of rural origin in Mizoram and Meghalaya.

Table 4.13.1

Comparison of mathematics anxiety between rural origin secondary school students of Mizoram and Meghalaya

Sl. No.	Range of z-score	Grade	Levels of Mathematics Anxiety	No. of rural origin students in Mizoram		No. of rural origin students in Meghalaya	
				N	%	N	%
1	(+1.51 and above)	A	High anxiety	9	8.41	6	3.55
2	(+0.51 to 1.50)	B	Above average anxiety	37	34.58	52	30.77
3	(-0.50 to +0.50)	C	Average anxiety	32	29.91	58	34.32
4	(-1.50 to -0.51)	D	Below average anxiety	17	15.89	41	24.26
5	(-1.51 and below)	E	Low anxiety	12	11.21	12	7.10
Total				107	100	169	100

Table 4.13.1 reveals that in the high anxiety category, a higher percentage of rural origin students from Mizoram (8.41%) report high anxiety as compared to those from Meghalaya (3.55%). In the above average anxiety category, Mizoram students (34.58%) have a higher percentage than those from Meghalaya (30.77%). In the average anxiety category, students from Meghalaya (34.32%) show a higher percentage compared to Mizoram students (29.91%). For the below average anxiety category, a higher percentage of students from Meghalaya (24.26%) experience below average anxiety compared to those from Mizoram (15.89%). Finally, in the low anxiety category, Mizoram students have 11.21% showing higher percentage than Meghalaya students with 7.10%.

Figure 4.13.1

Bar graph showing the comparison of mathematics anxiety between rural origin secondary school students of Mizoram and Meghalaya

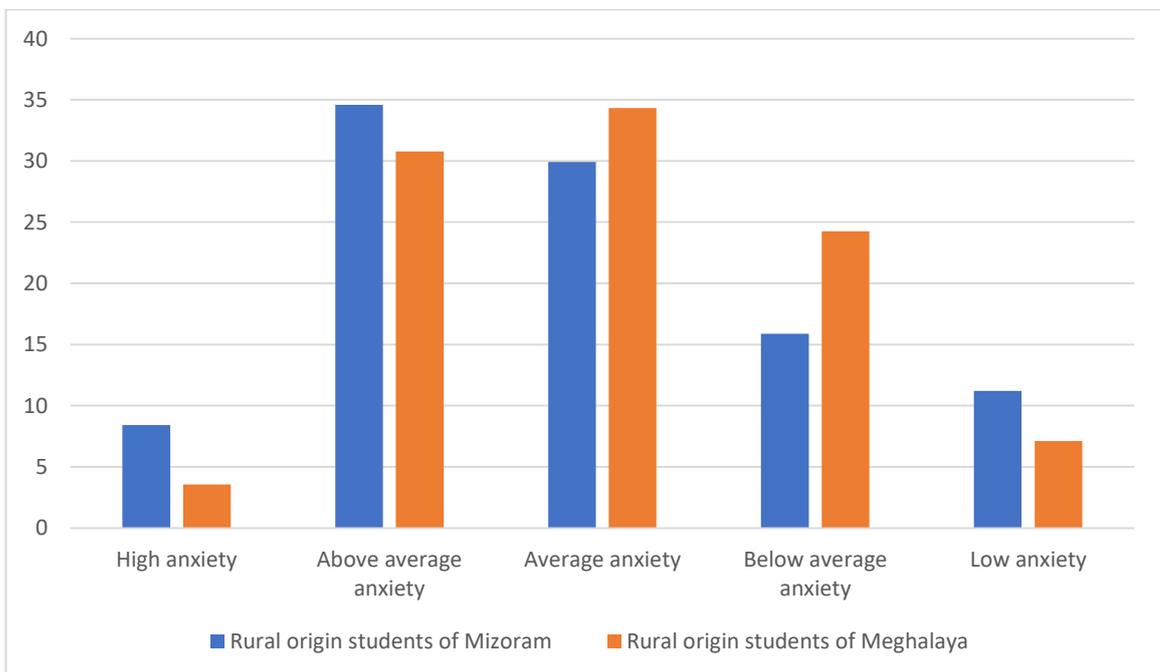


Figure 4.13.1 clearly shows that the percentage differences between rural-origin students of Mizoram and Meghalaya vary significantly across the different anxiety levels. The orange bar, representing rural-origin students from Meghalaya, is

taller than the blue bar for average and above average anxiety levels, indicating a higher percentage in those categories. However, in all other anxiety levels, rural-origin students from Mizoram exhibit a higher percentage.

4.13.2 Comparison by test of significance

For comparison of mathematics anxiety between rural origin secondary school students of Mizoram and Meghalaya, the hypothesis which stated that ‘There is significant difference in the level of mathematics anxiety between rural origin secondary school students of Mizoram and Meghalaya,’ was converted to a null hypothesis which stated that, ‘There is no significant difference in the level of mathematics anxiety between rural origin secondary school students of Mizoram and Meghalaya.’. The significant difference of the mean scores between the two groups, i.e., were tested using t-test. The detail is highlighted in the following.

Table 4.13.2

Comparison of mathematics anxiety between rural origin secondary school students of Mizoram and Meghalaya by test of significance

State	No. of students	Mean	Standard Deviation	SED	t-value	df	Significance level
Mizoram	107	114.30	24.71				
Meghalaya	169	123.15	22.19	8.62	3.01	274	Significant at 0.01

Table 4.13.2 compares the mathematics anxiety between rural origin students of Mizoram and Meghalaya. The t-value was found to be 3.01 which is greater than the critical value. Thus, showing significant difference at 0.01 level.

Consequently, the null hypothesis, ‘There is no significant difference in the level of mathematics anxiety between rural origin secondary school students of Mizoram and Meghalaya’ is rejected.

An analysis of their mean scores further suggest that rural origin students of Meghalaya show higher anxiety as compared to the rural origin students of Mizoram.

Focus group discussion:

Students of rural origin from Mizoram expressed:

“...I used to talk to my friends for discussion and help only when before exam or test. Most of the time, I avoid studying mathematics...” -B3

“...I feel if there are more solved examples to guide us, it will give me the security I would need to solve mathematics...” -G5

Students of rural origin from Meghalaya also shared:

“...I get scared when I see numbers or equations, or the thought of people asking me to solve them...” -G1

“...Even when someone just mentions mathematics, I get stressed out. I often avoid such conversations...”-G2

The findings of the quantitative analysis concur with the findings of the focus group discussion. Students of rural origin from both Mizoram and Meghalaya expressed challenges with mathematics. However, rural-origin students from Mizoram demonstrated a more positive attitude towards learning mathematics and focusing on self-improvement and continuing to study despite procrastination. Meanwhile rural origin students of Meghalaya seem to be showing a more emotional distress towards mathematics by addressing their fear and avoidance of the subject.

4.14 Objective No. 14: To compare the level of mathematics anxiety between urban origin secondary school students of Mizoram and Meghalaya

The number of secondary students of urban origin from Mizoram and Meghalaya in each level of anxiety is given through a comparison table (Table 4.14.1). The bar graph in Figure 4.14.1 also depicts the comparison of mathematics anxiety between the two groups. Each level of anxiety corresponds each bar in the given figure. A t-test was conducted to test the significance of the differences

between the two groups, i.e., between secondary school students of urban origin in Mizoram and secondary school students of urban origin in Meghalaya.

4.14.1 Comparison based on levels of mathematics anxiety

The following table depicts the comparison of mathematics anxiety between urban origin secondary school students of Mizoram and Meghalaya.

Table 4.14.1

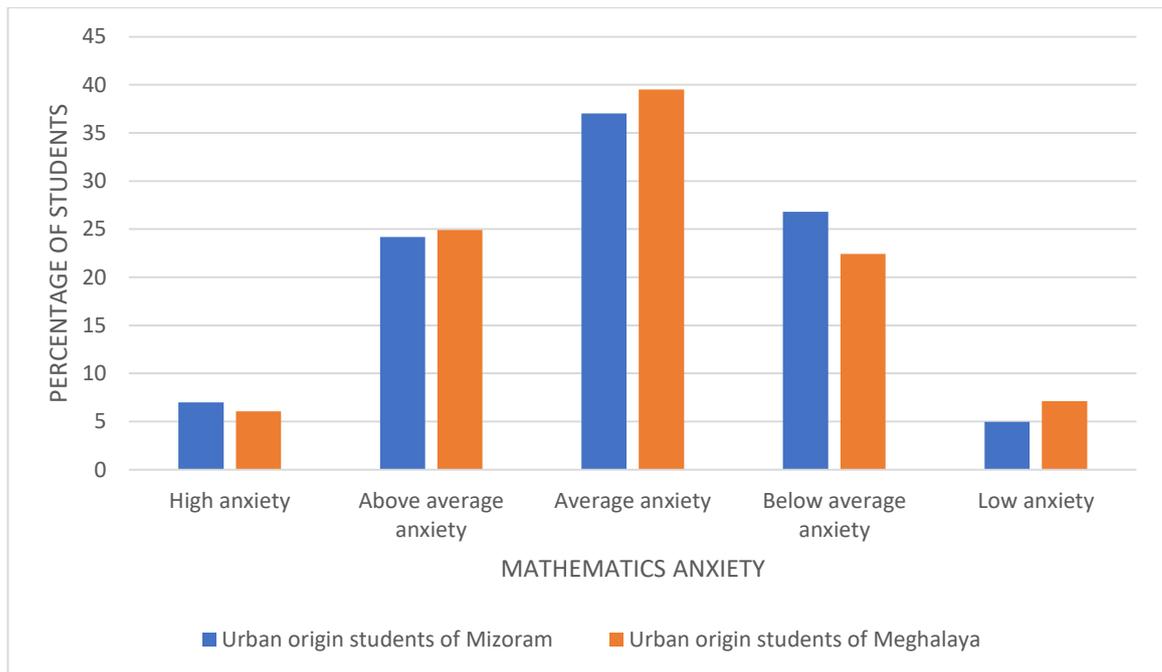
Comparison of mathematics anxiety between urban origin secondary school students of Mizoram and Meghalaya

Sl. No.	Range of z-score	Grade	Levels of Mathematics Anxiety	No. of urban students in Mizoram		No. of urban students in Meghalaya	
				N	%	N	%
1	(+1.51 and above)	A	High anxiety	24	7	17	6.05
2	(+0.51 to 1.50)	B	Above average anxiety	83	24.20	70	24.91
3	(-0.50 to +0.50)	C	Average anxiety	127	37.03	111	39.50
4	(-1.50 to -0.51)	D	Below average anxiety	92	26.82	63	22.42
5	(-1.51 and below)	E	Low anxiety	17	4.96	20	7.12
Total				343	100	281	100

Table 4.14.1 reveals that urban-origin students in Mizoram have a higher percentage at the high anxiety level (7%) compared to those in Meghalaya (6.05%). For above average anxiety, urban students in Mizoram (24.20%) show a slightly higher percentage than those in Meghalaya (24.91%). In the average anxiety category, Mizoram students (37.03%) report a lower percentage compared to Meghalaya students (39.50%). Rural students in Mizoram have a higher percentage of below average anxiety (26.82%) than those in Meghalaya (22.42%). Lastly, urban students in Mizoram have a lower percentage of low anxiety (4.96%) compared to those in Meghalaya (7.12%).

Figure 4.14.1

Bar graph showing the comparison of mathematics anxiety between urban origin secondary school students of Mizoram and Meghalaya



It can be clearly observed from Figure 4.14.1 that urban origin students of Mizoram (blue bar) tend to experience higher levels of mathematics anxiety at the high anxiety, above average anxiety and at low anxiety level. However, across the levels of average and below average level, urban origin students of Meghalaya show

higher mathematics anxiety as compared to urban origin secondary students of Mizoram.

4.14.2 Comparison by test of significance

For comparison of mathematics anxiety between urban origin secondary school students of Mizoram and Meghalaya, the hypothesis which stated that ‘There is significant difference in the level of mathematics anxiety between urban origin secondary school students of Mizoram and Meghalaya’ was converted to a null hypothesis which stated that, ‘There is no significant difference in the level of mathematics anxiety between urban origin secondary school students of Mizoram and Meghalaya’. The significant difference of the mean scores between the two groups were tested using t-test. The detail is highlighted in the following table.

Table 4.14.2

Comparison of mathematics anxiety between urban origin secondary school students of Mizoram and Meghalaya by test of significance

State	No. of students	Mean	Standard Deviation	SED	t-value	df	Significance level
Mizoram	343	114.22	25.54	4.81	2.92	622	Significant at 0.01
Meghalaya	281	107.81	28.60				

Table 4.14.2 compares the mathematics anxiety between urban origin students of Mizoram and Meghalaya, showing the number of students, mean anxiety scores, standard deviations, standard error difference and the results of the t-test conducted. The t-value is 2.92, with 622 degrees of freedom and the result is significant at the 0.01 level. Urban origin students of Mizoram have a mean score of 114.22, which is higher than the urban origin students of Meghalaya whose mean score is of 107.81.

Consequently, the null hypothesis, 'There is no significant difference in the level of mathematics anxiety between urban origin secondary school students of Mizoram and Meghalaya' is rejected.

Focus group discussion:

A student from Meghalaya shared:

"...I rush through mathematics homework just to get them over with quickly. And when I face difficult problems in mathematics, I tend to work on simpler tasks and wait for the last moment to finish the difficult problems." -B1

Students from Mizoram also shared:

"...Whenever I get stuck on some questions, instead of working through them, I just move on to the next one without completing it..." -G3

"...I get so frustrated whenever I know I have to do mathematics homework, and that is almost every day. The thought of starting it stresses me out, and I don't even know where to begin..." -G4

The quantitative findings align with the qualitative results, showing that urban-origin students from Mizoram experience higher levels of anxiety compared students of Meghalaya. Students from Mizoram voiced strong frustrations with mathematics, abandoning problems without attempting to solve them. In contrast, students from Meghalaya demonstrated a more passive approach to the subject in which they express willingness to engage with mathematics despite their dislike for it.

4.15 Objective No. 15: To analyse the reason or reasons for mathematics anxiety among secondary school students

In order to find the reason(s) of mathematics anxiety among secondary school students of Mizoram and Meghalaya, an opinionnaire was developed by the researcher. The researcher also conducted Focus Group Discussion among 8 students selected randomly from each state.

From the 900 secondary school students taken as sample, 266 were found to have anxiety in mathematics. This is based on their z-scores which were categorized into the different levels of anxiety as per the norm given by the Mathematics Anxiety Scale developed by the researcher.

The 266 respondents with mathematics anxiety sorted by the Mathematics Anxiety Scale developed by the researcher were assessed using the Opinionnaire created by the researcher. The focus group discussion then supported the credibility of the findings of the opinionnaire in finding the reason(s) for mathematics anxiety among secondary students.

Table 4.15.1

Level of education at which students started experiencing Mathematics Anxiety

Sl. No.	Level of education	No. of students	Percentage (%) of students
1	Not sure	3	1.13
2	Primary	37	13.91
3	Middle	105	39.47
4	Secondary school	121	45.49
Total		266	100

Table 4.15.1 presents data on the level of education at which respondents started experiencing mathematics anxiety. Out of a total of 266 students, majority (45.49%) identified secondary school as the period when they first encountered mathematics anxiety. This is followed by 39.47% of students who reported experiencing it in middle school whereas 13.91% in primary school. A small

percentage, 1.13%, were not particularly sure of when they first experienced mathematics anxiety.

Focus group discussion

Two students shared the level at which they believed they first experienced mathematics anxiety.

A girl stated:

“...I feel I started having difficulty when I was in Class 9...” – G2

One of the boys also shared:

“...I think I started feeling a pressure in learning mathematics from the beginning of Class 9...” – B3

The data collected from the opinionnaire indicated that students who began experiencing mathematics anxiety at the secondary level were of maximum in number. This finding is further supported by the qualitative data from the focus group discussion, where two students shared that they first experienced anxiety in mathematics at the secondary level of education.

Table 4.15.2

Coping strategies of secondary students

Sl. No.	Coping strategies	No. of students	Percentage (%)
1	Not very sure	2	0.75
2	Seeking help from others	49	18.42
3	Seeking help from tutors	99	37.22
4	Engage in self-study	92	34.59
5	Avoid mathematics related tasks	24	9.02
Total		266	100

Table 4.9.2 outlines various coping strategies used by secondary students to manage mathematics anxiety. Among the 266 respondents, the most common approach, chosen by 37.22%, was seeking help from tutors. This was closely followed by 34.59% of students who engaged themselves in self-study to cope with their anxiety. Another 18.42% sought help from others while 9.02% avoided mathematics-related tasks altogether. A small portion, 0.75%, were unsure of their coping strategies.

Focus group discussion

Few students upon discussing shared their experience related to how they deal with mathematics anxiety:

“...For me, my parents also suggested so I took tuition in mathematics, I think I became a little comfortable after that...” – B1

“...I used to talk to my friends for discussion and also try to study problems on my own with the help of solved examples from text books and very often through YouTube videos...” – G4

The findings in the opinionnaire showed maximum number of students among the many options reported they seek help from tutors to deal with their anxiety in mathematics. It can also be seen that almost 35% engaged themselves in self-study for the same. These findings are in line with the qualitative findings of the focus group discussion in which two students shared they approached tutors and also in self-study in dealing with their anxiety.

Table 4.15.3

Opinion of secondary school students in relation to personal experiences

I. Personal experiences					
Sl. No.	ITEMS	Response			
		Positive (+)		Negative (-)	
		No.	%	No.	%
1	My poor concept in mathematics affects my ability in learning mathematics.	176	66.17	90	33.83
2	I struggle with basic mathematical operations like addition, subtraction, multiplication and division.	2	0.75	75	99.25
3	I struggle with understanding mathematical symbols and vocabularies.	142	53.38	124	46.62
Total		320	52.55	289	47.45

Table 4.9.3 provides insights into personal experiences that may cause mathematics anxiety in secondary students. For the statement "My poor concept in mathematics affects my ability in learning mathematics," 66.17% of students responded positively while 33.83% responded negatively. Regarding basic mathematical operations, a significant majority (99.25%) reported having difficulty, with only 0.75% reporting no issues. Finally, when asked about struggles with understanding mathematical symbols and vocabulary, 53.38% of students responded positively whereas 46.62% did not perceive it as a difficulty.

The researcher found that 52.55% students had positive response in the area of 'Personal Experience' indicating that most students believe mathematics anxiety is caused by difficulty faced at a personal level of experience

Focus group discussion

A boy (B2) and a girl (G2) shared their anxiety in mathematics and how its cause is related to their personal experience in the subject as –

"...Once we don't grasp the concept of certain portions, it is hard to understand the next part or the next lesson. For example, I skipped Trigonometry portion in Class 9, and now I'm having trouble in Class 10 even more..." - B2

"...Whenever I solve sums or problems in mathematics, I get confused on multiplications, divisions and other process and tend to make mistakes..." – G2

The findings of the opinionnaire showed that majority of the students responded mathematics anxiety is caused by difficulty faced at a personal level of experiences. This concurs with the findings of the focus group discussion where students shared their weakness in conceptual understanding such as simple arithmetic. Students also mentioned their personal experience of weakness in the subject by saying that the current problem they faced is the result of neglected lessons in previous classes.

Table 4.15.4**Opinion of secondary school students in relation to family issues****II. FAMILY ISSUES**

Sl. No.	ITEMS	Response			
		Positive (+)		Negative (-)	
		No.	%	No.	%
1	Lack of encouragement from my family contributes to my fear of mathematics.	79	29.70	187	70.30
2	I'm confident that practicing more will improve my proficiency in mathematics.	155	58.27	111	41.73
Total		234	43.98	298	56.02

Table 4.9.4 reveals secondary school students' opinions on family-related factors influencing their mathematics anxiety. For the statement "Lack of encouragement from my family contributes to my fear of mathematics," 29.70% of students responded positively, agreeing that family encouragement does affect their confidence, while 70.30% disagreed. 58.27% of students expressed confidence that increased practice would improve their proficiency in mathematics whereas 41.73% were less certain.

The researcher found that 56.02% students had negative response in the area of 'Family issues' indicating that most students do not believe the cause of mathematics anxiety is concerned with the welfare of the family in which the student belongs.

Focus group discussion

Two students upon discussing the reasons of mathematics anxiety related to family support shared:

“...My parents expect so much from me and think I should get good marks in mathematics is very stressful, makes me more nervous...” – B1

“...Everyone, my teachers, parents and all tells me to study mathematics and work very hard, this makes me nervous...” – G1

The opinionnaire findings revealed that the majority of students disagreed with that anxiety is not caused by family issues or lack of support. This aligns with the focus group discussion, where two students shared that their parents' high expectations made them feel nervous. This suggests that their anxiety was driven by the family's desire for them to excel in mathematics. Without this pressure, they might not have experienced the anxiety. These findings support the results from the opinionnaire.

Table 4.15.5

Opinion of secondary school students in relation to their teachers

III. TEACHER CONCERNED					
Sl. No.	ITEMS	Response			
		Positive (+)		Negative (-)	
		No.	%	No.	%
1	My mathematics teacher does not give clear explanation during class.	67	25.19	199	74.81
2	My teacher does not have required qualification to teach mathematics in class.	20	7.52	246	92.48
3	My mathematics teacher is consistently unprepared.	34	12.78	232	87.22
4	Students find teachers' remarks about their mathematical abilities discouraging.	196	73.68	70	26.32
5	My mathematics teacher does not show concern for slow learners.	70	26.32	197	73.68
6	A very large teacher-student ratio negatively affects our learning environment in mathematics	174	65.41	92	34.59
Total		561	35.13	1036	64.87

Table 4.9.5 summarizes on teacher-related factors that could supposedly affect the mathematics anxiety of secondary students. 25.19% agreed that their mathematics teacher does not give clear explanations and the rest 74.81% disagreed, hinting teachers are not to be blamed for their anxiety. Only 7.52% of students reported that teachers lacked required qualifications to teach mathematics while 92.48% expressed confidence in their teacher's qualifications. 12.78% felt their teachers are consistently unprepared, whereas 87.22% do not feel the same way. For statements concerning discouraging remarks against students 26.32% of respondents disagreed while approximately 73.68% agreed to the statement. In case of lack of concern for slower learners, 73.68% did not acknowledge this issue while the rest 26.32 agreed to the statement. A smaller percentage (34.59%) do not agree that teacher-student ratio affects the effectiveness and perspective of students towards mathematics while 65.41% agreed that it affects anxiety of mathematics in secondary students.

The researcher found that 64.87% students had negative response regarding teachers as one of the anxiety factors. This indicates that most students do not believe the cause of mathematics anxiety is concerned with their teachers. However few points such as teacher's remarks and teacher-student ratio indicated that teachers do have an impact on their anxiety.

Focus group discussion

Most students when discussion was open for finding reasons for the anxiety they felt in mathematics, talked of their teachers. Some of whose statements are shown in the following:

"...Giving harsh criticism could be quite hurtful to the students..." – G1

"...When teachers give comment on our weakness in mathematics, it can be discouraging as we need support and encouragement in studying..." – G3

"...If the student-teacher ratio is a bit smaller than what we have in our school right now, students and teachers will have a closer relationship and teachers will be able to care for students better..." – B3

The findings of opinionnaire showed that majority of the students found teachers' remarks about their mathematical abilities discouraging. A student also mentioned how student-teacher ratio negatively affected his anxiety in mathematics. This validated by the findings of the focus group discussion in which two students shared how harsh criticisms and comments on their weakness on the subject discouraged and hurt them, and how one student expressed student-teacher ratio have an impact on his anxiety in mathematics. These statements collectively point to the idea that teacher behaviors, including harsh criticism and lack of encouragement can significantly influence students' emotional responses to mathematics and contribute to anxiety. It also points to an idea that an appropriate student-teacher ratio affects anxiety in mathematics.

Table 4.15.6

Opinion of secondary school students in relation to transaction of lesson in classroom teaching

IV. TRANSACTION					
Sl. No.	ITEMS	Response			
		Positive (+)		Negative (-)	
		No.	%	No.	%
1	I find it hard to understand how my mathematics teachers teach in class.	135	50.75	131	49.25
2	My teacher never motivates me in mathematics class.	36	13.53	230	86.47
3	I have problems in understanding the language/accnt used by my teacher in mathematics class.	73	27.44	193	72.56
Total		244	30.58	554	69.42

Table 4.9.6 reveals the opinion of secondary school students in relation to transaction of lessons in mathematics class which may contribute to the cause of mathematics anxiety. When asked if students struggle to understand their teachers'

instruction methods, responses nearly split, with 49.25% disagreeing while 50.75% agreed. Majority (86.47%) felt that their teachers provided sufficient motivation, while only 13.53% felt a lack of encouragement by their teachers. Regarding difficulty faced

in not understanding class teaching because of teacher's language or accent, 27.44% of students asserted that this was the case while 72.56% did not encounter such problems.

The researcher found that 69.42% students had negative response regarding transaction of lesson in mathematics class as one of the anxiety factors. This indicates

that most students do not believe the cause of mathematics anxiety is concerned with transaction of lesson in mathematics class. However, majority (50.75%) of the students find it hard to understand how their mathematics teachers teach in class.

This finding is in line with the findings of many researchers such as Mollah (2017) and Kunwar (2020), who found unconstructive teaching methods in mathematics class contributes to anxiety in mathematics. Kathuria (2021) also found that reliance on rote learning, inadequate teacher-designed positive experiences and lack of humour in teaching mathematics resulted in anxiety.

Focus group discussion

Transaction of lesson in the class can be considered an important factor for determining interest or disinterest of students in mathematics. Upon discussing transaction of lessons in the class, the following statements were made by students:

“...I feel when our teacher explains in the class, it easily becomes boring. I don't understand what he says...” - B1

“...Sometime our teachers speak too fast. I used to understand half of what they say but the other half is usually not understandable...” – G3

“...Our mathematics teacher speaks very fast and do not give clear explanation...” - G5

These statements clearly show how students have problems in understanding how their teachers transact lessons in class. This is in line with one of the items in the opinionnaire regarding transaction of lesson, where students agreed to find difficulty understanding how their mathematics teachers teach in class.

Table 4.15.7

Opinion of secondary school students in relation to economic concerned

V. ECONOMIC CONCERNED					
Sl. No.	ITEMS	Response			
		Positive (+)		Negative (-)	
		No.	%	No.	%
1	I believe I will not excel in mathematics without tuition.	140	52.63	126	47.37
2	I hope to improve in mathematics if I have a better space to study at home.	149	56.02	117	43.98
Total		289	66.90	143	33.10

Table 4.9.7 reflects secondary school students' opinions on economic factors that may impact their perspective on mathematics. 52.63% of students agreed they will not excel in mathematics without the help of tutors, stating that they do need tuitions for dealing with their anxiety. However, 47.37% no not feel the need for it. Furthermore, 56.02% of students expressed hope for improvement in mathematics with better study environment at home, to contribute to tackling their negative perspective on mathematics, whereas 43.98% did not consider this a necessity.

The researcher found that 66.90% students had positive response regarding economic condition of students as one of the anxiety factors. This indicates that most students believe the cause of mathematics anxiety is concerned with the economic condition of secondary student.

Focus group discussion

In the focus group discussion, upon discussing the coping strategies of mathematics anxiety, a boy stated:

“...For me, my parents also suggested so I took tuition in mathematics, I think I became a little comfortable after that...” – B1

This statement showed how tuitions could help students in lessening their anxiety in mathematics. And without it, many students might face even more difficulties and tension. This is in line with the findings of the opinionnaire in which majority of students agreed without tuitions, they would not be able to excel in mathematics.

Table 4.15.8

Opinion of secondary school students in relation to misconception on mathematics learning

VI. MISCONCEPTION					
Sl. No.	ITEMS	Response			
		Positive (+)		Negative (-)	
		No.	%	No.	%
1	I believe boys are better in mathematics than girls	125	46.99	141	53.01
2	Mathematical intelligence is an inborn quality	127	47.74	139	52.26
Total		252	47.37	280	53.63

Table 4.9.8 shows secondary school students' beliefs regarding common misconceptions in mathematics, which ultimately may affect the anxiety of secondary students in mathematics. For the statement "I believe boys are better in mathematics than girls," 46.99% of students agreed, while a slightly larger proportion, 53.01%, disagreed. Although the differences are minimal. Similarly,

while 47.74% of students believed that mathematical intelligence is an inborn quality, almost the same number of students, i.e., 52.26% did not share this view.

The researcher found that 53.63% students had negative response regarding misconception of mathematics learning as one of the anxiety factors. This indicates that most students do not believe the cause of mathematics anxiety is concerned with misconceptions in mathematics learning.

Focus group discussion

In the focus group discussion, students agreed when they were asked if they have heard of people talked about how they believe males are expected to be better than females in mathematics anxiety. However, when asked if they believed their gender contributes to the anxiety they have in mathematics, none agreed. This finding concurs with the findings of the opinionnaire in which majority of students (53.26%) disagreed than misconception played roles in contributing towards mathematics anxiety.

Table 4.15.9

Opinion of secondary school students in relation to syllabus

VII. SYLLABUS					
Sl. No.	ITEMS	Response			
		Positive (+)		Negative (-)	
		No.	%	No.	%
1	Our mathematics syllabus should be reduced.	165	62.03	101	37.97
2	Solved problems in textbooks are too less.	140	52.63	126	47.37
3	The problems presented in mathematics textbooks lack interesting contents.	153	57.52	113	42.48
4	There is typically never enough time to cover the syllabus thoroughly.	149	56.02	117	43.98
5	The absence of connecting mathematics lessons with real-life experiences diminish my interest in mathematics.	148	55.64	118	44.36
Total		755	56.77	575	43.23

Secondary school students' perspectives on syllabus-related factors impacting their mathematics anxiety are observed from Table 4.9.9. A majority of students (62.03%) felt the syllabus heavy and that it should be reduced, while 37.97% disagreed. Additionally, 52.63% believed the few solved problems in textbooks contributes to their negative perspectives in mathematics subject. Meanwhile, 57.52% found the content in mathematics problems to lack interest while the rest do not share this view. Furthermore, 56.02% of students noticed the rush of covering syllabus with not enough time to be one of the factors for the cause of mathematics

anxiety while 55.64% felt that the lack of real-life connections in lessons reduces their interest.

The researcher found that 56.77% students had positive response regarding syllabus as one of the anxiety factors. This indicates that most students believe the cause of mathematics anxiety is concerned with the syllabus.

Focus group discussion

Syllabus could be considered to contribute to one of the most important factors in the success or failure of any education goals or objectives. When asked upon the reasons for anxiety in mathematics, many students spoke of the heavy syllabus and talked of the text-book as well, some of whose statements are given below:

“...The solved problems in the text books are too less and sometimes very different from the questions...” – G2

“...I feel if there are more solved examples to guide us, it will give me the security I would need to solve mathematics...” – G5

“...I feel pressured when we have to rush to finish the syllabus, I think our syllabus is too heavy...” – G5

The findings of the opinionnaire showed that majority of students felt syllabus have to do with their experience of anxiety in mathematics. This finding concurs with the finds of the focus group discussion where few students spoke of the inadequacy of their textbooks as well as the rush to finish syllabus often pressured them resulting in making them anxious of the subject.

Table 4.15.10**Opinion of secondary school students in relation to infrastructure**

VIII. INFRASTRUCTURE					
Sl. No.	ITEMS	Response			
		Positive (+)		Negative (-)	
		No.	%	No.	%
1	The noise from other classes makes it difficult to concentrate during mathematics class.	105	39.47	161	60.53
2	Our congested classroom makes it hard to concentrate in mathematics.	91	34.21	175	65.79
3	The poor quality of black board/white board reduces enthusiasm for learning mathematics.	55	20.68	211	79.32
Total		251	31.45	547	68.55

It can be observed from Table 4.9.10 that only few respondents (39.47%) have difficulty concentrating due to noises heard from nearby classrooms indicating the contribution of poor infrastructure towards mathematics anxiety. Although the rest (60.53%) do not have a problem in this regard. 65.79% of the respondents do not have issues with congested classrooms to affect their anxiety whereas the rest 34.21% have problems and agreed to this issue contributing towards mathematics anxiety. Only 20.68% of the respondents experience poor quality of black-board and white-board to lessen their enthusiasm towards learning mathematics while the majority 79.32% reported not having problems with this regard.

The researcher found that 68.55% students had negative response regarding infrastructure as one of the anxiety factors. This indicates that most students do not believe the cause of mathematics anxiety is concerned with infrastructure.

Focus group discussion

When students were asked of how infrastructure might affect their overall perspectives towards mathematics and how it could be one of the reasons contributing to their anxiety in the subject, none agreed to it.

This finding of the focus group discussion concurs with the finding of the opinionnaire where almost 70% of students felt infrastructure did not contribute to their anxiety in mathematics.

4.16 Objective No. 16: To find out the relationship between mathematics anxiety and achievement in mathematics.

A correlation analysis was computed using SPSS to determine the strength and direction of the relationship between mathematics anxiety and academic achievement in mathematics.

Range of Pearson's Product Moment Correlation Coefficient (r) was based for the correlation analysis. The Correlation Coefficient measures the strength and direction of the linear relationship between two variables. Its value ranges from -1 to +1, where -1 represents a perfect negative linear correlation, 0 indicates no linear relationship, and +1 signifies a perfect positive linear correlation (Basumatary et al. 2023).

To test the correlation, the hypothesis which stated that 'There is a significant relationship between mathematics anxiety and achievement in mathematics among secondary school students of Mizoram and Meghalaya' is converted to the null hypothesis 'There is no significant relationship between mathematics anxiety and achievement in mathematics among secondary school students of Mizoram and Meghalaya'.

A correlation coefficient was then calculated in which **-0.48** was found by Pearson's Product Moment Correlation method, indicating a *moderate negative relationship* between the two variables- Mathematics anxiety and Academic achievement in mathematics. The table below reveals the detail-

Table 4.16.1

Statistics of mathematics anxiety and achievement in mathematics

	Mean	Standard deviation	No. of samples
Mathematics anxiety	113.90	26.36	900
Mathematics marks	52.38	21.56	900

It can be observed from Table 4.10.1 that the mean of mathematics anxiety score is 113.90 while it is 53.38 for the mathematics mark (achievement in mathematics). The table also shows the standard deviation for both, i.e., 26.36 and 21.56 respectively. These are taken from 900 sample students.

Table 4.16.2

Correlation of mathematics anxiety and achievement in mathematics.

	Mathematics anxiety	Mathematics mark
Mathematics anxiety	1	-0.48*
Mathematics mark	-0.48*	1

*Correlation is significant at the 0.01 level

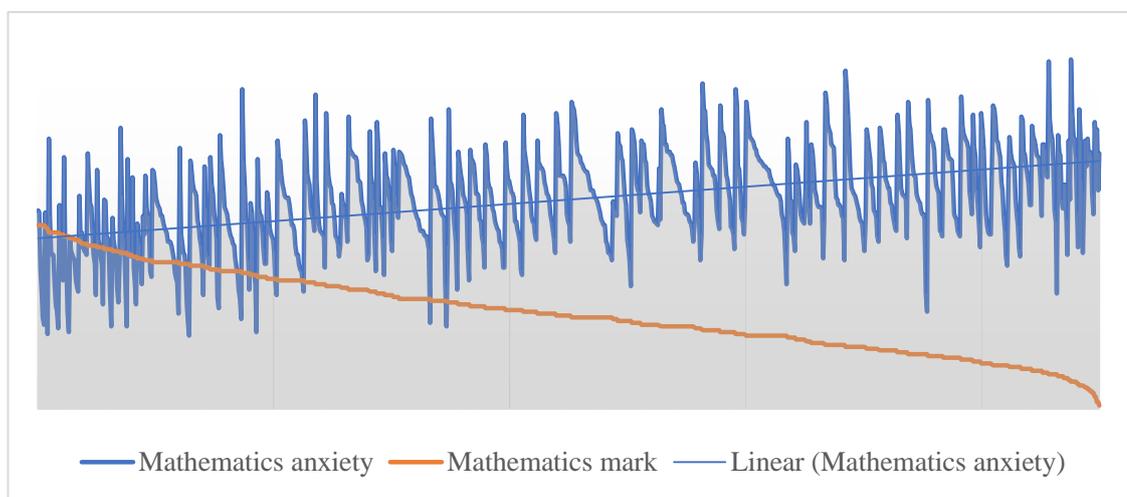
The data from Table 4.10.2 reveals that there exists a negative but moderate correlation between the mathematics anxiety and mathematics mark (achievement in mathematics). This correlation is deemed statistically significant at the 0.01 level.

Therefore, the null hypothesis 'There is no significant relationship between mathematics anxiety and achievement in mathematics among secondary school students of Mizoram and Meghalaya,' is rejected.

The relationship between mathematics anxiety and achievement in mathematics is visually depicted in Figure 4.10.1. The data score of the respondents collected using the Mathematics Anxiety Scale developed by the researcher and the mathematics mark (achievement in mathematics) scored by the respondents in their previous examination is plotted in a graph, as shown in the following-

Figure 4.16.1

Correlation of Mathematics Anxiety with Mathematics Mark



The pictorial representation in Figure 4.16.1 illustrates the correlation between mathematics anxiety and mathematics achievement (marks). The blue zig-zag line represents the anxiety scores with a trendline added for clearer visualization of its direction, while the orange line depicts the marks scored in mathematics.

It can be observed that as the blue line goes up, the orange line goes down, i.e., as the anxiety increases, the mark decreases.

4.17 Objective No. 17: To examine the impact of mathematics anxiety on academic achievement in mathematics among secondary school students.

Prediction of academic achievement in mathematics (indicated by mathematics mark) based on mathematics anxiety was made using regression analysis computed by excel worksheet. To test the impact of mathematics anxiety on mathematics mark, the hypothesis which stated that ‘Mathematics anxiety has an

impact on the academic achievement in mathematics among secondary school students.’ is converted to the null hypothesis ‘Mathematics anxiety has no impact on the academic achievement in mathematics among secondary school students.’ The details of regression analysis are shown in table 4.17.1 and the line of best fit of the regression analysis is depicted in figure 4.17.1.

Table 4.17.1

Regression results on the impact of mathematics anxiety on academic achievement in mathematics

Regression Analysis	
Multiple R	0.48
R Square	0.23
Adjusted R Square	0.23
Standard Error	18.87
Observations	900

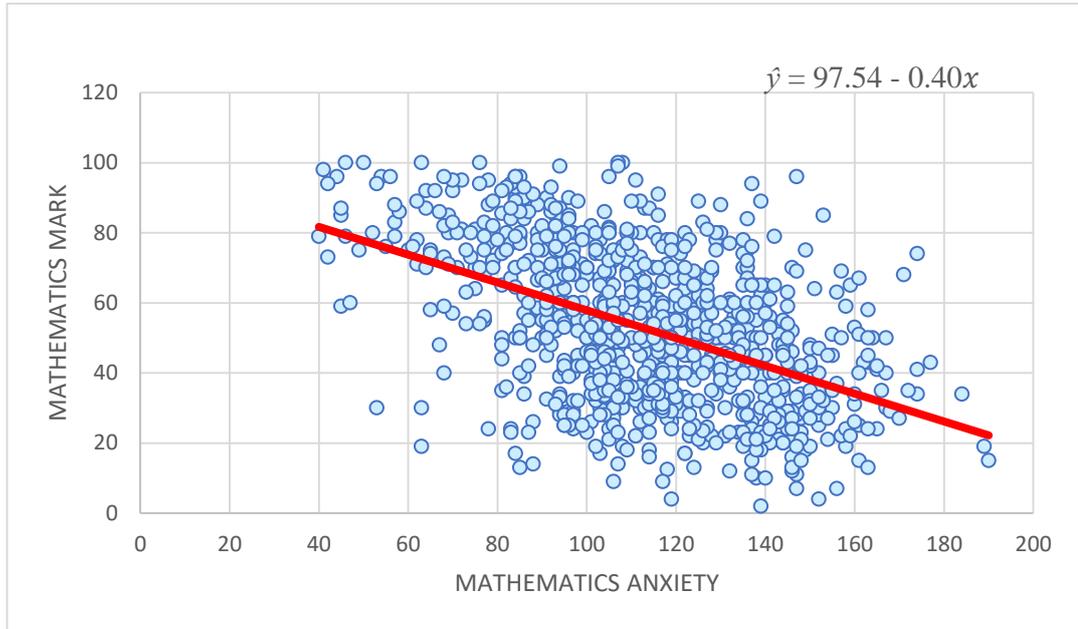
Estimates of Regression Coefficients

	<i>Coefficients</i>	<i>Std. Error</i>	<i>t-stat</i>	<i>P-value</i>
Intercept	97.54	2.79	34.93***	0.000
Mathematics anxiety	-0.40	0.02	-16.60***	0.000

***Significant at 1% level of significance

Figure 4.17.1

**Line of best fit for prediction of academic achievement in mathematics
based on mathematics anxiety**



It is observed from table 4.17.1 that mathematics anxiety significantly predicts academic achievement in mathematics ($R = -0.48$, $p < 0.01$) (negative sign indicated by slope -0.40). The table further reveals $R^2 = 0.23$, which implies that the independent variable (mathematics anxiety) accounted for 23% of academic achievement in mathematics. i.e., mathematics anxiety impact mathematics mark by 23% and the rest 77% may be impacted by other factors. The table also shows that for every unit increase in mathematics anxiety, mathematics mark decreases by 0.40. The estimated regression equation is given as $\hat{y} = 97.54 + (-0.40)x$, i.e., $\hat{y} = 97.54 - 0.40x$, where \hat{y} is the predicted value of mathematics mark and x is the mathematics anxiety of secondary students.

Figure 4.17.1 depicts the prediction of academic achievement in mathematics based on mathematics anxiety, wherein the line in red colour represents the line of best fit and the dots are data points of the present study. The figure reveals that as mathematics anxiety increases, academic achievement in mathematics decreases.

CHAPTER-V

MAJOR FINDINGS, DISCUSSIONS, RECOMMENDATIONS, AND SUGGESTIONS FOR FURTHER RESEARCH

The present chapter focuses on the major findings of the study, discussions, recommendations and suggestions for further research.

5.1 MAJOR FINDINGS:

The major findings of the present study highlighted in the following illustrate how the objectives are met. They are presented as follows:

5.1.1 Standardization of Mathematics Anxiety Scale

A Likert type Mathematics Anxiety Scale had been constructed and standardized. The reliability of the scale was found by test-retest method in which a reliability coefficient of 0.84 was found. The validity of this Mathematics Anxiety Scale was assessed through content validity, ensured by logical analysis by experts, and concurrent validity, which was validated with a coefficient of 0.82. The norms for the scale were established and presented in the form of z-scores.

5.1.2 Study on the level of mathematics anxiety among secondary school students of Mizoram

Among the 450 secondary students in Mizoram, the levels of mathematics anxiety, listed from highest to lowest, were found as follows:

1. 39.56% of the students experienced average anxiety in mathematics.
2. 25.33% of the students felt below-average anxiety in mathematics.
3. 22.67% of the students faced above-average anxiety in mathematics.
4. 7.11% of the students had high anxiety in mathematics.
5. 5.33% of the students encountered low anxiety in mathematics.

Focus group discussion: The focus group discussion revealed that all participants from Mizoram who spoke of their experiences expressed having mathematics anxiety. This aligned with the quantitative findings which showed that the highest percentage of students (39.56%) falls in the average level of mathematics anxiety. Comments made by some of the participants indicated that their anxiety could be addressed and reduced through specific actions.

5.1.3 Study on the level of mathematics anxiety among secondary school students of Meghalaya

For the 450 secondary students in Meghalaya, the levels of mathematics anxiety were as follows:

1. 38.89% of the students experienced average anxiety in mathematics.
2. 28% of the students had above-average anxiety in mathematics.
3. 20.44% of the students felt below-average anxiety in mathematics.
4. 8% of the students faced low anxiety in mathematics.
5. 4.67% of the students encountered high anxiety in mathematics.

Focus group discussion: Participants of the discussion expressed their feelings towards mathematics, in which negative statements made by students from Meghalaya revealed mathematics anxiety among the students. This explains why the highest percentage of students (38.89%) are in average mathematics anxiety level.

5.1.4 Comparison on the level of mathematics anxiety between secondary school students of Mizoram and Meghalaya

5.1.4.1 Comparison based on levels of mathematics anxiety

1. Average anxiety was most common among the two states.
2. 7.11% of students in Mizoram and 4.67% of students in Meghalaya experienced high anxiety in mathematics.
3. 22.67% of students in Mizoram and 28% of students in Meghalaya encountered above average anxiety in mathematics.

4. 39.56% of students in Mizoram and 38.89% of students in Meghalaya felt average anxiety in mathematics.
5. 25.33% of students in Mizoram and 20.44% of students in Meghalaya had below average anxiety in mathematics.
6. 5.33% of students in Mizoram and 8% from Meghalaya faced low anxiety in mathematics.

5.1.4.2 Comparison by test of significance

There was no significant difference in the level of mathematics anxiety between secondary school students of Mizoram and Meghalaya.

Focus group discussion: According to the statements made by participants, although all students reported experiencing mathematics anxiety, not everyone experienced severe mathematics anxiety; rather, they felt only mild anxiety when faced with more difficult problems. The qualitative discussion helped explain the quantitative findings in which a larger number of students experienced average mathematics anxiety. Not much difference was observed in the intensity of mathematics anxiety between the two states based on their statements, which also explained the insignificance found by t-test.

5.1.5 Comparison on the level of mathematics anxiety between male and female secondary school students of Mizoram and Meghalaya

5.1.5.1 Comparison based on levels of mathematics anxiety

1. Average anxiety was most common among both genders.
2. 7.54% of males and 6.34% of females experienced high anxiety in mathematics
3. 21.41% of males and 24.34% of females had above average anxiety in mathematics.
4. 40.63% of males and 35.79% of females encountered average anxiety in mathematics.
5. 24.57% of males and 27.20% of females had below average anxiety in mathematics.

6. 5.84% of males and 6.34% of females faced low anxiety in mathematics.

5.1.5.2 Comparison by test of significance

There was a significant difference in the level of mathematics anxiety between male and female secondary school students of Mizoram and Meghalaya, with females exhibiting higher anxiety scores compared to males. (Significant at 0.01).

Focus group discussion: The qualitative findings indicated that male students showed a more positive strategy for addressing challenges in willing to seek help from others. In contrast, many female students tended to avoid challenges and were stressed by mathematical problems. Although male students also experienced anxiety about the subject, they were more inclined to seek assistance and complete their tasks, rather than leaving them unfinished. This explained why females had higher mathematics anxiety as compared to males.

5.1.6 Comparison on the level of mathematics anxiety between male secondary school students of Mizoram and Meghalaya.

5.1.6.1 Comparison based on levels of mathematics anxiety

1. Average anxiety was most common among male students in both states.
2. 6.90% male students of Mizoram and 6.25% male students of Meghalaya experienced high anxiety in mathematics.
3. 24.14% male students of Mizoram and 25.48% male students of Meghalaya had above average anxiety in mathematics.
4. 38.92% male students of Mizoram and 40.38% male students of Meghalaya encountered average anxiety in mathematics.
5. 24.14% male students of Mizoram and 20.19% male students of Meghalaya felt below average anxiety in mathematics.
6. 5.91% male students of Mizoram and 7.69% male students of Meghalaya faced low anxiety in mathematics.

5.1.6.2 Comparison by test of significance

There was no significant difference in the level of mathematics anxiety between male secondary school students of Mizoram and Meghalaya.

Focus group discussion: The qualitative research, gathered through focus group discussion, showed that male students who shared their anxiety-related issues reported similar levels of degree in their negative experiences with mathematics.

5.1.7 Comparison on the level of Mathematics Anxiety between female secondary school students of Mizoram and Meghalaya.

5.1.7.1 Comparison based on levels of Mathematics Anxiety

1. Average anxiety was most common among female students in both states.
2. 12.96% female students of Mizoram and 2.89% female students of Meghalaya experienced high anxiety in mathematics.
3. 17.41% female students of Mizoram and 31.40% female students of Meghalaya had above average anxiety in mathematics.
4. 37.25% female students of Mizoram and 33.88% female students of Meghalaya encountered average anxiety in mathematics.
5. 27.94% female students of Mizoram and 23.55% female students of Meghalaya felt below average anxiety in mathematics.
6. 4.45% female students of Mizoram and 8.26% female students of Meghalaya faced low anxiety in mathematics.

5.1.7.2 Comparison by test of significance

There was a significant difference in the level of mathematics anxiety between female secondary school students of Mizoram and Meghalaya, with female students of Meghalaya exhibiting higher anxiety in mathematics. (Significant at 0.05).

Focus group discussion: The findings of the discussion concurred with the quantitative findings in which female students of Meghalaya had higher anxiety in mathematics as compared to female secondary students of Mizoram. The students of

Meghalaya expressed feeling nervous with the encouragement of their teachers and parents which is indicative of their negative perception towards mathematics. Struggles with basic mathematical operations would definitely result in anxiety as well. However, the problems mentioned by female students from Mizoram appeared to be manageable as they also mentioned not requiring assistance from others to help them understand mathematics.

5.1.8 Comparison on the level of mathematics anxiety between male and female secondary school students of Mizoram

5.1.8.1 Comparison based on levels of mathematics anxiety

1. Average anxiety was most common among both genders
2. 5.42% of males and 4.45% of females experienced high anxiety in mathematics.
3. 24.63% of males and 27.94% of females had above average anxiety in mathematics.
4. 40.39% of males and 37.25% of females encountered average anxiety in mathematics.
5. 25.12% of males and 21.05% of females felt below average anxiety in mathematics.
6. 4.43% of males and 9.31% of females faced low anxiety in mathematics.

5.1.8.2 Comparison by test of significance

There was a significant difference in the level of mathematics anxiety between male and female secondary school students of Mizoram, with females exhibiting higher mean scores compared to their males. (Significant at 0.01).

Focus group discussion: The findings of the discussion revealed that female students expressed their mathematics anxiety with more emotional intensity, indicating higher anxiety. In contrast, male students adopted a more detached, resigned attitude, choosing to complete the work rather than avoid it. This difference in how they talked about their experiences with mathematics have indicated a deeper

sense of unease and self-doubt among females, which explained their higher anxiety as compared to the males.

5.1.9 Comparison on the level of mathematics anxiety between male and female secondary school students of Meghalaya

5.1.9.1 Comparison based on levels of mathematics anxiety

1. Average anxiety was the most prevalent level for both genders.
2. 7.69% of males and 8.26% of females experienced high anxiety in mathematics.
3. 20.19% of males and 23.55% of females had above average anxiety in mathematics.
4. 40.38% of males and 33.88% of females encountered average anxiety in mathematics.
5. 25.48% of males and 31.40% of females had below average anxiety in mathematics.
6. 6.25% of males and 2.89% of females faced low anxiety in mathematics.

5.1.9.2 Comparison by test of significance

There was a significant difference in the level of mathematics anxiety between male and female secondary school students of Meghalaya, where females experienced greater mathematics anxiety compared to males. (Significant at 0.01).

Focus group discussion: A male participant's statement reflected frustration and comparison but lacked long-term self-doubt about his ability in mathematics. In contrast, female students expressed deeper feelings of hopelessness and inadequacy in mathematical abilities, contributing to higher anxiety. While males focused on external comparisons, females struggled more with self-doubt at the cognitive level by which their higher anxiety levels in mathematics was explained.

5.1.10 Comparison on the level of mathematics anxiety between secondary school students of rural and urban origin

5.1.10.1 Comparison based on levels of mathematics anxiety

1. A significant percentage of students fell in the average level of anxiety in both groups, i.e., rural origin and urban origin.
2. 4.71% students of rural origin and 9.29% students of urban origin experienced high anxiety in mathematics.
3. 26.45% students of rural origin and 23.40% students of urban origin encountered above average anxiety in mathematics.
4. 36.23% students of rural origin and 34.46% students of urban origin had average anxiety in mathematics.
5. 27.54% students of rural origin and 24.04% students of urban origin felt below average anxiety in mathematics.
6. 5.07% students of rural origin and 8.81% students of urban origin faced low anxiety in mathematics.

5.1.10.2 Comparison by test of significance

There was a significant difference in the level of mathematics anxiety between secondary school students of rural and urban origin, where rural origin students were found to have higher mathematics anxiety indicated by larger mean scores. (Significant at 0.01).

5.1.11 Comparison on the level of mathematics anxiety between rural and urban origin secondary school students of Mizoram

5.1.11.1 Comparison based on levels of mathematics anxiety

1. The highest percentage of students of both rural origin and urban origin were in the average level of anxiety.
2. 3.74% students of rural origin and 4.96% students of urban origin experienced high anxiety in mathematics.

3. 23.36% students of rural origin and 26.82% students of urban origin encountered above average anxiety in mathematics.
4. 47.66% students of rural origin and 37.03% students of urban origin had average anxiety in mathematics.
5. 16.82% students of rural origin and 24.20% students of urban origin felt below average anxiety in mathematics.
6. 8.41% students of rural origin and 7% students of urban origin faced low anxiety in mathematics.

5.1.11.2 Comparison by test of significance

There was a significant difference in the level of mathematics anxiety between rural and urban origin secondary school students of Mizoram where rural origin students were found to have greater mathematics anxiety indicated by larger mean scores. (Significant at 0.05).

5.1.12 Comparison on level of mathematics anxiety between rural and urban origin secondary school students of Meghalaya

5.1.12.1 Comparison based on levels of mathematics anxiety

1. 11.24% students of rural origin and 7.12% students of urban origin experienced high anxiety in mathematics.
2. 14.79% students of rural origin and 22.42% students of urban origin encountered above average anxiety in mathematics.
3. 20.71% students of rural origin and 39.50% students of urban origin had average anxiety in mathematics.
4. 44.97% students of rural origin and 24.91% students of urban origin felt below average anxiety in mathematics.
5. 8.28% students of rural origin and 6.05% students of urban origin faced low anxiety in mathematics.

5.1.12.2 Comparison by test of significance

There was a significant difference in the level of mathematics anxiety between rural and urban origin secondary school students of Meghalaya where rural origin students were found to have greater mathematics anxiety indicated by larger mean scores. (Significant at 0.01)

Focus group discussion: The quantitative analysis of the data in Objectives 10, 11 and 12 had revealed similar findings in which students of rural origin had higher mathematics anxiety than students of urban origin. This finding concurred with the qualitative findings obtained by the focus group discussion. Students of rural origin expressed stronger sense of stress, fear and avoidance toward mathematics, especially in performance situations such as solving problems in front of others. In contrast, urban-origin students' expressed frustration as to where to start and lack of focus, but without similar intensity of emotional distress. This reflected that rural-origin students experienced greater mathematics anxiety compared to urban-origin students.

5.1.13 Comparison on level of mathematics anxiety between rural origin secondary school students of Mizoram and Meghalaya

5.1.13.1 Comparison based on levels of mathematics anxiety

1. 8.41% students of rural origin and 3.55% students of urban origin experienced high anxiety in mathematics.
2. 34.58% students of rural origin and 30.77% students of urban origin encountered above average anxiety in mathematics.
3. 29.91% students of rural origin and 34.32% students of urban origin had average anxiety in mathematics.
4. 15.89% students of rural origin and 24.26% students of urban origin felt below average anxiety in mathematics.
5. 11.21% students of rural origin and 7.10% students of urban origin faced low anxiety in mathematics.

5.1.13.2 Comparison by test of significance

There was a significant difference in the level of mathematics anxiety between rural origin secondary school students of Mizoram and Meghalaya where rural origin students of Meghalaya were found to have greater mathematics anxiety indicated by larger mean scores. (Significant at 0.01).

Focus group discussion: The findings of the quantitative analysis concurred with the findings of the focus group discussion. Students of rural origin from both Mizoram and Meghalaya expressed challenges with mathematics. However, rural-origin students from Mizoram demonstrated a more positive attitude towards learning mathematics and focusing on self-improvement and continuing to study despite procrastination. Meanwhile rural origin students of Meghalaya seemed to be showing a more emotional distress towards mathematics by addressing their fear and avoidance of the subject.

5.1.14 Comparison on level of mathematics anxiety between urban origin secondary school students of Mizoram and Meghalaya

5.1.14.1 Comparison based on levels of mathematics anxiety

1. 7% students of rural origin and 6.05% students of urban origin experienced high anxiety in mathematics.
2. 24.20% students of rural origin and 24.91% students of urban origin encountered above average anxiety in mathematics.
3. 37.03% students of rural origin and 39.50% students of urban origin had average anxiety in mathematics.
4. 26.82% students of rural origin and 22.42% students of urban origin felt below average anxiety in mathematics.
5. 4.96% students of rural origin and 7.12% students of urban origin faced low anxiety in mathematics.

Comparison by test of significance

There was a significant difference in the level of mathematics anxiety between urban origin secondary school students of Mizoram and Meghalaya where urban origin students of Mizoram were found to have greater mathematics anxiety indicated by larger mean scores. (Significant at 0.01).

Focus group discussion: The quantitative findings aligned with the qualitative results, showing that urban-origin students from Mizoram experienced higher levels of anxiety compared to students of Meghalaya. Students from Mizoram voiced strong frustrations with mathematics, abandoning problems without attempting to solve them. In contrast, students from Meghalaya demonstrated a more passive approach to the subject in which they expressed willingness to engage with mathematics despite their dislike for the subject.

5.1.15 Reasons for mathematics anxiety among secondary school students.

5.1.15.1 Findings on level of education at which students started experiencing mathematics anxiety and coping strategies of secondary students

The opinionnaire aimed to analyse the reasons for mathematics anxiety among secondary school students by first assessing the level of education at which they began to experience anxiety and how they coped with it. The findings were as follows:

1. 45.49% started experiencing mathematics anxiety at Secondary level of education.
2. 39.47% started experiencing mathematics anxiety at Middle level of education.
3. 13.91% started experiencing mathematics anxiety at Primary level of education.
4. 1.13% are not sure when they first experienced mathematics anxiety.

Focus group discussion: The focus group discussion found that most students started experiencing mathematics anxiety at the secondary level of education.

Secondary school students have different coping strategies.

1. 37.22% sought help from tutors.
2. 34.59% engaged themselves in self-study.
3. 18.42% sought help from others.
4. 9.02% simply avoid mathematics related tasks.
5. Only 0.7% are unaware of how they cope with mathematics anxiety.

Focus group discussion: The qualitative discussion found that students dealt with their anxiety in mathematics by seeking help from tutors and solving problems on their own. Participants of the discussion shared that self-study and peer support played a significant role in managing their mathematics anxiety.

5.1.15.2 Findings on opinion of secondary school students

A. Findings on opinion of secondary school students in relation to personal experiences:

1. It was shown that 66.17% of the secondary students gave positive response whereas 33.83% of the students gave a negative response towards the statement, ‘My poor concept in mathematics affects my ability in learning mathematics.’
2. It was found that 0.75% of the secondary students had a positive response whereas 99.25% of the students had a negative response towards the statement ‘I struggle with basic mathematical operations like addition, subtraction, multiplication and division.’
3. It was revealed that 53.38% of the secondary students had a positive response whereas the rest of the 46.62% had a negative response towards the statement ‘I struggle with understanding mathematical symbols and vocabularies.’

Majority (52.55%) of the students agreed mathematics anxiety was caused by difficulty faced at a personal level of experience in mathematics. (Poor concept, struggles with basic mathematical operations, symbols and vocabularies).

Focus group discussion: The focus group discussed the reasons for mathematics anxiety and agreed that it was largely caused by personal issues. Some students

identified weak conceptual understanding and omission of certain topics at previous levels of education as contributors to their anxiety in mathematics.

B. Findings on opinion of secondary school students in relation to family issues:

1. It was revealed that 29.70% of the secondary students had a positive response whereas 70.30% had a negative response towards the statement ‘Lack of encouragement from my family contributes to my fear of mathematics.’
2. It was shown that 58.27% of the secondary students had a positive response whereas 41.73% had a negative response towards the statement ‘I’m confident that practicing more will improve my proficiency in mathematics.’

Majority (56.02%) of the students did not agree that the cause of mathematics anxiety was concerned with the welfare of the family in which the student belong.

Focus group discussion: The qualitative group discussion revealed that parents' high expectations caused students to feel nervous and stressed, leading to increased anxiety in mathematics.

C. Findings on opinion of secondary school students in relation to teacher concerned:

1. It was revealed that 25.19% of the secondary students gave a positive response whereas 74.81% gave a negative response towards the statement ‘My mathematics teacher does not give clear explanation during class.’
2. It was shown that 7.52% of the secondary students had a positive response whereas 92.48% had a negative response towards the statement ‘My teacher does not have required qualification to teach mathematics in class.’
3. It was revealed that 12.78% of the secondary students had a positive response whereas 87.22% had a negative response towards the statement ‘My mathematics teacher is consistently unprepared.’

4. It was shown that 73.68% of the secondary students had a positive response whereas 26.32% had a negative response towards the statement ‘Students find teachers’ remarks about their mathematical abilities discouraging.’
5. It was found that 26.32% of the secondary students had a positive response whereas 73.68% had a negative response towards the statement ‘My mathematics teacher does not show concern for slow learners.’
6. It was shown that 65.41% of the secondary students had a positive response whereas 34.59% had a negative response towards the statement ‘A very large teacher-student ratio affects our learning environment in mathematics.’

i.e., 73.68% of students found teachers’ remarks about their mathematical abilities discouraging. 65.41% found teacher-student ratio affected their anxiety as well.

Focus group discussion: The participants of the focus group discussion revealed that negative comments and harsh criticisms about their weaknesses in the subject discouraged and hurt them. This lack of positive reinforcement made them feel incapable thus creating anxiety in mathematics.

D. Findings on opinion of secondary school students in relation to transaction of lesson in mathematics class:

1. It was revealed that 50.75% of the secondary students had a positive response whereas 49.25% had a negative response towards the statement ‘I find it hard to understand how my mathematics teachers teach in class.’
2. It was shown that 13.53% of the secondary students had a positive response whereas 86.47% had a negative response towards the statement ‘My teacher never motivates me in mathematics class.’
3. It was found that 27.44% of the secondary students had a positive response whereas 72.56% had a negative response towards the statement ‘I have problems in understanding the language/accents used by my teacher in mathematics class.’

Majority (50.75%) of the students find it hard to understand *how* their mathematics teachers taught in class, thus agreed that transaction of lessons in mathematics class contributed to mathematics anxiety.

Focus group discussion: The focus group discussion revealed that transaction of lessons in mathematics classes contributed to mathematics anxiety. Students expressed feeling bored or disengaged with how teachers taught, thus failing to hold their attention. Therefore, transaction of lessons contributed to anxiety in mathematics.

E. Findings on opinion of secondary school students in relation to economic concerned:

1. It was revealed that 52.63% of the secondary students had a positive response whereas 47.37% had a negative response towards the statement ‘I believe I will not excel in mathematics without tuition.’
2. It was shown that 56.02% of the secondary students had a positive response whereas 43.98% had a negative response towards the statement ‘I hope to improve in mathematics if I have a better space to study at home.’

Majority of students (66.90%) students regarded economic condition of students as one of the anxiety factors.

Focus group discussion: The qualitative discussion revealed how factor such as economic conditions could impact students' anxiety in mathematics. Participants of the discussion mentioned that tutoring helped reduce their anxiety, as it provided extra support. Thus, failing to attend to anxiety in a way of seeking help from tutors contributed to anxiety in mathematics.

F. Findings on opinion of secondary school students in relation to misconception on mathematics learning:

1. It was revealed that 46.99% of the secondary students had a positive response whereas 53.01% had a negative response towards the statement ‘I believe boys are better in mathematics than girls.’

2. It was shown that 47.74% of the secondary students had a positive response whereas 52.26% had a negative response towards the statement ‘Mathematical intelligence is an inborn quality.’

Most students (53.63%) do not believe the cause of mathematics anxiety is concerned with misconceptions in mathematics learning. (Innate ability, gender biased beliefs).

Focus group discussion: The discussion showed that the cause of mathematics anxiety was not related to misconceptions about gender or innate ability. The statements taken from both male and female students described experiencing similar levels of anxiety.

G. Findings on opinion of secondary school students in relation to syllabus:

1. It was revealed that 62.03% of the secondary students had a positive response whereas 37.97% had a negative response towards the statement ‘Our mathematics syllabus should be reduced.’
2. It was found that 52.63% of the secondary students had a positive response whereas 47.37% had a negative response towards the statement ‘Solved problems in textbooks are too less.’
3. It was shown that 57.52% of the secondary students had a positive response whereas 42.48% had a negative response towards the statement ‘The problems presented in mathematics textbooks lack interesting contents.’
4. It was revealed that 56.02% of the secondary students had a positive response whereas 43.98% had a negative response towards the statement ‘There is typically never enough time to cover the syllabus thoroughly.’
5. It was shown that 55.64% of the secondary students had a positive response whereas 44.36% had a negative response towards the statement ‘The absence of connecting mathematics lessons with real-life experiences diminish my interest in mathematics.’

Majority of the students (56.77%) students agreed that most students believed the cause of mathematics anxiety was concerned with the syllabus. (Huge syllabus, less solved problems in textbooks, rushed pace of finishing syllabus, absence of real-life experiences).

Focus group discussion: The discussion revealed that syllabus caused students' anxiety. Many students pointed out the inadequacy of textbooks, which they felt did not provide enough solved examples and explanations for difficult concepts. The rushed pace of needing to complete the syllabus also contributed to their stress eventually causing anxiety in the subject.

H. Findings on Opinion of secondary school students in relation to infrastructure:

1. It was revealed that 39.47% of the secondary students had a positive response whereas 60.53% had a negative response towards the statement 'The noise from other classes makes it difficult to concentrate during mathematics class.'
2. It was shown that 34.21% of the secondary students had a positive response whereas 65.79% had a negative response towards the statement 'Our congested classroom makes it hard to concentrate in mathematics.'
3. It was found that 20.68% of the secondary students had a positive response whereas 79.32% had a negative response towards the statement 'The poor quality of black board/white board reduces enthusiasm for learning mathematics.'

Majority of the students (68.55%) did not believe the cause of mathematics anxiety was concerned with infrastructure of their schools. (Noise because of poor condition of the buildings, congested rooms, poor quality of black board).

Focus group discussion: The discussion on how infrastructure could affect mathematics anxiety revealed that, students disagreed infrastructure of their institutions contributed to their anxiety. Thus, infrastructure was not a factor in their struggles with mathematics.

5.1.16 Relationship between mathematics anxiety and achievement in mathematics.

A moderate negative correlation with coefficient of -0.48 was found between mathematics anxiety and academic achievement in mathematics among secondary school students of Mizoram and Meghalaya. The correlation was significant at 0.01 level.

5.1.17 Mathematics anxiety impact on academic achievement in mathematics (indicated by mathematics mark)

Mathematics anxiety significantly predicted academic achievement in mathematics ($R = -0.48$, $p < 0.01$). Mathematics anxiety accounted for 23% of academic achievement in mathematics. ($R^2 = 0.23$).

5.2 DISCUSSIONS ON THE FINDINGS

The discussion of findings is considered one of the most crucial parts of a thesis. It is where the researcher presents the underlying findings of the research done. In this section, the findings are examined in relation to the research questions, objectives, and hypotheses. The discussion addresses to how and why these results are valid and how they align with or differ from previous studies on similar topics (Uniproject materials, 2018).

The findings are presented in italics for ease of reference, followed by the discussion outlined below:

5.2.1 Discussion on the findings related to the level of mathematics anxiety among secondary school students of Mizoram

Among the 450 secondary students in Mizoram, the levels of mathematics anxiety, listed from highest to lowest, were found as follows:

- *39.56% of the students experienced average anxiety in mathematics.*
- *25.33% of the students felt below-average anxiety in mathematics.*
- *22.67% of the students faced above-average anxiety in mathematics.*
- *7.11% of the students had high anxiety in mathematics.*

- *5.33% of the students encountered low anxiety in mathematics.*

The highest percentage of secondary students in Mizoram, nearly 40%, experienced an average level of anxiety in mathematics. This suggested that anxiety in mathematics was relatively common and moderate in intensity for a considerable portion of the student body. This finding was in line with the findings of Khatoon and Mahmood (2010), Ambaranti and Retnowati (2019), Anugrah et al. (2019), Bhan and Kumar (2023) and Kiso (2024) who in their studies among secondary students found an average anxiety in mathematics.

Average anxiety could stem from parent's frequent stress on the importance of mathematics as well as consistent reminder of the subject's importance. This encouragement often leads students to take a genuine interest to put effort into their mathematics studies. Mizoram, a highly literate state (98.36%, Census2011, n.d., para. 2) places great emphasis on mathematics education and its life impact. Culturally, there is a strong tradition of parents and elders encouraging mathematics proficiency, often regarded as essential for career success. This focus on mathematics may lead to heightened anxiety for some students. However, the findings that the highest percentage of students were in the average level of mathematics anxiety proved most students were mindful of the value of mathematics. The findings, however is contrast to the findings of Moyo (2023) who found a high anxiety among the secondary students and Szczygiel and Pieronkiewicz (2021) who found a mild level of anxiety among the respondents studied for mathematics anxiety.

Furthermore, about a quarter (25.33%) of the students reported below-average anxiety. These students may feel more comfortable with mathematics and experience less stress compared to their peers, possibly contributing to more positive attitudes and confidence in the subject. Almost a similar portion, 22.67%, experienced above-average anxiety who may struggle with mathematics more than their peers with lower anxiety levels who may require targeted support to manage their stress. A smaller, yet significant group of students (7.11%) were found to have a high anxiety. These portions of the students may face considerable challenges in learning mathematics due to overwhelming stress, which could possibly impact their academic performance and interest in the subject. The smallest proportion of students

i.e., 5.33%, experienced low anxiety in mathematics. These students may have a natural aptitude or may possess a solid ground in mathematics, which would probably allow them to engage with the subject with minimal stress.

The findings of the focus group discussion added to the credibility of the findings in the level of anxiety. The data gathered from the discussion clearly showed no participant of Mizoram was completely free from mathematics anxiety. Every student demonstrated some degree of anxiety, which helped explain why the highest percentage of students (39.56%) were in 'average anxiety' category. For instance, some students expressed possible causes of a mild level of anxiety, suggesting that with some effort, their anxiety could be reduced. Additionally, while one student attributed the cause of anxiety to parental pressure, another mentioned avoiding the subject altogether. Both factors, along with others have contributed significantly to the anxiety experienced by students in mathematics.

5.2.2 Discussion on the findings related to the level of mathematics anxiety among secondary school students of Meghalaya

For the 450 secondary students in Meghalaya, the levels of mathematics anxiety were as follows:

- 38.89% of the students experienced average anxiety in mathematics.
- 28% of the students had above-average anxiety in mathematics.
- 20.44% of the students felt below-average anxiety in mathematics.
- 8% of the students faced low anxiety in mathematics.
- 4.67% of the students encountered high anxiety in mathematics.

The highest percentage of secondary students in Meghalaya, nearly 39%, were found to have an average levels of mathematics anxiety, indicating that moderate stress in mathematics is a shared experience for a significant number of the student population. This finding concurred with the findings of Ameen (2016), Anugrah et al. (2019), Ambaranti and Retnowati (2019), Bhan and Kumar (2023) and Kiso (2024), who found in their studies among secondary school students that mathematics anxiety was at the average level.

Meghalaya has always been a leading well reputed state in education and higher educational facilities that is exemplary (RUSA Meghalaya, n.d.). This reputation may have an effect on students to be encouraged in recognizing the importance of the subject and make it a meaningful part of their lives. It may also foster a healthy respect for academic subjects especially mathematics, resulting in a balanced, average level of anxiety as students feel motivated, without extreme stress.

Furthermore, a notable 28% of students experienced above-average anxiety in mathematics, who in this group might struggle more than their peers. The group of students in this level of anxiety may be capable of benefiting from supportive strategies to help them build confidence and reduce anxiety. Around one-fifth of students have below-average anxiety potentially reflecting group of students who felt more comfortable and less stressed about the subject. This comfort may help these students perform well in the subject and with a positive attitude towards it. Only 8% of students reported low anxiety suggesting that few felt completely at ease with the subject. This may include students with a natural inclination with a strong foundation in mathematics. A small but significant 4.67% of students experienced high anxiety in mathematics, which could be a barrier to learning and engagement in the subject.

From the focus group discussion, it was clear that there was no one in the group who had no anxiety in mathematics. Each student experienced mathematics anxiety in one or more than one dimension. Some even blamed other individuals for this anxiety, which clearly explained why an unhealthy 28.8% of the students experienced high anxiety. It could be observed from the discussion that some students had an anxiety because of the difficulty level in their mathematical course, another had a problem because of a deep inability to understand mathematical concepts, both reasons being enough to create an anxiety in the students.

5.2.3 Discussion on the findings related to comparison on the level of mathematics anxiety between secondary school students of Mizoram and Meghalaya

Both the findings based on the different levels of anxiety and finding based on test of significance are discussed in the following:

1. *Average anxiety was most common among the two states.*
2. *7.11% of students in Mizoram and 4.67% of students in Meghalaya experienced high anxiety in mathematics.*
3. *22.67% of students in Mizoram and 28% of students in Meghalaya encountered above average anxiety in mathematics.*
4. *39.56% of students in Mizoram and 38.89% of students in Meghalaya felt average anxiety in mathematics.*
5. *25.33% of students in Mizoram and 20.44% of students in Meghalaya had below average anxiety in mathematics.*
6. *5.33% of students in Mizoram and 8% from Meghalaya faced low anxiety in mathematics.*
7. *There was no significant difference in the level of mathematics anxiety among secondary school students of Mizoram and Meghalaya.*

Moderate level of anxiety was predominant in both states, with 39.56% students in Mizoram and 38.89% in Meghalaya experiencing average anxiety. This suggested that although students in both states recognized the importance of mathematics, they did not generally experience extreme anxiety, which could possibly reflect balanced academic expectations and familiarity with the subject. The findings of Khatoon and Mahmood (2010), Anugrah et al. (2019), Ambaranti and Retnowati (2019), Bhan and Kumar (2023) and Kiso (2024), agreed to this finding as they also found secondary student's anxiety to be at a moderate level. Furthermore, the present study found that there was no significant difference in the level of mathematics anxiety between secondary school students of Mizoram and Meghalaya.

Meghalaya and Mizoram are two states in North-East India that have maintained communication and transportation links for many years, particularly in the field of education. Until June 2021, Mizoram fell under the jurisdiction of North-Eastern Hill University (NEHU), which was based in Meghalaya (Josaa, n.d.). This connection highlighted the potential influence these two states have on each other's educational systems, at all levels of education. Furthermore, both states have their secondary schools governed by their respective boards, MBSE and MBOSE, which implements very similar curricula in mathematics. Therefore, students transferring

between these two boards are likely to face minimal challenges as well. Besides the many other possibilities, this similarity in educational structure and the familiarity between the states could be considered to help explain the similar results of highest percentage of students in the average anxiety level of mathematics anxiety in both states, as well as the reason for no significant difference in anxiety between the two states.

The findings of the focus group discussion highlighted several key issues that contributed to mathematics anxiety. A recurring theme that could be observed was the sense of being overwhelmed by the complexity of mathematical tasks. Another significant factor contributing to anxiety was a perception of personal inadequacy, language barriers and abstract teaching methods. The abstract nature of mathematics, which very often involves theoretical concepts disconnected from real-world applications, was also highlighted. Despite these challenges, some students did express a more neutral stance. This highlighted the need for a more supportive classroom environment where students could feel comfortable and could work through problems **without fear** of embarrassment.

5.2.4 Discussion on the findings related to

A. Comparison on the level of mathematics anxiety between male and female secondary school students of Mizoram and Meghalaya

B. Comparison on the level of mathematics anxiety between male and female secondary school students of Mizoram

C. Comparison on the level of mathematics anxiety between male and female secondary school students of Meghalaya

Discussion has been presented collectively in a single section on findings corresponding to Objective 5, Objective 6 and Objective 7, as they revealed similar patterns in mathematics anxiety wherein:

- i) Each finding on the three objectives revealed the highest percentage of students were found to have average anxiety in mathematics.

- ii) A significant difference was found between male students and female students, with females consistently exhibiting higher anxiety across these objectives.

The discussion on the findings will be addressed in terms of the ‘various levels of mathematics anxiety’ and the results from the ‘test of significance.’

5.2.4.1 Discussion on findings based on the different levels of anxiety

- **Comparison on the level of mathematics anxiety between male and female secondary school students of Mizoram and Meghalaya**

1. *Average anxiety was most common among both genders.*
2. *7.54% of males and 6.34% of females experienced high anxiety in mathematics*
3. *21.41% of males and 24.34% of females had above average anxiety in mathematics.*
4. *40.63% of males and 35.79% of females encountered average anxiety in mathematics.*
5. *24.57% of males and 27.20% of females had below average anxiety in mathematics.*
6. *5.84% of males and 6.34% of females faced low anxiety in mathematics.*

- **Comparison on the level of mathematics anxiety between male and female secondary school students of Mizoram**

1. *Average anxiety was most common among both genders*
2. *5.42% of males and 4.45% of females experienced high anxiety in mathematics.*
3. *24.63% of males and 27.94% of females had above average anxiety in mathematics.*
4. *40.39% of males and 37.25% of females encountered average anxiety in mathematics.*
5. *25.12% of males and 21.05% of females felt below average anxiety in mathematics.*
6. *4.43% of males and 9.31% of females faced low anxiety in mathematics.*

- **Comparison on the level of mathematics anxiety between male and female secondary school students of Meghalaya**

1. *Average anxiety was the most prevalent level for both genders.*
2. *7.69% of males and 8.26% of females experienced high anxiety in mathematics.*
3. *20.19% of males and 23.55% of females had above average anxiety in mathematics.*
4. *40.38% of males and 33.88% of females encountered average anxiety in mathematics.*
5. *25.48% of males and 31.40% of females had below average anxiety in mathematics.*
6. *6.25% of males and 2.89% of females faced low anxiety in mathematics.*

Both Mizoram and Meghalaya had the highest percentage of students having average mathematics anxiety, showing that moderate levels of mathematics anxiety are common across genders. This finding was in line with the findings of Khatoun and Mahmood (2010) and Bhan and Kumar (2023) who found that secondary students had moderate anxiety in mathematics. However, the finding contrasted with the findings of Mutodi and Ngirande (2014), where there were high levels of mathematics anxiety among the respondents of the study.

The generally average level of students' anxiety may reflect a widespread familiarity with mathematics in both the states, where the subject has received considerable societal attention. Lower anxiety could be ideal for fostering progressive achievement; however, this is not observed in the current students, which may be due to factors such as teaching methods, curriculum implementation, teacher quality, or economic challenges faced by the students.

5.2.4.2 Discussion on findings based on test of significance

- **Comparison on the level of mathematics anxiety between male and female secondary school students of Mizoram and Meghalaya**

There was a significant difference in the level of mathematics anxiety between male and female secondary school students of Mizoram and Meghalaya, with females exhibiting higher anxiety scores compared to males. (Significant at 0.01).

- **Comparison on the level of Mathematics Anxiety between male and female secondary school students of Mizoram**

There was a significant difference in the level of mathematics anxiety between male and female secondary school students of Mizoram, with females exhibiting higher anxiety scores compared to males. (Significant at 0.01).

- **Comparison on the level of Mathematics Anxiety between male and female secondary school students of Meghalaya**

There was a significant difference in the level of mathematics anxiety between male and female secondary school students of Meghalaya, with females exhibiting higher anxiety scores compared to males. (Significant at 0.01).

There was a significant gender-based difference in mathematics anxiety among secondary school students of Mizoram as well as among the students of Meghalaya, where female students were found to have higher anxiety scores than males, statistically significant at the 0.01 level in both the states. These findings indicated a reliable gender difference in mathematics anxiety levels in the studied population.

The findings of the present study concurred with the research findings of Khatoon and Mahmood (2010), Abbasi et al. (2013), Chowdhury (2014), Srivastava et al. (2016), Ambaranti and Retnowati (2019), Kathuria (2021), Rahaman et al. (2023), Dungdung and Bankira (2023); in their study of mathematics anxiety among secondary school students, establishing females have higher anxiety compared to male counterparts. Mandal (2020) and Mahato and Sen (2021) also found a significant difference between male and female secondary students but found that

males have higher anxiety compared to females. Apart from the study on secondary students, Ho et al. (2000), Mutodi and Ngirande (2014), Sarfo et al. (2020) and Nirmal et al. (2021) also found significant differences between male and female students but at the tertiary level of education.

The findings of significant differences between the two genders in the present study was in contrast with the findings of Karmi and Venkatesan (2009), Mohamed and Tarmizi (2010), Chaman (2014), Bhowmik and Roy (2015), Bhalla (2018), Kundu and Kar (2018), Yadav and Singh (2018), Buratta et al. (2019), Siddiqui and Khanam (2021), Kumar and Srivastava (2021), Uniyal and Bhardwaj (2021), Bashir et al. (2023), Sangral and Kumar (2023), Kiso (2024); who in their study found no significance between male and female secondary students on their mathematics anxiety.

In examining the different research findings concerned with gender differences in mathematics anxiety, as described and highlighted, it was frequently observed that female students exhibited significantly higher anxiety levels compared to their male counterparts. This phenomenon could initially be attributed to a complex interplay of educational, social, and psychological factors that might have shaped females' attitudes toward mathematics right from an early age.

Societal expectations and stereotypes on 'gender and mathematics' could be considered to play a substantial role. According to Xie & Liu (2023), women were often besieged by stereotypical remarks and views, such as "women are not good at mathematics." This traditional belief that mathematics has been perceived as a male-dominated field, with implicit societal biases suggesting that males are naturally more adept in mathematical skills, has been prevailing since generations.

This kind of beliefs may have created self-doubt in female students, leading to increased anxiety and lower self-confidence in mathematical abilities. Furthermore, differential treatment from teachers and parents may also be a contributor to elevate anxiety levels in females. Even teachers, knowingly or unknowingly, may hold different expectations for their male and female students. Additionally, it is possible that parents may inadvertently reinforce anxiety when projecting their own worries

or lower expectations about the performance of their female children in mathematics. These influences may contribute to internalising and regarding mathematics as a source of stress, resulting in higher anxiety levels.

Through the focus group discussion, the findings of the qualitative studies revealed important insights into gender differences in mathematics anxiety and coping strategies employed by male and female students. Male students were more inclined to seek help from others. This willingness to ask for assistance indicates a proactive approach towards addressing difficulties. In contrast, many female students, although stressed by mathematical problems, often chose to disengage with the problems directly. Certain tailored strategies that could promote help-seeking behaviour, reduce avoidance, and encourage deeper understanding of the subject may help lessen the impact of mathematics anxiety.

5.2.5 Discussion on the findings related to comparison on the level of mathematics anxiety between male secondary school students of Mizoram and Meghalaya.

- 1. Average anxiety was most common among male students in both states.*
- 2. 6.90% male students of Mizoram and 6.25% male students of Meghalaya experienced high anxiety in mathematics.*
- 3. 24.14% male students of Mizoram and 25.48% male students of Meghalaya had above average anxiety in mathematics.*
- 4. 38.92% male students of Mizoram and 40.38% male students of Meghalaya encountered average anxiety in mathematics.*
- 5. 24.14% male students of Mizoram and 20.19% male students of Meghalaya felt below average anxiety in mathematics.*
- 6. 5.91% male students of Mizoram and 7.69% male students of Meghalaya faced low anxiety in mathematics.*
- 7. There was no significant difference in the level of mathematics anxiety between male secondary school students of Mizoram and Meghalaya.*

In general, male students may be expected to experience similar types of anxiety, regardless of regional differences or their location. However, from the

statements made by male students from both states in the focus group discussion, it was revealed that there was no significant difference between the statements made by male students from Mizoram and Meghalaya regarding their views on mathematics and their classroom experiences.

The statement shared by a male student from Mizoram on how he rushed through mathematics homework and on how he didn't really like the subject but he did it anyways seemed to be in the same degree of struggle with statements made by a male student from Meghalaya. He mentioned that he became more comfortable after he took tuitions as per the advice of his parents. Both statements focus on engaging in the subject and completing the work rather than engaging deeply with the subject.

Furthermore, a Mizoram student's remarks on how he felt a student-teacher ratio would bring a closer relationship and teachers would be able to care for students, and a Meghalaya student's remarks on how he did not understand his teacher's teaching and how bored he felt, both reflected concerns about the effectiveness of teaching, with students from both states expressing a desire for more personalized attention and engagement in class. These shared concerns indicated no significant difference in the experiences of male students from Mizoram and Meghalaya regarding mathematics.

5.2.6 Discussion on the findings related to comparison on the level of mathematics anxiety between female secondary school students of Mizoram and Meghalaya.

- 1. Average anxiety was most common among male students in both states.*
- 2. 12.96% female students of Mizoram and 2.89% female students of Meghalaya experienced high anxiety in mathematics.*
- 3. 17.41% female students of Mizoram and 31.40% female students of Meghalaya had above average anxiety in mathematics.*
- 4. 37.25% female students of Mizoram and 33.88% female students of Meghalaya encountered average anxiety in mathematics.*

5. *27.94% female students of Mizoram and 23.55% female students of Meghalaya felt below average anxiety in mathematics.*
6. *4.45% female students of Mizoram and 8.26% female students of Meghalaya faced low anxiety in mathematics.*
7. *There was a significant difference in the level of mathematics anxiety between female secondary school students of Mizoram and Meghalaya (Significant at 0.05), where students of Meghalaya had higher anxiety in mathematics.*

The experiences shared by female students from Mizoram and Meghalaya in the focus group discussion highlighted some common challenges in learning mathematics, but notable differences were identified in the degree of anxiety. Female students from Mizoram tended to rely on peer discussions, self-study with textbooks, and online resources in order to overcome difficulties in mathematics.

However, their challenges were seen to stem primarily from issues like the lack of practical teaching and language barriers which affected their understanding. In contrast, female students from Meghalaya exhibited a higher level of anxiety related to external pressures. They expressed nervousness due to constant encouragement from teachers and parents to perform well in mathematics. This pressure appeared to be a key source of stress, suggesting that students from Meghalaya may have experienced greater emotional strain related to their academic performance. Additionally, confusion especially with basic operations like multiplication and division which may basically be considered the building blocks of mathematics learning could point to a deeper sense of insecurity and frustration in their mathematical abilities, further indicating a higher level of anxiety compared to their Mizoram secondary students.

5.2.7 Discussion on the findings related to

A. Comparison on the level of mathematics anxiety between secondary school students of rural and urban origin

B. Comparison on the level of mathematics anxiety between rural and urban origin secondary school students of Mizoram

C. Comparison on the level of mathematics anxiety between rural and urban origin secondary school students of Meghalaya

Discussion has been presented collectively in a single section on findings corresponding to Objective 10, Objective 11 and Objective 12, as they revealed similar pattern in mathematics anxiety wherein, a significant difference was found between rural origin and urban origin secondary students, with rural origin students consistently exhibiting higher anxiety across these objectives.

The discussion on the findings will be addressed in terms of the ‘various levels of mathematics anxiety’ and the results from the ‘test of significance.’

5.2.7.1 Discussion on findings based on the different levels of anxiety

- Comparison on the level of mathematics anxiety between secondary school students of rural and urban origin
 1. *The highest percentage of students were in the average level of anxiety in both groups of rural origin and urban origin.*
 2. *4.71% students of rural origin and 9.29% students of urban origin experienced high anxiety in mathematics.*
 3. *26.45% students of rural origin and 23.40% students of urban origin encountered above average anxiety in mathematics.*
 4. *36.23% students of rural origin and 34.46% students of urban origin had average anxiety in mathematics.*
 5. *27.54% students of rural origin and 24.04% students of urban origin felt below average anxiety in mathematics.*

6. 5.07% students of rural origin and 8.81% students of urban origin faced low anxiety in mathematics.

- **Comparison on the level of mathematics anxiety between rural and urban origin secondary school students of Mizoram**

1. The highest percentage of both rural origin and urban origin students were found to have average level of anxiety.

2. 3.74% students of rural origin and 4.96% students of urban origin experienced high anxiety in mathematics.

3. 23.36% students of rural origin and 26.82% students of urban origin encountered above average anxiety in mathematics.

4. 47.66% students of rural origin and 37.03% students of urban origin had average anxiety in mathematics.

5. 16.82% students of rural origin and 24.20% students of urban origin felt below average anxiety in mathematics.

6. 8.41% students of rural origin and 7% students of urban origin faced low anxiety in mathematics.

- **Comparison on the level of Mathematics Anxiety between rural and urban origin secondary school students of Meghalaya**

1. 11.24% students of rural origin and 7.12% students of urban origin experienced high anxiety in mathematics.

2. 14.79% students of rural origin and 22.42% students of urban origin encountered above average anxiety in mathematics.

3. 20.71% students of rural origin and 39.50% students of urban origin had average anxiety in mathematics.

4. 44.97% students of rural origin and 24.91% students of urban origin felt below average anxiety in mathematics.

5. 8.28% students of rural origin and 6.05% students of urban origin faced low anxiety in mathematics.

Most students from rural and urban backgrounds exhibited average levels of anxiety in mathematics, in the study of the whole population (i.e., in both Mizoram

and Meghalaya together) as well as between rural and urban origin secondary school students of Mizoram. This shared majority may stem from the standardized curriculum and administration across states, alongside the similarities in educational structure and familiarity between the two states, as well as the common administration ethos of the state Mizoram. The number of students with average anxiety notably higher in the first two findings of objectives could be possibly due to societal emphasis on mathematics in both states, fostering attentiveness towards the subject. Yet, with the thought that lower anxiety may better the students, majority in the average anxiety level might result from a repetitive approach to lessons and instructional methods, thereby limiting reductions in anxiety for many students.

However, the significantly higher percentage of rural-origin students in Meghalaya performing at below-average levels may be attributed to the attention and support provided by the government as well as the possible local support system.

5.2.7.2 Discussion on findings based on test of significance

- **Comparison on the level of mathematics anxiety between secondary school students of rural and urban origin**

There was a significant difference in the level of mathematics anxiety between secondary school students of rural and urban origin, where rural origin students were found to have greater mathematics anxiety indicated by larger mean scores.

- **Comparison on the level of mathematics anxiety between rural and urban origin secondary school students of Mizoram**

There was a significant difference in the level of mathematics anxiety between rural and urban origin secondary school students of Mizoram where rural origin students were found to have greater mathematics anxiety indicated by larger mean scores. (Significant at 0.05).

- **Comparison on the level of Mathematics Anxiety between rural and urban origin secondary school students of Meghalaya**

There was a significant difference in the level of mathematics anxiety between rural and urban origin secondary school students of Meghalaya where rural origin

students were found to have greater mathematics anxiety indicated by larger mean scores. (Significant at 0.01).

The significant difference in the level of mathematics anxiety between rural and urban origin found in the present study was in line with the findings of Brown et al. (2020), who studied mathematics anxiety across culture from two different regions, Delgado-Monge et al. (2020) who found same level of anxiety between two countries, Kundu and Kar (2018), Ameen et al. (2016) and Sangral and Kumar (2023), Rani & Rani (2024) who found that rural students have higher anxiety than of urban; Sadaphal and Bhandarl (2020) whose study found that urban students are more anxious than students in rural areas. But this finding negated the findings of Mandal (2020) and Souza et al. (2024), who in their study of mathematics anxiety found no significant difference between students of rural and urban areas.

The significant difference between rural and urban secondary school students could be due to various factors such as differences in quality of education, access to resources and exposure to diverse opportunities. The findings of Rani & Rani (2024) discussed that the financial weakness of family, previous background of mathematical understanding, and competition level generated might contribute more to peer pressure among rural students resulting in low mathematical achievement. The significant difference may also reflect contrast in mathematics teaching and learning between rural and urban in Mizoram and Meghalaya. To bridge this gap and to improve the overall anxiety in students, targeted interventions may be necessary to ensure equal opportunities.

The quantitative analysis of the data in Objective 10, Objective 11 and Objective 12 has revealed similar findings in which students of rural origin have greater anxiety than students of urban origin. This finding concurred with the qualitative findings obtained by the focus group discussion. The focus group discussion revealed the credibility of the quantitative findings which found that rural students were more anxious than urban secondary students. The fear and avoidance of rural students could be considered a response to the pressure of public performance, which worsened their anxiety. In contrast, urban-origin students tended

to express frustration as well as lack of focus, but their emotional distress appeared to be less severe as compared to that of their rural counterparts. Targeted interventions to address the challenges faced by rural origin students would definitely enhance their learning of mathematics.

5.2.8 Discussion on the findings related to comparison on the level of mathematics anxiety between rural origin secondary school students of Mizoram and Meghalaya

- 1. 8.41% students of rural origin from Mizoram and 3.55% students of rural origin from Meghalaya experienced high anxiety in mathematics.*
- 2. 34.58% students of rural origin from Mizoram and 30.77% students of rural origin from Meghalaya encountered above average anxiety in mathematics.*
- 3. 29.91% students of rural origin from Mizoram and 34.32% students of rural origin from Meghalaya had average anxiety in mathematics.*
- 4. 15.89% students of rural origin from Mizoram and 24.26% students of rural origin from Meghalaya felt below average anxiety in mathematics.*
- 5. 11.21% students of rural origin from Mizoram and 7.10% students of rural origin from Meghalaya faced low anxiety in mathematics.*
- 6. There was a significant difference in the level of mathematics anxiety between rural origin secondary school students of Mizoram and Meghalaya where rural origin students of Meghalaya reported higher levels of mathematics anxiety indicated by larger mean scores. (Significant at 0.01).*

The comparison between rural origin secondary students from Mizoram and Meghalaya revealed important differences in the levels of mathematics anxiety. Although rural origins may be perceived to have similar upbringing patterns, the conditions can greatly vary depending on the state and the specific region. This could be possibly due to factors such as regional educational resources, teaching methods, or cultural attitudes towards the subject.

The significant difference found in anxiety levels between the two groups, as indicated by the larger mean scores for students from Meghalaya, highlighted that

rural origin students of Meghalaya are likely to be under more stress and may struggle more intensely with mathematics as compared to students of Mizoram. This difference could imply that support systems may be needed in Meghalaya to address specific needs of students there, particularly to reduce anxiety.

The findings of the quantitative analysis were in line with the findings of the focus group discussion. Students of rural origin from both Mizoram and Meghalaya expressed difficulties and challenges with mathematics. However, rural-origin students from Mizoram had demonstrated a more positive attitude towards learning mathematics focusing on betterment and continuing to study despite procrastination. Meanwhile rural origin students of Meghalaya seemed to show a more emotional distress towards mathematics subject by as they address their fear and avoidance of the subject.

Students from rural areas despite from different regions may be believed to face similar disadvantages, particularly during the foundational stages of education. This is because students raised in urban areas benefit from excellent educational facilities and a competitive environment which fosters effective teaching methods which is an advantage that rural students may not have access to. However, regional and cultural differences may impact the learning and perception of mathematics.

Students of rural origin in both Mizoram and Meghalaya expressed challenges with mathematics, but there existed a noticeable difference in the level of anxiety they experience. Rural students from Mizoram seemed to approach their difficulties more passively, postponing their studies and seeking help only around exam time. While they acknowledged the need for additional resources, such as solved examples, they didn't exhibit strong emotional distress or overwhelming fear.

On the other hand, rural origin students from Meghalaya appeared to experience significantly higher levels of anxiety. Their reactions to mathematics are marked by fear and stress, with many expressing a strong objection to even discussing the subject. This heightened emotional response suggested that students of rural origin from Meghalaya faced more intense anxiety and avoidance behaviors compared to students of Mizoram.

5.2.9 Discussion on the findings related to comparison on the level of mathematics anxiety between urban origin secondary school students of Mizoram and Meghalaya

- 1. 7% urban origin students of Mizoram and 6.05% urban origin students of Meghalaya experienced high anxiety in mathematics.*
- 2. 24.20% urban origin students of Mizoram and 24.91% urban origin students of Meghalaya encountered above average anxiety in mathematics.*
- 3. 37.03% urban origin students of Mizoram and 39.50% urban origin students of Meghalaya had average anxiety in mathematics.*
- 4. 26.82% urban origin students of Mizoram and 22.42% urban origin students of Meghalaya felt below average anxiety in mathematics.*
- 5. 4.96% urban origin students of Mizoram and 7.12% urban origin students of Meghalaya faced low anxiety in mathematics.*
- 6. There was a significant difference in the level of mathematics anxiety between urban origin secondary school students of Mizoram and Meghalaya where urban origin students of Mizoram reported higher levels of mathematics anxiety indicated by larger mean scores. (Significant at 0.01).*

The findings of the comparison between the two groups revealed a small percentage difference in each level of mathematics anxiety. This could be attributed to shared educational and psychological factors that influence their experiences of mathematics anxiety. The significant difference in the level of mathematics anxiety between urban origin students from Mizoram and Meghalaya indicated that regional factors might be influencing students' experiences. Students from Mizoram were found to have higher levels of anxiety, which could be linked to educational systems, teaching practices, or cultural factors that are unique to the region. Addressing this disparity may help improved mathematics anxiety in the urban origin students of Mizoram.

Gender has often been a key variable in identifying differences in various studies showing that similar gender may portraint similar attributes. However, students from urban areas, being raised in different locations, may experience distinct

educational advantages based on the educational status of their environment along with other related factors. The quantitative findings were consistent with the qualitative results of the focus group discussion. In Mizoram, students expressed significant frustration with mathematics in which they abandoned problems without making an effort to solve them. Their discomfort with the subject stemmed from a sense of helplessness. On the other hand, students from Meghalaya acknowledged their dislike for the subject but still expressing a willingness to engage with it. This suggested that while students in Meghalaya may not experience the same intense frustration as those in Mizoram, they still faced considerable challenges. The difference in their attitudes highlighted how mathematical anxiety can vary based on regional factors.

5.2.10 Discussion on the findings related to reasons for mathematics anxiety among secondary school students.

5.2.10.1 Discussion on findings on level of education at which students started experiencing mathematics anxiety and coping strategies of secondary students

Level of education where mathematics anxiety started:

- 1. 45.49% started experiencing mathematics anxiety at Secondary level of education.*
- 2. 39.47% started experiencing mathematics anxiety at Middle level of education.*
- 3. 13.91% started experiencing mathematics anxiety at Primary level of education.*
- 4. 1.13% are not sure when they first experienced mathematics anxiety.*

The findings of the present study suggested that majority (45.49%) of students started experiencing anxiety in mathematics at secondary level of education. As indicated in the findings, 39.47% started at middle level, and the rest of the students experienced the anxiety at primary level while a small portion were unsure. Weir (2023) claimed that mathematics anxiety could begin as early as elementary school. For some, it showed up around middle school, when mathematics subject started getting more complex. Estimates suggested that about 20% to 25% of

children experience at least some mathematics anxiety, and often lasts into adulthood. Anyhow, the anxiety could be assumed to be experienced when students start to feel the pressure in studying the subject.

The participants of the focus group discussion expressed their experiences and how they felt the difficulty in the subject. Two students shared that they first experienced anxiety in mathematics at the secondary level of education. This was in line with the findings of the opinionnaire which found that majority (45.49%) of students started experiencing mathematics anxiety at the secondary level of education.

Different coping strategies:

1. 37.22% sought help from tutors.
2. 34.59% engaged themselves in self-study.
3. 18.42% sought help from others.
4. 9.02% simply avoid mathematics related tasks.
5. Only 0.7% are unaware of how they cope with mathematics anxiety.

Most students sought help from tutors, which appears to be a positive strategy for the improvement of their performance, as indicated by the current study (37.22%). A nearly equal percentage (34.59%) dealt with their anxiety through self-study, another proactive approach for improvement. The coping strategies students adopted and the methods used to support themselves could play an important role in overcoming anxiety and bringing about change in their perception of the subject.

The focus group discussion revealed the coping strategies of students in dealing with their anxiety in mathematics. Students shared their experiences in which a student revealed she has taken the help of tutors which have actually helped her in dealing with her mathematics anxiety. Students also engaged themselves in self-study. These findings of the discussion concurred with findings of the opinionnaire in which the two largest percentage of students (37.22%) and (34.59%), coped by seeking help from tutors and through self-study respectively.

5.2.10.2 Findings on opinion of secondary school students

A. In relation to personal experiences:

- 1. Data analysis revealed that 66.17% of the secondary students had a positive response whereas 33.83% had a negative response towards the statement ‘My poor concept in mathematics affects my ability in learning mathematics.’*
- 2. Data analysis revealed that 0.75% of the secondary students had a positive response whereas 99.25% had a negative response towards the statement ‘I struggle with basic mathematical operations like addition, subtraction, multiplication and division.’*
- 3. Data analysis revealed that 53.38% of the secondary students had a positive response whereas 46.62% had a negative response towards the statement ‘I struggle with understanding mathematical symbols and vocabularies.’*

The findings in the opinion of secondary school students on possible causes of mathematics anxiety found more than half of the students having positive response. Thus, we can say that secondary students agreed with personal experience in mathematics to play a role in contributing to mathematics anxiety, indicating that most students believed mathematics anxiety was caused by difficulty faced at a personal level of experiences.

This finding concurred with the findings of Brewster and Miller (2023) who found that missed opportunities to learn foundational mathematical skills affected the anxiety of students at a later stage while Singh (2022) in his research found that insufficient understanding of mathematical concepts as a key contributor to mathematics anxiety.

Apart from the items given as above under Personal experiences of encountering mathematics, the other researchers and their findings concerned with personal issues were as- Rubinsten et al. (2018) found intrinsic factors such as including neuro-cognitive predispositions and genetic influences to be one of the reasons for mathematics anxiety; Das and Gupta (2020) included insufficient cognitive ability to grasp mathematical concepts and students’ disinterest in

mathematics a key contributor to anxiety. Kaushal et al. (2022) and Kunwar (2020) identified cognitive processes and negative perceptions held by students to be one of the reasons for mathematics anxiety.

The focus group discussion added to the credibility of the findings in which students mentioned lack of conceptual knowledge act as a reason for their anxiety in mathematics. Participants also explained how difficulty in simple arithmetic and skipping knowledge of previous classes negatively affected their current study of mathematics, establishing that personal level of experiences in mathematics contributed to their anxiety.

According to Global Indian International School. (n.d.), Mathematics is built on fundamental concepts, thus making it important to understand the basic concepts first. Understanding these concepts will result in ability to tackle more complex problems later on. Eventually when fundamental concepts are not fully grasped, it becomes difficult to understand more advanced topics. This gap in knowledge might lead to frustration and anxiety.

Brewster and Miller (2023) in their research found that missed opportunities to learn foundational mathematical skills affected the anxiety of students in mathematics. Furthermore, Singh (2022) also found that insufficient understanding of mathematical concepts was one of the reasons for the cause of mathematics anxiety.

B. In relation to family issues

- 1. Data analysis revealed that 29.70% of the secondary students had a positive response whereas 70.30% had a negative response towards the statement 'Lack of encouragement from my family contributes to my fear of mathematics.'*
- 2. Data analysis revealed that 58.27% of the secondary students had a positive response whereas 41.73% had a negative response towards the statement 'I'm confident that practicing more will improve my proficiency in mathematics.'*

The findings in the opinion of secondary school students that family issues caused mathematics anxiety found more than half of the students having negative response. Thus, we can say that secondary students did not believe family issues contributed to mathematics anxiety among secondary students.

This finding negated with the findings of Trujillo and Hadfield (1999) who included insufficient family support as a contributor for the cause of mathematics anxiety. Kaushal et al. (2022) also found parents as one of the factors for anxiety in students. (Beilock et al., 2010, as cited in Leary et al., 2017) reported having a parent who is mathematics anxious also affect the anxiety of students.

The findings of the focus group discussion revealed that most of the participant's disagreed anxiety was not caused by family issues or lack of support, where two students shared that their parents' high expectations made them feel nervous. This could suggest that their anxiety was driven by the family's yearning for them to succeed in mathematics. Without this pressure, they probably might not have experienced the anxiety.

C. In relation to teacher concerned

1. *Data analysis revealed that 25.19% of the secondary students had a positive response whereas 74.81% had a negative response towards the statement 'My mathematics teacher does not give clear explanation during class.'*
2. *Data analysis revealed that 7.52% of the secondary students had a positive response whereas 92.48% had a negative response towards the statement 'My teacher does not have required qualification to teach mathematics in class.'*
3. *Data analysis revealed that 12.78% of the secondary students had a positive response whereas 87.22% had a negative response towards the statement 'My mathematics teacher is consistently unprepared.'*
4. *Data analysis revealed that 73.68% of the secondary students had a positive response whereas 26.32% had a negative response towards the statement 'Students find teachers' remarks about their mathematical abilities discouraging.'*

5. *Data analysis revealed that 26.32% of the secondary students had a positive response whereas 73.68% had a negative response towards the statement 'My mathematics teacher does not show concern for slow learners.'*
6. *Data analysis revealed that 65.41% of the secondary students had a positive response whereas 34.59% had a negative response towards the statement 'A very large teacher-student ratio affects our learning environment in mathematics.'*

The findings in the opinion of secondary school students that teachers contribute to the cause of mathematics anxiety, found that majority of the students agreed teachers' remarks about their mathematical abilities were discouraging and a large teacher-student ratio affects their learning environment in mathematics.

Abbasi et al. (2013) found teachers' personality characteristics responsible for mathematics anxiety. Rubinsten et al. (2018), Mollah (2017) and Smith (2024), found that negative attitude of teachers and their disposition, as well as their teaching styles contributes to mathematics anxiety.

The findings of the focus group discussion shared how harsh criticisms and comments on students' weakness in mathematics was found discouraging. These statements collectively point to the idea that teacher behaviors, including harsh criticism and lack of encouragement can influence students' emotional responses to mathematics and bring about anxiety. This finding is related and agreed upon by findings of Kathuria (2021), who found that inadequate teacher-designed positive experiences, negative classroom dynamics and a non-conducive learning environment caused anxiety in mathematics.

Many research has examined the influence of environmental factors, such as having a teacher who is mathematics anxious (Beilock et al., 2010, as cited in Leary et al., 2017) may infer that being exposed to such negative attitudes of mathematics may lead to mathematics anxiety. These negative attitudes could reflect on the teacher's behaviour in the class and could be observed by students.

Negative or discouraging feedback from teachers as well said by a student in focus group discussion of the present study contributed to mathematics anxiety. However, giving students feedback about their errors not only favoured students' learning in general but may, more specifically, have reduced mathematics anxiety and improved the performance of high mathematics-anxious students. (Pena et al., 2015).

D. In relation to transaction of lesson in mathematics class

- 1. Data analysis revealed that 50.75% of the secondary students had a positive response whereas 49.25% had a negative response towards the statement 'I find it hard to understand how my mathematics teachers teach in class.'*
- 2. Data analysis revealed that 13.53% of the secondary students had a positive response whereas 86.47% had a negative response towards the statement 'My teacher never motivates me in mathematics class.'*
- 3. Data analysis revealed that 27.44% of the secondary students had a positive response whereas 72.56% had a negative response towards the statement 'I have problems in understanding the language/accents used by my teacher in mathematics class.'*

The findings in the opinion of secondary school students that transaction of lesson in the class contributed to the cause of mathematics anxiety, found majority of students believed how their mathematics teacher taught in class contributed to mathematics anxiety among secondary students.

This finding was in line with the study of many researchers such as Mollah (2017) and Kunwar (2020), who found unconstructive teaching methods in mathematics class contributes to anxiety in mathematics. Kathuria (2021) also found that reliance on rote learning, inadequate teacher-designed positive experiences and lack of humour in teaching mathematics resulted in anxiety.

The findings of focus group discussion were in line with the findings of the opinionnaire. Students shared how the transaction of lesson by their teachers affect their learning of mathematics and how they see the subject. Transaction of lesson

was very important as it determined the potential interest or disinterest that a person might have in the lessons taught. Finlayson (2014), Das and Gupta (2020), Moyo (2023) and Zanabazar et al. (2023) found that certain teaching styles, inadequate teaching methods with error in lesson delivery, ineffective learning practices and lack of student engagement in the process of transacting lessons in mathematics cause anxiety in students. Kathuria (2021) also found that a focus on procedural knowledge over conceptual understanding caused anxiety in mathematics.

E. In relation to economic concerned

- 1. Data analysis revealed that 52.63% of the secondary students had a positive response whereas 47.37% had a negative response towards the statement 'I believe I will not excel in mathematics without tuition.'*
- 2. Data analysis revealed that 56.02% of the secondary students had a positive response whereas 43.98% had a negative response towards the statement 'I hope to improve in mathematics if I have a better space to study at home.'*

The findings in the opinion of secondary school students on how economic condition of students may contribute to the cause of mathematics anxiety was that majority of students believed they would not excel in mathematics without tuition, is considered to be of an economic aspect in mathematics learning as it may need extra expenditure.s This finding concurred with the research findings of Das and Gupta (2020) who included students' low economic status as a key contributor to mathematics anxiety.

The focus group discussion revealed that students participating in the discussion felt more comfortable when tuitions were taken, coping with the stress of mathematics anxiety. This was in line with the finding that a one-on-one mathematics tutoring program could relief anxiety about doing mathematical problems, wherein the tutoring could fix abnormal responses in the brain's fear circuits (Menon, 2015, as cited in Stanford Medicine, 2015).

F. In relation to misconceptions on mathematics learning

- 1. Data analysis revealed that 46.99% of the secondary students had a positive response whereas 53.01% had a negative response towards the statement 'I believe boys are better in mathematics than girls.'*
- 2. Data analysis revealed that 47.37% of the secondary students had a positive response whereas 53.63% had a negative response towards the statement 'Mathematical intelligence is an inborn quality.'*

The findings in the opinion of secondary school students that misconception in mathematics learning contributed to the cause of mathematics anxiety, found majority of students having negative response. Thus, we can say that secondary students did not believe misconception in mathematics learning contributed to mathematics anxiety.

In line with the finding in the present study, American Association of University Women (n.d.) stated that research indicated there were no such cognitive biological differences between men and women in mathematics, debunking the idea of a male "math brain." Some researchers have even described this belief as one of the most self-destruct misconceptions in contemporary American society.

The focus group discussion found that a misconception on mathematics learning such as gender wise misconception or innate ability of being a mathematical genius is not agreed upon by students. American Association of University Women (n.d.) claimed that research showed no cognitive biological differences between men and women in mathematics, so the idea of a male "math brain" assuming that males are better in mathematics than females was not true. However, the finding was in contrast with the finding of Hayder et al. (2020), who found that teachers believe mathematics success depends on innate ability.

G. In relation to syllabus

- 1. Data analysis revealed that 62.03% of the secondary students had a positive response whereas 37.97% had a negative response towards the statement 'Our mathematics syllabus should be reduced.'*

2. *Data analysis revealed that 52.63% of the secondary students had a positive response whereas 47.37% had a negative response towards the statement 'Solved problems in textbooks are too less.'*
3. *Data analysis revealed that 57.52% of the secondary students had a positive response whereas 42.48% had a negative response towards the statement 'The problems presented in mathematics textbooks lack interesting contents.'*
4. *Data analysis revealed that 56.02% of the secondary students had a positive response whereas 43.98% had a negative response towards the statement 'There is typically never enough time to cover the syllabus thoroughly.'*
5. *Data analysis revealed that 55.64% of the secondary students had a positive response whereas 44.36% had a negative response towards the statement 'The absence of connecting mathematics lessons with real-life experiences diminish my interest in mathematics.'*

The findings in the opinion of secondary school students that syllabus contributed to the cause of mathematics anxiety, found majority of students having positive response. Thus, we can say that secondary students believed syllabus contributed to mathematics anxiety among secondary students.

This finding was in line with the findings of Das and Gupta (2020) and Kaushal et al. (2022) who included flaws in curriculum structure and an unsupportive learning environment key contributor to mathematics anxiety. Such a structure impacted the syllabus, which directly serves as the primary plan for engaging students and teaching in the classroom. Furthermore, Kathuria (2021) and Vargas (2021) found a non-conducive learning environment a critical factor in the onset of mathematics anxiety.

The focus group discussion added to the credibility of the findings in opinionnaire in which few students spoke of the inadequacy school textbooks as well as the rush to finishing their syllabus often pressured them resulting in making them anxious of mathematics.

H. In relation to infrastructure

- 1. Data analysis revealed that 39.47% of the secondary students had a positive response whereas 60.53% had a negative response towards the statement 'The noise from other classes makes it difficult to concentrate during mathematics class.'*
- 2. Data analysis revealed that 34.21% of the secondary students had a positive response whereas 65.79% had a negative response towards the statement 'Our congested classroom makes it hard to concentrate in mathematics.'*
- 3. Data analysis revealed that 20.68% of the secondary students had a positive response whereas 79.32% had a negative response towards the statement 'The poor quality of black board/white board reduces enthusiasm for learning mathematics.'*

The findings in the opinion of secondary school students that infrastructure contributed to the cause of mathematics anxiety, found majority of students having negative response. Thus, it can be said that secondary students did not believe infrastructure contributed to mathematics anxiety among secondary students. The assumptions that lack of proper facilities and equipment might affect the perception and overall attitude in mathematics was not true with respect to the findings in the present study.

This finding of the focus group discussion concurred with the finding of the opinionnaire where almost 70% of students felt infrastructure did not contribute to their anxiety in mathematics. However, this study was in contrast with the study of Das and Gupta (2020), Kunwar (2020) and Zanabazar et al. (2023) who in their research found that reasons for anxiety in mathematics included lack of technological resources and school facilities, outdated educational resources, an unsupportive learning environment and inadequate use of technological tools.

5.2.11 Discussion on the findings related to relationship between mathematics anxiety and achievement in mathematics

A moderate negative correlation with coefficient of -0.48 was found between mathematics anxiety and academic achievement in mathematics among secondary school students of Mizoram and Meghalaya. The correlation was significant at 0.01 level.

A statistically significant relationship between mathematics anxiety and academic achievement in mathematics among secondary school students in Mizoram and Meghalaya was observed with the significance level of 0.01. The findings concurred with the findings of Zakaria (2012) and Mandal (2020) who in their studies found significant differences between mathematics anxiety and academic achievement.

Furthermore, the present study found that there was a moderate negative relationship with a correlation coefficient of -0.48. The moderate negative relationship indicated that as the mathematics anxiety increases, academic achievement in mathematics tends to decrease. In line with this, studies conducted by Mohamed and Tarmizi (2010), Reali et al. (2016), Shishigu (2018), Li et al. (2021), Mutegi et al. (2021) and Bornaa et al. (2023) revealed a negative correlation between mathematics anxiety and academic achievement. In contrast to this, the finding of Degnan (1967) suggested that anxiety may positively influence learning in certain contexts. Mweni et al. (2023) also found a statistically significant positive correlation between anxiety and achievement. Furthermore, Malu et al. (2024) found no significant relationship between mathematics anxiety and academic achievement.

5.2.12 Discussion on the findings related to the impact of mathematics anxiety on academic achievement in mathematics (indicated by mathematics mark)

Mathematics anxiety significantly predicts academic achievement in mathematics ($R = -0.48$, $p < 0.01$). Mathematics anxiety accounted for 23% of academic achievement in mathematics. ($R^2 = 0.23$).

A statistically significant prediction was made on academic achievement in mathematics based on the mathematics anxiety of secondary school students of Mizoram and Meghalaya.

$R^2 = 0.23$, indicated that mathematics anxiety accounted for 23% of the academic achievement in mathematics. This implied that mathematics anxiety had an impact on mathematics scores by 23%, while the remaining 77% may be influenced by other factors. The estimated regression equation was given as $\hat{y} = 97.54 + (-0.40)x$, i.e., $\hat{y} = 97.54 - 0.40x$, where \hat{y} stood for the predicted value of mathematics mark and x , the mathematics anxiety of secondary school students.

Additionally, the data showed that for each unit increase in mathematics anxiety, mathematics scores decreased by 0.40 points. This finding concurred with the findings of Asanre, A. A et al. (2023) who predicted that mathematics anxiety was accounted for 53% achievement in mathematics. Francis (2024) also found that mathematics fear had a significant negative influence on students' performance in Mathematics. The findings suggested that addressing mathematics anxiety could significantly improve academic achievement in the subject.

5.3 EDUCATIONAL IMPLICATIONS

The present research holds significant educational implications, shedding light on the crucial intersection of life skills and cognitive abilities among college students in Mizoram. This study has the potential to contribute substantially to educational practices and policies in the region. First, understanding the relationship between life skills and cognitive abilities allows educators to tailor and enhance the existing curriculum to better address the specific needs of college students in Mizoram. Integrating life skills development into the academic curriculum can promote holistic education; preparing students not only for academic success but also for the challenges they may face in their personal and professional lives. Second, the construction and standardization of the Life Skills Inventory will provide a tool for identifying specific life skills that may be lacking among college students in Mizoram. This information is invaluable for educators and policymakers as it enables them to target interventions and design programs aimed at filling these gaps,

ensuring that students are adequately equipped with the essential skills for personal and professional success. Third, recognizing the relationship between life skills and cognitive abilities allows for the development of personalized learning strategies. By tailoring teaching methods to enhance both cognitive abilities and life skills, educators can create a more supportive and engaging learning environment. This approach is likely to result in improved academic performance, increased motivation, and better overall well-being among college students. Fourth, the study's findings can serve as a catalyst for a paradigm shift in educational practices, emphasizing the importance of holistic development. Beyond academic achievements, colleges can actively promote the acquisition of life skills, fostering personal growth, emotional intelligence, and resilience. This holistic approach aligns with the evolving demands of the 21st-century workforce, where interpersonal skills and adaptability are increasingly valued. Fifth, the research can inform the development of guidance and counseling programs that specifically target the identified life skills needs of college students in Mizoram. These programs can offer support in areas such as decision-making, communication, time management, and stress management. By addressing these aspects, colleges can contribute to the overall well-being and mental health of their students. Sixth, life skills play a crucial role in preparing students for the demands of the workforce. The study's insights into the relationship between life skills and cognitive abilities can inform the development of career readiness programs. These programs can equip students with the skills and mindset necessary for successful transition into the professional world, promoting employability and long-term career success. Seventh, the research findings can be instrumental in shaping educational policies in Mizoram. Policymakers can use the evidence-based insights to formulate policies that prioritize the integration of life skills education within the broader academic framework. This may involve curriculum adjustments, teacher training programs, and the establishment of support systems to ensure the effective implementation of life skills education. Eighth, the study's educational implications extend beyond individual students to the broader society. Graduates who possess a strong foundation in both cognitive abilities and life skills are more likely to contribute positively to their communities. By fostering well-rounded individuals,

colleges in Mizoram can play a pivotal role in building a society characterized by resilience, empathy, and effective problem-solving.

In a nutshell, the research on the construction and standardization of a Life Skills Inventory and its relationship with cognitive abilities among college students in Mizoram holds immense potential to transform educational practices. By addressing the identified gaps and integrating life skills development into the educational system, colleges can better prepare students for the challenges they will face in their academic, professional, and personal lives. The implications of this study extend to curriculum design, teaching methodologies, counseling services, and policy formulation, ultimately contributing to the holistic development of individuals and the betterment of society.

5.4 RECOMMENDATIONS

Based on the findings of the present study, the researcher made several recommendations to reduce mathematics anxiety and prevent future issues related to it among secondary school students.

1. It is recommended to give targeted support to students at different levels of anxiety. For average students, fostering a more enriching classroom with proper mentorship could be helpful so as to improve their anxiety. Students with above average and high level of anxiety may be offered counselling or one-to-one help arranged by parents or teachers.
2. The findings in the present study indicated that females tended to experience higher levels of anxiety than males. To prevent the reinforcement of possible stereotypes that may have given such results, such as males are innately more capable to excel in mathematics, it is important to educate teachers and parents on how to support students without promoting these misconceptions. Workshops or meetings addressing this issue can be held for this purpose. Additionally, students should be made aware of these myths, supported by research findings that challenge them.
3. The findings in the present study indicated that urban secondary students were more anxious compared to rural secondary students. Research findings (Rani &

Rani, 2024) have reported that many factors such as the financial weakness of family, previous background of mathematical understanding, etc are reasons contributing to the anxiety of rural students. To address these issues and mitigate their potential effects, it is essential for the Government to ensure that qualified mathematics teachers are recruited who can meet the specific needs of students. Continuous supervision and support for teachers are crucial to ensure that capable mathematics teachers are always available to assist students effectively.

4. Mathematics is a highly sequential subject, making prior knowledge crucial. Therefore, it is recommended that the mathematics curriculum include regular assessments to ensure students are reminded of, or even re-taught, the necessary concepts before starting each new lesson. It is also essential to design assessment tools and techniques that are both accurate and appropriate. The curriculum should ensure that such assessments are consistently implemented.
5. It is recommended that textbooks and other resources in the mathematics curriculum be closely connected to real-life situations. This connection will help students understand the relevance of what they are learning and enable them to apply classroom knowledge effectively in practical contexts.
6. It is recommended that the Government implement a strict and thorough process for recruiting qualified and competent mathematics teachers. Additionally, regular in-service teacher training should be conducted so as to keep teachers at pace with the latest teaching methods and trends, helping them maintain effective teaching practices. Well-trained and qualified teachers are less likely to engage in negative behaviors towards students, such as making discouraging comments, showing favouritism, making unrealistic comparisons, or setting excessively high expectations, etc.
7. The NEP 2020 has planned to emphasize the development of essential literacy and numeracy skills during early years of education. Given the importance of these skills and their role in addressing issues stemming from weak mathematical foundations, it is recommended that the Government take proactive steps to ensure the effective teaching and reinforcement of foundational mathematics concepts. This will also help ensure confidence in students and avoid unnecessary frustration and anxiety in the future.

8. The Government must ensure that the teacher-student ratio requirement is effectively implemented in both Government-run and Private secondary schools. Effective communication between teachers and students, which is achievable only through individualized attention and care, is essential to meet students' needs, particularly for excelling in subjects like mathematics.
9. It is also recommended that the Government organize activities at different levels of education within the curriculum to raise students' awareness on the importance of mathematics. Mathematics clubs, laboratories, and other initiatives should be encouraged and implemented across schools, providing students with engaging activities and learning platforms.

By implementing these recommendations, secondary schools in Mizoram and Meghalaya can significantly reduce mathematics anxiety, leading to improved performance in mathematics and overall academic success.

5.5 SUGGESTIONS FOR FURTHER RESEARCH

The researcher offers the following suggestions for further research:

1. A comparative study on Mathematics Anxiety among secondary students from different districts in Mizoram could be conducted. The same study may be conducted in Meghalaya as well.
2. A comparative study on Mathematics Anxiety among secondary school students representing each of the main tribes in Meghalaya may be conducted.
3. A comparative study on Mathematics anxiety among secondary students of different districts in Mizoram as well as Meghalaya and may be conducted.
4. A correlational study between Attitude towards Mathematics and Mathematics Anxiety may be conducted among secondary students of Mizoram and Meghalaya.
5. A comparative study of Mathematics Anxiety among secondary school students in North East India may be conducted.
6. A comparative study of Mathematics Anxiety among secondary school students in India and other foreign Country known for mathematics proficiency may be conducted.

7. A study on Mathematics Anxiety among mathematics teachers in Mizoram and Meghalaya may be conducted to identify the specific in-service training needs.
8. A qualitative study may be conducted to explore the reasons behind Mathematics Anxiety among adults who report experiencing anxiety in the subject.
9. Similar studies could be conducted for different levels of education such as among college students and among higher secondary students of Mizoram as well as Meghalaya.
10. Similar studies may be conducted for in-service teachers of Mizoram as well as Meghalaya.

SUMMARY

INTRODUCTION

Mathematics is a subject that occupies a central role, standing as one of the most essential subjects within the school curriculum. It spans a diverse range of disciplines and finds applications in all aspects of life. Mathematics in simple term refers to the science and area of study that deals with numbers, structure, pattern, space, logic, shapes and arrangement.

Secondary education is a critical stage in the educational structure as it prepares students for higher education. It links the primary education and the higher education. The primary education aims in providing minimum requirements for survival while the secondary education prepares a person to be a full member of the challenging society. The secondary stage of education in India is broken into a two-year cycle, generally referred to as General/Lower Secondary School, and Higher/Senior Secondary School.

According to Cambridge dictionary, anxiety is an uncomfortable feeling of nervousness or worry about something that is happening, or might happen in the future (Cambridge dictionary, 2022). However, when anxiety begins to interfere with a person's ability to carry out routine activities and affects daily functioning, it becomes problematic. At this stage, it can eventually evolve into an anxiety disorder, which requires attention and management in order to prevent it from significantly diminishing the overall well-being of an individual.

Mathematics anxiety can simply be explained as a negative reaction towards mathematics. It is a negative emotion that may interfere in solving mathematical problems of any kind. Richardson and Suinn defined mathematics anxiety as feelings that involves tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations (Richardson & Suinn, 1972, as cited in Suinn & Winston, 2003).

According to Hoque (2017), the domains of learning can be categorized as cognitive domain (knowledge), psychomotor domain (skills) and affective domain

(attitudes). This categorization is best explained by the Taxonomy of Learning Domains which was formulated by a group of researchers led by Benjamin Bloom in 1956. This domain of learning is commonly known among educators as Bloom's Taxonomy. Bloom's Taxonomy may serve as a comprehensive framework for anxiety studies as it covers the full range of learning, including cognitive, affective, and psychomotor domains. Thus, mathematics anxiety can be evident in cognitive, affective and behavioral expressions.

Academic achievement is the outcome of education and the extent to which a student, a teacher or an institution has achieved their various educational goals. Academic achievement is usually measured and taken from continuous assessment or results in examinations, although there is no strict agreement on how it should be measured or in deciding which aspects should be given most importance. Furthermore, academic achievement refers to a person's excellent performance in a given academic field. The most well-known indicator is the student's 'score' in a specific period of studies such as the overall period of academic year, etc. (Paulpandi & Govindharaj, 2017). Academic achievement in mathematics therefore, refers to the achievement or accomplishment of students in mathematics subject. This may be measured from a specific period of time.

RATIONALE OF THE STUDY

The secondary stage of education is a critical period during which students are at the age of making decisions about their future and the possible career paths they will pursue. They are at the age of adolescence where the brain has an astonishing ability to adapt and respond to new experiences and situations (National Institute of Mental Health, n.d.). Understanding the levels of mathematics anxiety among secondary school students will help identify ways to address potential issues effectively. Comparative education is a field of education that assists in developing educational system of different regions. Furthermore, comparing education across different regions can rather be an intriguing endeavor.

Meghalaya has always been reputable to be the hub for education and higher educational facilities that is exemplary (RUSA Meghalaya, n.d). The investigator dug

deep but found no studies that convey that the state has ever been subjected to comparison with other states in India, let alone any North-East states on account of mathematics anxiety among secondary school students. Additionally, enhancing both convenience and educational advantage, Mizoram as a neighbouring state which ranks the third in literacy rate in the country (Onmanorama, 2023), is one of the most suitable and intriguing state to compare with Meghalaya. The investigator felt a study such as mathematics anxiety among secondary school students between the two states would be an engaging and highly informative educational study with the hope that it will open the minds for positive furtherance in several fields.

Moreover, this research aims to identify and address the impact of differences among students from the two states on their mathematics anxiety, considering the societal context. In which, the society in Mizoram follows a patriarchal society which is different from that of Meghalaya which follows a matriarchal society. No other study has been found that conducts a comparative study on mathematics anxiety of secondary students of different regions with such a societal situation over the past. So, the investigator felt the need to conduct the study to see if gender had an impact on the mathematics anxiety among secondary school students while taking into account the varying societal situations.

Various factors contribute to mathematical anxiety among students, including environmental influences, cognitive factors, inappropriate teaching methods, learner characteristics, parental factors, etc (Kour & Razaqi, 2024). Understanding and identifying these underlying reasons will definitely contribute to implementing effective strategies to minimise mathematical anxiety and improve students' experiences in mathematics.

The researcher thus recognized the necessity of conducting a study between the two states, with anticipation that it would reveal the current perceptions of mathematics among secondary school students in the said region and possibly lead to necessary actions for the advancement of mathematics subject in both the states, Mizoram and Meghalaya and potentially benefit others as well.

STATEMENT OF THE PROBLEM

The problem proposed to be investigated reads as,

‘Mathematics Anxiety and Academic Achievement in Mathematics among Secondary School Students of Mizoram and Meghalaya.’

OBJECTIVES OF THE STUDY

1. To standardize a scale to measure the mathematics anxiety of secondary school students.
2. To find out the level of mathematics anxiety among secondary school students of Mizoram.
3. To study the level of mathematics anxiety among secondary school students of Meghalaya.
4. To compare the level of mathematics anxiety between secondary school students of Mizoram and Meghalaya.
5. To compare the level of mathematics anxiety between male and female secondary school students of Mizoram and Meghalaya.
6. To compare the level of mathematics anxiety between male secondary school students of Mizoram and Meghalaya.
7. To compare the level of mathematics anxiety between female secondary school students of Mizoram and Meghalaya.
8. To compare the level of mathematics anxiety between male and female secondary school students of Mizoram.
9. To compare the level of mathematics anxiety between male and female secondary school students of Meghalaya.
10. To compare the level of mathematics anxiety between secondary school students of rural and urban origin.
11. To compare the level of mathematics anxiety between rural and urban origin secondary school students of Mizoram.
12. To compare the level of mathematics anxiety between rural and urban origin secondary school students of Meghalaya.

13. To compare the level of mathematics anxiety between rural origin secondary school students of Mizoram and Meghalaya.
14. To compare the level of mathematics anxiety between urban origin secondary school students of Mizoram and Meghalaya.
15. To analyse the reason or reasons for mathematics anxiety among secondary school students.
16. To find out the relationship between mathematics anxiety and achievement in mathematics.
17. To examine the impact of mathematics anxiety on academic achievement in mathematics among secondary school students.

HYPOTHESES OF THE STUDY

1. There is significant difference in the level of mathematics anxiety among secondary school students of Mizoram and Meghalaya.
2. There is significant difference in the level of mathematics anxiety between male and female secondary school students of Mizoram and Meghalaya.
3. There is significant difference in the level of mathematics anxiety between male secondary school students of Mizoram and Meghalaya.
4. There is significant difference in the level of mathematics anxiety between female secondary school students of Mizoram and Meghalaya.
5. There is significant difference in the level of mathematics anxiety between male and female secondary school students of Mizoram.
6. There is significant difference in the level of mathematics anxiety between male and female secondary school students of Meghalaya.
7. There is significant difference in the level of mathematics anxiety between secondary school students of rural and urban origin.
8. There is significant difference in the level of mathematics anxiety between rural and urban origin secondary school students of Mizoram.
9. There is significant difference in the level of mathematics anxiety between rural and urban origin secondary school students of Meghalaya.
10. There is significant difference in the level of mathematics anxiety between rural origin secondary school students of Mizoram and Meghalaya.

11. There is significant difference in the level of mathematics anxiety between urban origin secondary school students of Mizoram and Meghalaya
12. There is a significant relationship between mathematics anxiety and achievement in mathematics among secondary school students of Mizoram and Meghalaya.
13. Mathematics anxiety has an impact on the academic achievement in mathematics among secondary school students.

OPERATIONAL DEFINITIONS OF THE KEY TERMS USED

Mathematics: For the present study, mathematics refers to the subject studied by secondary school students.

Anxiety: It refers to a feeling of pressure and worries which affect a person's life.

Mathematics anxiety: For the present study, it is the negative reaction that secondary school students show when encountering any mathematics related situations.

Academic Achievement: For the present study, it is the mark obtained by secondary students in mathematics subject in their previous class, i.e., Class IX.

Secondary school students: Secondary school students in this present study includes students in 10th grade.

RESEARCH APPROACH

The present research was descriptive in nature. A mixed research approach in which both qualitative and quantitative approaches were employed. Furthermore, explanatory sequential design was adopted for the qualitative part of research. Data was collected from two main sources by the researcher -

Primary sources: Secondary school students from Mizoram and Meghalaya made up the primary sources for the present study.

Secondary sources: In order to realize the research objectives, data from School Education Department of the two states, Government records, research

reports from within the country and outside, books, articles from journals and records about the two states on education were considered as secondary sources.

POPULATION, SAMPLE AND SAMPLING DESIGN

The population for the present study consisted of all secondary school students in Mizoram and Meghalaya. However, to meet different objectives, samples were categorised into three groups. The first samples were taken from the general population using the most appropriate sampling method. The other two samples emerged from this bigger sample to meet the requirement of specific objectives.

i) In order to find out the level of Mathematics anxiety among secondary students from each state, a total of 900 students, 450 from each state were considered as samples using stratified systematic random sampling method. As shown in table No. 3.1, five districts, representing the four directions i.e., north, east, west, south and the centre were selected from Mizoram, where 90 students each were randomly selected as sample from the selected districts to get a total of 450 students.

From the three main hills of Meghalaya, i.e., Khasi hills, Garo hills and Jaintia hills, one district each, was randomly selected and out of each district, a sample of 150 students were selected so as to obtain the desired sample of 450 secondary school students. Furthermore, as reflected in Table No. 3.2, the selected samples were categorised in terms of gender and origin.

Table No. 3.1

No. of selected samples

STATE	Districts	No. of samples taken	Total no. of samples in each state	Total no. of samples
MEGHALAYA	Khasi Hills	150	450	900
	Jaintia Hills	150		
	Garo Hills	150		
MIZORAM	Aizawl	90	450	
	Lunglei	90		
	Champhai	90		
	Mamit	90		
	Kolasib	90		

Table No. 3.2

Sample students to find out the mathematics anxiety level among secondary school students of Mizoram and Meghalaya

STATE	No. of male students	No. of female students	Students of urban origin	Students of rural origin
MIZORAM	203	247	343	107
MEGHALAYA	208	242	281	169
A				
TOTAL	411	489	624	276

ii) To analyse the reason(s) for mathematics anxiety among secondary school students, the sample of 266 secondary students were selected purposively from sample students with average or higher levels of anxiety, as indicated by their mathematics anxiety scores. The sample students were then divided into male and female groups as presented in Table 3.3.

Table No. 3.3

No. of students with average or higher-level anxiety

No. of male students	No. of female students
143	123
Total: 266	

iii) For the *focus group discussion*, a sample of 10 students from Mizoram and Meghalaya who exhibited average and above average levels of mathematics anxiety were selected by means of purposive stratified sampling method. However, as depicted in Table 3.3, only 8 students turned up for the discussion.

Table No. 3.3

Detailed nature of sample students for Focus group discussion

STATE	No. of male students	No. of female students
MIZORAM	2	3
MEGHALAYA	1	2
TOTAL	3	5

TOOLS/TECHNIQUES USED FOR DATA COLLECTION

1. Mathematics Anxiety Scale (2024):

The researcher developed Mathematics Anxiety Scale using Likert's Method. This scale consisted of 38 items which were all framed as negative statements; thus, the pattern of scoring was consistent across all items. The scale was organized into three major dimensions by which mathematics anxiety is expressed: *Cognitive dimension, Emotional dimension and Behavioral dimension*, with the 38 items distributed across these categories. It used a five-point rating system, which included Strongly Agree, Agree, Undecided, Disagree, and Strongly Disagree. The reliability and the validity were established as explained in the following. Additionally, norms for the scale were established and presented in the form of z-scores.

Reliability

Reliability of Mathematics Anxiety Scale developed by the researcher was calculated by using the scores of 103 subjects on 38 items on the final form. The reliability of the Mathematics Anxiety Scale was assessed, with a reliability coefficient of 0.84 using the Pearson's Product Moment Correlation method.

Validity

Validity of the Mathematics Anxiety Scale was assessed by content validity which was ensured through logical analysis by experts.

Concurrent validity of the developed scale was also established by comparing it with the Mathematics Anxiety Scale created by Sadia Mahmood and Dr. Tahira

Khatoon. A correlation coefficient of 0.82 was found using Pearson's Product Moment Correlation method

2. Mathematics Anxiety Scale for Secondary and Senior Secondary School Students (2012):

The final form of the Mathematics Anxiety Scale for Secondary and Senior Secondary School Students had 14 statements. It was bi-dimensional and a shorter instrument in which among the items, 7 were worded positively and the remaining 7 items worded negatively. It is a 5-point Likert type instrument assessing positive and negative dimensions of mathematics anxiety. Both reliability and validity were established as explained in the following.

The reliability of the Mathematics Anxiety Scale (MAS) was established with a coefficient of 0.81 using the split-half method, which increased to 0.90 after applying the Spearman-Brown Prophecy Formula. Additionally, Cronbach's alpha was 0.87, indicating strong internal consistency. For validity, the MAS was validated using teachers' judgment, where a t-test confirmed a significant difference between high- and low-anxiety groups ($t = 14.50$, $p < 0.01$). Concurrent validity was also supported through a negative correlation of -0.41 with the Fennema-Sherman Attitude Scale, indicating that students with a more positive attitude towards mathematics experienced less anxiety.

3. Opinionnaire:

In order to find the reason(s) why secondary school students face mathematics anxiety the researcher prepared an opinionnaire. The opinionnaire included three multiple-choice questions aimed at assessing the students' level of anxiety, the level of education when they first encountered mathematics anxiety, and how they coped with the anxiety.

Additionally, the opinionnaire also included a multiple-choice question structured as a Yes/No inquiry. It consisted of 26 questions which were organized into eight categories: Personal experiences, family issues, teacher related factors, classroom interactions, economic concerns, misconceptions, syllabus, and infrastructure.

4. Focus Group Discussion:

A Focus Group Discussion (FGD) was conducted in which a sample of 10 students were randomly selected from each state among students who exhibited average or higher levels of mathematics anxiety, as determined by their scores on the Mathematics Anxiety Scale developed by the researcher. However, only 8 students consisting of three males and five females turned up for the discussion. All participants were 15 to 16-year-old students from Class 10. To ensure confidentiality, participants were coded as B1, B2, B3, G1, G2, G3, G4 and G5 where 'B' represents 'Boy' and 'G' represents 'Girl.' The purpose of FGD was to provide the researcher with a more comprehensive understanding of the issue at hand, complementing the quantitatively gathered data. This discussion allowed for a deeper exploration of the topic from the participants' perspectives.

ADMINISTRATION OF TOOLS AND COLLECTION OF DATA

The Mathematics Anxiety Scale and the opinionnaire developed by the researcher were administered to more than 900 secondary school students, so as to achieve the goal of having a sample of 900. Primary data from both the states, Mizoram and Meghalaya were collected by the researcher. When the data were collected, a minor data cleaning was conducted in order to filter out the responses which were not complete. Each response was assigned a number and the first 900 responses emerged as the final sample.

The objectives and guidelines of the study for marking the chosen responses of students in the Mathematics Anxiety Scale and Opinionnaire were effectively communicated to all the participants. Participants were provided ample time to reflect on the statements to ensure genuine responses. They were assured that their answers would be kept confidential and solely utilized for research purposes. Great care was taken during the administration of the tools and conduct of the discussion meeting to ensure that all questions and required personal information were properly addressed.

Both the opinionnaire and Focus Group discussion (FGD) was employed for qualitative assessment. Since the opinionnaire aimed to identify the causes of

mathematics anxiety, only the responses from students performing average and above level of anxiety (as per the established norm) were analysed.

The FGD was held online via Zoom Meet since the participants were located in different regions. The meeting was recorded for analysis. The researcher, who also served as the moderator of the focus group discussion carefully presented the questions and discussion topics to the participants.

TABULATION OF DATA

The information collected from 900 secondary school students were carefully examined, categorised, and evaluated using established protocols. Following the evaluation of responses from the Mathematics Anxiety Scale as well as the opinionnaire, a tabulation process was conducted. The obtained scores were recorded in an Excel spreadsheet and subjected to statistical analysis using the specified statistical methods for the analysis. SPSS was also used for tabulation. Furthermore, data from the focus group discussion were analysed and thoroughly examined to address the specific objectives of the study.

PROCEDURES ADOPTED FOR DATA ANALYSIS

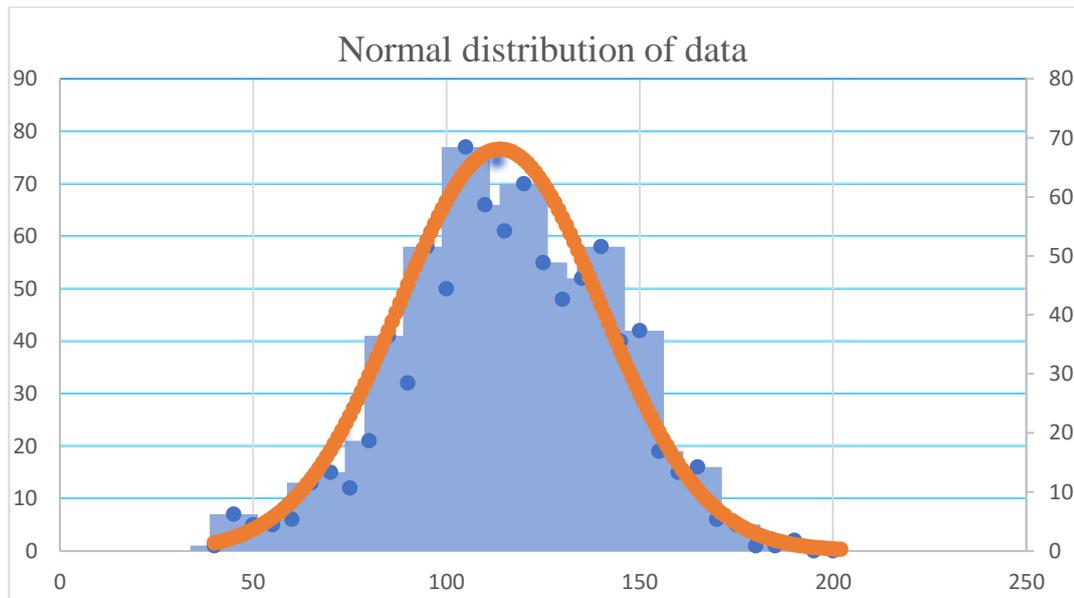
1. Quantitative data analysis

Normality test is necessary so as to decide the kind of test to be used for data analysis, whether parametric or non-parametric. The data in the present study showed a skewness of **-0.14** and a kurtosis of **-0.13**, indicating that normality assumptions were met and the data was normally distributed (Orcan, 2020). To further validate this normality, the data was presented by a histogram, and a normal distribution curve (bell-shaped) was plotted to visually represent the data's normal distribution. Therefore, with normality established, further steps were taken using parametric tests.

Fig 3.1

Bell curve showing normal distribution of data for the present study

Mean=113.9, Standard deviation=26.36



Considering the nature of the data which has established normality, and in accordance with the objectives, the researcher employed the following statistical methods for data analysis:

- 1) *Descriptive statistics measures:* Various measures of central tendency, standard deviation which is a measure of variability, percentage and z-scores, were employed to understand the distribution of scores and to classify students into different categories based on the nature of their scores.
- 2) *Inferential statistics:*
 - A t-test was applied to determine the significance of differences in mean scores between different groups categorized by gender (male and female) and by origin (urban and rural).
 - The Pearson's Product Moment Correlation method was used to investigate the relationship between mathematics anxiety and academic achievement in mathematics.

- Regression analysis was used for predicting the impact of mathematics anxiety on academic achievement in mathematics.

In summary, these statistical techniques were selected based on the characteristics of the data and the specific research objectives. Each technique was carefully chosen to address key variables, interpret relationships within the data, test hypotheses, and eventually contributing to the overall rigor and reliability of the findings in the present study.

2. *Qualitative data Analysis*

The researcher adopted an explanatory sequential design in which qualitative data was collected by a *focus group discussion* based on the quantitative data already collected and analysed (Cresswell & Cresswell, 2018, as cited in Gonzaga University Library, 2023).

Therefore, methodological triangulation was applied by using quantitatively analysed data from the Mathematics Anxiety Scale and qualitatively analysed data from the focus group discussion. The method of triangulation aimed to enhance the credibility and validity of the findings in the present research.

MAJOR FINDINGS

1. Standardization of Mathematics Anxiety Scale

A Likert type Mathematics Anxiety Scale had been constructed and standardized.

2. Study on the level of mathematics anxiety among secondary school students of Mizoram

- 1) 39.56% of the students experienced average anxiety in mathematics.
- 2) 25.33% of the students felt below-average anxiety in mathematics.
- 3) 22.67% of the students faced above-average anxiety in mathematics.
- 4) 7.11% of the students had high anxiety in mathematics.
- 5) 5.33% of the students encountered low anxiety in mathematics.

Focus group discussion: The focus group discussion revealed that all participants from Mizoram who shared their experiences expressed having mathematics anxiety. This aligned with the quantitative findings which showed that

the highest percentage of students (39.56%) falls in the average level of mathematics anxiety. Comments made by some of the participants indicated that their anxiety could be addressed and reduced through specific actions.

3. Study on the level of mathematics anxiety among secondary school students of Meghalaya

- 1) 38.89% of the students experienced average anxiety in mathematics.
- 2) 28% of the students had above-average anxiety in mathematics.
- 3) 20.44% of the students felt below-average anxiety in mathematics.
- 4) 8% of the students faced low anxiety in mathematics.
- 5) 4.67% of the students encountered high anxiety in mathematics.

Focus group discussion: Participants of the discussion expressed their feelings towards mathematics, in which negative statements made by students from Meghalaya revealed mathematics anxiety among the students. This explains why majority (38.89%) are in average mathematics anxiety level.

4. Comparison on the level of mathematics anxiety between secondary school students of Mizoram and Meghalaya

• Comparison based on levels of Mathematics Anxiety

- 1) Average anxiety was most common among the two states.
- 2) 7.11% of students in Mizoram and 4.67% of students in Meghalaya experienced high anxiety in mathematics.
- 3) 22.67% of students in Mizoram and 28% of students in Meghalaya encountered above average anxiety in mathematics.
- 4) 39.56% of students in Mizoram and 38.89% of students in Meghalaya felt average anxiety in mathematics.
- 5) 25.33% of students in Mizoram and 20.44% of students in Meghalaya had below average anxiety in mathematics.
- 6) 5.33% of students in Mizoram and 8% from Meghalaya faced low anxiety in mathematics.

- **Comparison by test of significance**

There was no significant difference in the level of mathematics anxiety between secondary school students of Mizoram and Meghalaya.

Focus group discussion: According to the statements made by participants, not all students experienced severe mathematics anxiety; rather, they felt only mild anxiety when faced with more difficult problems. The qualitative discussion helped explain the quantitative findings in which a larger number of students experienced average mathematics anxiety. Not much difference was observed in the intensity of mathematics anxiety between the two states based on their statements, which also explained the insignificance found by t-test.

5. Comparison on the level of mathematics anxiety between male and female secondary school students of Mizoram and Meghalaya

- **Comparison based on levels of Mathematics Anxiety**

- 1) Average anxiety was most common among both genders.
- 2) 7.54% of males and 6.34% of females experienced high anxiety in mathematics
- 3) 21.41% of males and 24.34% of females had above average anxiety in mathematics.
- 4) 40.63% of males and 35.79% of females encountered average anxiety in mathematics.
- 5) 24.57% of males and 27.20% of females had below average anxiety in mathematics.
- 6) 5.84% of males and 6.34% of females faced low anxiety in mathematics.

- **Comparison by test of significance**

There was a significant difference in the level of mathematics anxiety between male and female secondary school students of Mizoram and Meghalaya, with females exhibiting higher anxiety scores compared to males. (Significant at 0.01).

Focus group discussion: The qualitative findings indicated that male students showed a more positive strategy for addressing challenges in willing to seek help from others. In contrast, many female students tended to avoid challenges and were

stressed by mathematical problems. Although male students also experienced anxiety about the subject, they were more inclined to seek assistance and complete their tasks, rather than leaving them unfinished. This explains why females had higher mathematics anxiety as compared to males.

6. Comparison on the level of mathematics anxiety between male secondary school students of Mizoram and Meghalaya.

• Comparison based on levels of Mathematics Anxiety

- 1) Average anxiety was most common among male students in both states.
- 2) 6.90% male students of Mizoram and 6.25% male students of Meghalaya experienced high anxiety in mathematics.
- 3) 24.14% male students of Mizoram and 25.48% male students of Meghalaya had above average anxiety in mathematics.
- 4) 38.92% male students of Mizoram and 40.38% male students of Meghalaya encountered average anxiety in mathematics.
- 5) 24.14% male students of Mizoram and 20.19% male students of Meghalaya felt below average anxiety in mathematics.
- 6) 5.91% male students of Mizoram and 7.69% male students of Meghalaya faced low anxiety in mathematics.

• Comparison by test of significance

There was no significant difference in the level of mathematics anxiety between male secondary school students of Mizoram and Meghalaya.

Focus group discussion: The qualitative research, gathered through focus group discussion, showed that male students who shared their anxiety-related issues reported similar levels of degree in their negative experiences with mathematics.

7. Comparison on the level of mathematics anxiety between female secondary school students of Mizoram and Meghalaya.

• Comparison based on levels of Mathematics Anxiety

- 1) Average anxiety was most common among female students in both states.
- 2) 12.96% female students of Mizoram and 2.89% female students of Meghalaya experienced high anxiety in mathematics.

- 3) 17.41% female students of Mizoram and 31.40% female students of Meghalaya had above average anxiety in mathematics.
- 4) 37.25% female students of Mizoram and 33.88% female students of Meghalaya encountered average anxiety in mathematics.
- 5) 27.94% female students of Mizoram and 23.55% female students of Meghalaya felt below average anxiety in mathematics.
- 6) 4.45% female students of Mizoram and 8.26% female students of Meghalaya faced low anxiety in mathematics.

- **Comparison by test of significance**

There was a significant difference in the level of mathematics anxiety between female secondary school students of Mizoram and Meghalaya, with female students of Meghalaya exhibiting higher anxiety in mathematics. (Significant at 0.05).

Focus group discussion: The findings of the discussion concurred with the quantitative findings in which female students of Meghalaya had higher anxiety in mathematics as compared to female secondary students of Mizoram. The students of Meghalaya expressed feeling nervous with the encouragement of their teachers and parents which is indicative of their negative perception towards mathematics. Struggles with basic mathematical operations would definitely result in anxiety as well. However, the problems mentioned by female students from Mizoram appeared to be manageable as they also mentioned not requiring assistance from others to help them understand mathematics.

8. Comparison on level of mathematics anxiety between male and female secondary school students of Mizoram

- **Comparison based on levels of Mathematics Anxiety**

- 1) Average anxiety was most common among both genders
- 2) 5.42% of males and 4.45% of females experienced high anxiety in mathematics.
- 3) 24.63% of males and 27.94% of females had above average anxiety in mathematics.

- 4) 40.39% of males and 37.25% of females encountered average anxiety in mathematics.
- 5) 25.12% of males and 21.05% of females felt below average anxiety in mathematics.
- 6) 4.43% of males and 9.31% of females faced low anxiety in mathematics.

- **Comparison by test of significance**

There was a significant difference in the level of mathematics anxiety between male and female secondary school students of Mizoram, with females exhibiting higher mean scores compared to their males. (Significant at 0.01).

Focus group discussion: The findings of the discussion revealed that female students expressed their mathematics anxiety with more emotional intensity, indicating higher anxiety. In contrast, male students adopted a more detached, resigned attitude, choosing to complete the work rather than avoid it. This difference in how they talked about their experiences with mathematics have indicated a deeper sense of unease and self-doubt among females, which explained their higher anxiety as compared to the males.

9. Comparison on level of mathematics anxiety between male and female secondary school students of Meghalaya

- **Comparison based on levels of Mathematics Anxiety**

- 1) Average anxiety was the most prevalent level for both genders.
- 2) 7.69% of males and 8.26% of females experienced high anxiety in mathematics.
- 3) 20.19% of males and 23.55% of females had above average anxiety in mathematics.
- 4) 40.38% of males and 33.88% of females encountered average anxiety in mathematics.
- 5) 25.48% of males and 31.40% of females had below average anxiety in mathematics.
- 6) 6.25% of males and 2.89% of females faced low anxiety in mathematics.

- **Comparison by test of significance**

There was a significant difference in the level of mathematics anxiety between male and female secondary school students of Meghalaya, where females experienced greater mathematics anxiety compared to males. (Significant at 0.01).

Focus group discussion: A male participant's statement reflected frustration and comparison but lacked long-term self-doubt about his ability in mathematics. In contrast, female students expressed deeper feelings of hopelessness and inadequacy in mathematical abilities, contributing to higher anxiety. While males focused on external comparisons, females struggled more with self-doubt at the cognitive level by which their higher anxiety levels in mathematics was explained.

10. Comparison on level of mathematics anxiety between secondary school students of rural and urban origin

- **Comparison based on levels of Mathematics Anxiety**

- 1) A significant percentage of students fell in the average level of anxiety in both groups, i.e., rural origin and urban origin.
- 2) 4.71% students of rural origin and 9.29% students of urban origin experienced high anxiety in mathematics.
- 3) 26.45% students of rural origin and 23.40% students of urban origin encountered above average anxiety in mathematics.
- 4) 36.23% students of rural origin and 34.46% students of urban origin had average anxiety in mathematics.
- 5) 27.54% students of rural origin and 24.04% students of urban origin felt below average anxiety in mathematics.
- 6) 5.07% students of rural origin and 8.81% students of urban origin faced low anxiety in mathematics.

- **Comparison by test of significance**

There was a significant difference in the level of mathematics anxiety between secondary school students of rural and urban origin, where rural originated students reported higher levels of mathematics anxiety indicated by larger mean scores. (Significant at 0.01).

11. Comparison on the level of mathematics anxiety between rural and urban origin secondary school students of Mizoram

• Comparison based on levels of mathematics anxiety

- 1) The highest percentage of students of both rural origin and urban origin were in the average level of anxiety.
- 2) 3.74% students of rural origin and 4.96% students of urban origin experienced high anxiety in mathematics.
- 3) 23.36% students of rural origin and 26.82% students of urban origin encountered above average anxiety in mathematics.
- 4) 47.66% students of rural origin and 37.03% students of urban origin had average anxiety in mathematics.
- 5) 16.82% students of rural origin and 24.20% students of urban origin felt below average anxiety in mathematics.
- 6) 8.41% students of rural origin and 7% students of urban origin faced low anxiety in mathematics.

• Comparison by test of significance

There was a significant difference in the level of mathematics anxiety between rural and urban origin secondary school students of Mizoram where rural origin students were found to have greater mathematics anxiety indicated by larger mean scores. (Significant at 0.05).

12. Comparison on the level of mathematics anxiety between rural and urban origin secondary school students of Meghalaya

• Comparison based on levels of Mathematics Anxiety

- 1) 11.24% students of rural origin and 7.12% students of urban origin experienced high anxiety in mathematics.
- 2) 14.79% students of rural origin and 22.42% students of urban origin encountered above average anxiety in mathematics.
- 3) 20.71% students of rural origin and 39.50% students of urban origin had average anxiety in mathematics.

- 4) 44.97% students of rural origin and 24.91% students of urban origin felt below average anxiety in mathematics.
- 5) 8.28% students of rural origin and 6.05% students of urban origin faced low anxiety in mathematics.

- **Comparison by test of significance**

There was a significant difference in the level of mathematics anxiety between rural and urban origin secondary school students of Meghalaya where rural origin students were found to have greater mathematics anxiety indicated by larger mean scores. (Significant at 0.01)

Focus group discussion: The quantitative analysis of the data in Objectives 10, 11 and 12 had revealed similar findings in which students of rural origin had higher mathematics anxiety than students of urban origin. This finding concurred with the qualitative findings obtained by the focus group discussion. Students of rural origin expressed stronger sense of fear and avoidance toward mathematics, especially in performance situations such as solving problems in front of others. In contrast, urban-origin students' expressed frustration and lack of focus, but without similar intensity of emotional distress. This reflected that rural-origin students experienced greater mathematics anxiety compared to urban-origin students.

13. Comparison on the level of mathematics anxiety between rural origin secondary school students of Mizoram and Meghalaya

- **Comparison based on levels of Mathematics Anxiety**

- 1) 8.41% students of rural origin and 3.55% students of urban origin experienced high anxiety in mathematics.
- 2) 34.58% students of rural origin and 30.77% students of urban origin encountered above average anxiety in mathematics.
- 3) 29.91% students of rural origin and 34.32% students of urban origin had average anxiety in mathematics.
- 4) 15.89% students of rural origin and 24.26% students of urban origin felt below average anxiety in mathematics.
- 5) 11.21% students of rural origin and 7.10% students of urban origin faced low anxiety in mathematics.

- **Comparison by test of significance**

There was a significant difference in the level of mathematics anxiety between rural origin secondary school students of Mizoram and Meghalaya where rural origin students of Meghalaya were found to have greater mathematics anxiety indicated by larger mean scores. (Significant at 0.01).

Focus group discussion: The findings of the quantitative analysis concurred with the findings of the focus group discussion. Students of rural origin from both Mizoram and Meghalaya expressed challenges with mathematics. However, rural-origin students from Mizoram demonstrated a more positive attitude towards learning mathematics and focusing on self-improvement and continuing to study despite procrastination. Meanwhile rural origin students of Meghalaya seemed to be showing a more emotional distress towards mathematics by addressing their fear and avoidance of the subject.

14. Comparison on level of mathematics anxiety between urban origin secondary school students of Mizoram and Meghalaya

- **Comparison based on levels of Mathematics Anxiety**

- 1) 7% students of rural origin and 6.05% students of urban origin experienced high anxiety in mathematics.
- 2) 24.20% students of rural origin and 24.91% students of urban origin encountered above average anxiety in mathematics.
- 3) 37.03% students of rural origin and 39.50% students of urban origin had average anxiety in mathematics.
- 4) 26.82% students of rural origin and 22.42% students of urban origin felt below average anxiety in mathematics.
- 5) 4.96% students of rural origin and 7.12% students of urban origin faced low anxiety in mathematics.

- **Comparison by test of significance**

There was a significant difference in the level of mathematics anxiety between urban origin secondary school students of Mizoram and Meghalaya where urban origin students of Mizoram were found to have greater mathematics anxiety indicated by larger mean scores. (Significant at 0.01).

Focus group discussion: The quantitative findings aligned with the qualitative results, showing that urban-origin students from Mizoram experienced higher levels of anxiety compared to students of Meghalaya. Students from Mizoram voiced strong frustrations with mathematics, abandoning problems without attempting to solve them. In contrast, students from Meghalaya demonstrated a more passive approach to the subject in which they expressed willingness to engage with mathematics despite their dislike for the subject.

15. Reasons for mathematics anxiety among secondary school students.

➤ *Findings on level of education at which students started experiencing mathematics anxiety and coping strategies of secondary students*

The opinionnaire aimed to analyse the reasons for mathematics anxiety among secondary school students by first assessing the level of education at which they began to experience anxiety and how they coped with it. The findings were as follows:

1. 45.49% started experiencing mathematics anxiety at Secondary level of education.
2. 39.47% started experiencing mathematics anxiety at Middle level of education.
3. 13.91% started experiencing mathematics anxiety at Primary level of education.
4. 1.13% are not sure when they first experienced mathematics anxiety.

Focus group discussion: The focus group discussion found that most students started experiencing mathematics anxiety at the secondary level of education.

Secondary school students have different coping strategies.

1. 37.22% sought help from tutors.
2. 34.59% engaged themselves in self-study.
3. 18.42% sought help from others.
4. 9.02% simply avoid mathematics related tasks.
6. Only 0.7% are unaware of how they cope with mathematics anxiety.

Focus group discussion: The qualitative discussion found that students dealt with their anxiety in mathematics by seeking help from tutors and solving problems on their own. Participants of the discussion shared that self-study and peer support played a significant role in managing their mathematics anxiety.

➤ *Findings on Opinion of secondary school students*

A. Findings on Opinion of secondary school students in relation to personal experiences:

Majority (52.55%) of the students agreed mathematics anxiety is caused by difficulty faced at a personal level of experience in mathematics. (Poor concept, struggles with basic mathematical operations, symbols and vocabularies).

Focus group discussion: The focus group upon discussion agreed that mathematics anxiety was largely caused by personal level of experiences. Some students identified weak conceptual understanding and omission of certain topics at previous levels of education as contributors to their anxiety in mathematics.

B. Findings on Opinion of secondary school students in relation to family issues:

Majority (56.02%) of the students did not agree that the cause of mathematics anxiety is concerned with the welfare of the family in which the student belongs (Lack of encouragement from family).

Focus group discussion: The qualitative group discussion revealed that parents' high expectations caused students to feel nervous and stressed, leading to increased anxiety in mathematics.

C. Findings on Opinion of secondary school students in relation to teacher concerned:

73.68% of students found teachers' remarks about their mathematical abilities discouraging. 65.41% found teacher-student ratio affected their anxiety as well.

Focus group discussion: The participants of the focus group discussion revealed that negative comments and harsh criticisms about their weaknesses in the

subject discouraged and hurt them. This lack of positive reinforcement made them feel incapable thus creating anxiety in mathematics.

D. Findings on Opinion of secondary school students in relation to transaction of lesson in mathematics class:

Majority (50.75%) of the students find it hard to understand *how* their mathematics teachers teach in class, thus agreeing that transaction of lessons in mathematics class contributed to mathematics anxiety.

Focus group discussion: Participants of the focus group expressed feeling bored or disengaged with how teachers teach, thus failing to hold their attention. Therefore, transaction of lessons caused anxiety in mathematics.

E. Findings on Opinion of secondary school students in relation to economic concerned:

Majority of students (66.90%) students regarded economic condition of students as one of the anxiety factors.

Focus group discussion: Participants of the discussion mentioned that tutoring helped reduce their anxiety, as it provided extra support. Thus, failing to attend to anxiety in a way of seeking help from tutors contributed to anxiety in mathematics.

F. Findings on Opinion of secondary school students in relation to misconception on mathematics learning:

Most students (53.63%) do not believe the cause of mathematics anxiety is concerned with misconceptions in mathematics learning. (Innate ability, gender biased beliefs).

Focus group discussion: The discussion showed that the cause of mathematics anxiety was not related to misconceptions about gender or innate ability. The statements taken from both male and female students described experiencing similar levels of anxiety.

G. Findings on Opinion of secondary school students in relation to syllabus:

Majority of the students (56.77%) students agreed that most students believe the cause of mathematics anxiety is concerned with the syllabus. (Huge syllabus, less solved problems in textbooks, rushed pace of finishing syllabus, absence of real-life experiences within the syllabus, absence of real-life experiences).

Focus group discussion: The discussion revealed that syllabus cause students' anxiety. Many students pointed out the inadequacy of textbooks, which they felt did not provide enough solved examples and explanations for difficult concepts. The rushed pace of needing to complete the syllabus also contributed to their stress eventually causing anxiety in the subject.

H. Findings on Opinion of secondary school students in relation to infrastructure:

Majority of the students (68.55%) did not believe the cause of mathematics anxiety is concerned with infrastructure of their schools. (Noise because of poor condition of the buildings, congested rooms, poor quality of black board).

Focus group discussion: The discussion on how infrastructure could affect mathematics anxiety revealed that students disagreed infrastructure of their institutions contributed to their anxiety. Thus, infrastructure was not a factor in their struggles with mathematics.

16. Relationship between mathematics anxiety and achievement in mathematics.

A moderate negative correlation with coefficient of -0.48 was found between mathematics anxiety and academic achievement in mathematics among secondary school students of Mizoram and Meghalaya. The correlation was significant at 0.01 level.

17. Mathematics anxiety impact on academic achievement in mathematics (indicated by mathematics mark)

Mathematics anxiety significantly predicted academic achievement in mathematics ($R = -0.48$, $p < 0.01$). Mathematics anxiety accounted for 23% of academic achievement in mathematics. ($R^2 = 0.23$).

SUMMARY OF FINDINGS

Significance found:

1. Within the population studied, i.e., Mizoram and Meghalaya as well as in each of the two states, the highest proportion of secondary students reported experiencing an average level of mathematics anxiety.
2. Within the population studied, i.e., Mizoram and Meghalaya, as well as in each of the two states, female secondary students were found to have greater mathematics anxiety than their male counterparts.
3. Within the population studied, i.e., Mizoram and Meghalaya, as well as in each of the two states, rural origin secondary students were found to have greater mathematics anxiety than urban origin secondary students.
4. Rural origin students of Meghalaya had greater mathematics anxiety than rural origin secondary students of Mizoram.
5. Urban origin students of Mizoram had greater mathematics anxiety than urban origin secondary students of Meghalaya.
6. A moderate negative correlation was found between mathematics anxiety and academic achievement in mathematics.
7. Mathematics anxiety significantly predicted academic achievement in mathematics; mathematics anxiety accounted for 23% of academic achievement in mathematics.

No significance found:

1. There was no significant difference in the level of mathematics anxiety between secondary school students of Mizoram and Meghalaya.
2. There was no significant difference in the level of mathematics anxiety between male secondary school students of Mizoram and Meghalaya.

Starting Level of experiencing mathematics anxiety and coping strategy

1. Most students started experiencing mathematics anxiety at the secondary level of education.
2. Most students cope with mathematics anxiety by seeking help from tutors.

Reasons for mathematics anxiety among secondary school students

1. Personal level of experience in mathematics such as poor concept, difficulty faced in basic mathematical operations, mathematical symbols and vocabularies.
2. Teacher concerned such as teachers' negative remarks on students' mathematical abilities and a large teacher-student ratio.
3. Transaction of lesson in mathematics class.
4. Economic concerned such as not having to afford tuition and limited study space at home.
5. Syllabus concerned such as heavy syllabus, less solved examples and lack of interesting topics in mathematics text-books, rushed pace to finish syllabus and absence of connection between syllabus with real-life situations.

APPENDIX-I
MATHEMATICS ANXIETY SCALE FOR
SECONDARY SCHOOL STUDENTS

Ms. C. Lalsangpuii,

Research Scholar, Mizoram University

Kindly fill up the following:

Name:

Class & Section:

Age:

Phone No.:

Name of school:

Type of management of school (Govt. or Private):

District:

State:

Gender (male or female):

Locale (If from district capital 'Urban'; if not 'Rural'):

Type of management of elementary school where passed out (Govt. or Private):

Mother's Educational qualification:

Father's Educational qualification:

Occupation of father:

Govt. or Private:

Occupation of mother:

Govt. or Private:

Mathematics mark in class IX promotion/latest examination:

Mathematics Anxiety Scale

Instructions: Below is a list of statements aimed to study the mathematics anxiety of secondary school students. Please put a tick mark (✓) on any one of the five boxes given on the right side of each statement. *Please respond to every item.* There is no time limit but you have to respond as quickly as possible.

I. Cognitive Dimensions of Mathematics Anxiety

Sl. No	ITEMS	Strongly Agree	Agree (A dik)	Undecided	Disagree (A dik)	Strongly Disagree
1	My mind goes blank when trying to solve challenging problems in mathematics. Chhiarkawp (Mathematics) a zawhna har tak tak chawh ka tum hian ka rilru a mang vek thin.					
2	I doubt my ability to understand mathematical concepts. Chhiarkawp awmze bul (concept) hrethiam tur hian ka theihna in a tlinin ka hre lo.					
3	I believe that I will never fully grasp certain mathematical concepts. Chhiarkawp bulthut (concept) thenkhat hi chu ka hrethiam tak tak thei dawnin ka ring lo.)					
4	I am overwhelmed when presented with complex mathematical tasks. Chhiarkawp a eng emaw harsa deuh tih tur min pek hian ka chia thin.					
5	My mind gets jumbled when trying to understand word problems in mathematics.					

	Chhiarkawp a <i>word problem</i> ho hriatthiam ka tum hian ka rilru a buai vek thin.					
6	I dislike learning new topics in mathematics. Chhiarkawp a <i>topic</i> thar zir hi ka phur lo.					
7	I have difficulty concentrating when working on problems in mathematics. Chhiarkawp chawh lai hian rilru pek harsa ka ti.					
8	I think I am not smart enough to study mathematics. Chhiarkawp zir tur hian ka fing tawk lovin ka hria.					
9	I find it hard to remember mathematical formulas. Chhiarkawp a <i>formula</i> te hi hriat reng har ka ti.					
10	I constantly question my abilities in mathematics. Chhiarkawp hi thiam tawk lo hian ka in hre fo.					
11	I feel I am weaker in mathematics compared to others. Midang aiin chhiarkawp ah hian ka chak lo zawkin ka hria.					
12	I have difficulty visualizing mathematical concepts. Chhiarkawp awmze bul (concept) hrethiam tur hian ka mitthla thiam lo.					
13	I feel uncomfortable when asked to solve mathematical problems in front of others. Midang hmaa chhiarkawp chawk tura min tih hian nuam ka ti lo thin.					

II. Emotional Dimensions of Mathematics Anxiety

Sl. No	ITEMS	Strongly Agree	Agree (A dik)	Undecided	Disagree (A dil)	Strongly Disagree
14	The thought of solving mathematical problems makes me irritated. Chhiarkawp chawh ka ngaihtuah ringawt pawh hian ka hne nghal thin.					
15	I get frustrated when I am about to do mathematics homework. Chhiarkawp <i>homework</i> ka tih dawn hian ka peih lo lutuk thin.					
16	I become fretful when I cannot immediately solve a mathematical problem. Chhiarkawp ka chawh fuh theih loh chang hian ka hlauthawng thin.					
17	I feel worried when others excel in mathematics, and I don't. Midang chhiarkawp thiam deuh ka hmuh a, keiin ka thiam ve si loh hian ka mangang thin.					
18	I worry about being ridiculed for my mathematics performance. Chhiarkawp ka thiam loh avang hian miin min hmusit ang tih ka hlau thin.					
19	I feel a sense of fear when I see numbers and equations. <i>Number</i> leh <i>equations</i> ka hmuh ringawt pawh hian ka hlauthawng thin.					
20	I feel stressed when I have mathematics test. Chhiarkawp test neih lai hian ka rilru a hah (stress) nasa thei lutuk.)					

21	I tend to avoid mathematics because it makes me feel depressed. Chhiarkawp hian min tih hnual (depress) avangin pehhêl hram ka tum ðin.					
22	I get distressed even when someone mentions mathematics. Miin chhiarkawp lam hawi an sawi hrim hrim pawh hian hrehawm ka ti ðin.					
23	I feel tense when dealing with homework in mathematics. Chhiarkawp <i>homework</i> ka tih lai hian ka tawt up up ðin.					
24	Mathematics-related tasks make me anxious. Chhiarkawp lam hawi thil tih reng reng hian min ti hlauthawng ðin					
25	Mathematics makes me feel insecure. Chhiarkawp avang hian inrintâwkna ka nei lo.					
26	The need to learn mathematics stresses me out. Chhiarkawp zir ðulna hian min ti hah.					

III. Behavioural Dimensions of Mathematics Anxiety

Sl. No.	ITEMS	Strongly Agree	Agree (A dil)	Undecided	Disagree (A dil)	Strongly
27	I feel the urge to leave a conversation when any topic on mathematics is being discussed. Miin chhiarkawp lam hawi an sawi hian kalsan daih zel ka duh.					
28	I give up quickly when facing challenging mathematical problems. Chhiarkawp ah zawhna har deuh chawh tur ka neih hian ka beidawng vat ðin.					

29	<p>I distract myself with other activities to keep my homework in mathematics pending.</p> <p>Chhiarkawp <i>homework</i> tih nghal mai ka peih loh thin avangin thil dang ka tihsan phawt thin.</p>					
30	<p>I seek help from others to avoid dealing with mathematical tasks on my own.</p> <p>Chhiarkawp lam hawi mahni a tih ka hreh thin avangin midang puihna ka zawng thin.</p>					
31	<p>I rush through mathematics homework just to get them over with quickly.</p> <p>Chhiarkawp <i>homework</i> ka tih hian zawh vat vat ka duh avangin hmanhmawh takin ka ti liam puat thin.</p>					
32	<p>If I could, I would skip mathematics-related classes.</p> <p>Thei ila chu chhiarkawp lam hawi hrim hrim class hi ka pumpelhang.</p>					
33	<p>I avoid using mathematics in everyday life whenever possible.</p> <p>Ka nitin nunah hian chhiarkawp hmanna hrim hrim hi a theih chin chinah ka pumpelh thin.</p>					
34	<p>I avoid engaging in mathematics-related competitions.</p> <p>Chhiarkawp lam hawi intihsiakna reng reng a awmin ka tel peih lo.</p>					
35	<p>I choose subjects other than mathematics when I am given a choice to study.</p> <p><i>Subject</i> zir tur bik thlang thei a ka awm chuan chhiarkawp lo zel ka thlang thin.</p>					
36	<p>I have the habit of leaving mathematics problems unfinished.</p> <p>Chhiarkawp hi tuantling lova chawh ka ching dawklak.</p>					
37	<p>I engage in daydreams during lessons in mathematics</p> <p>Chhiarkawp class ah hian thil dang daih ka ngaihtuah veng veng thin.</p>					

38	<p>I tend to skip over difficult questions in mathematics while studying.</p> <p>Chhiarkawp ka chawh hian zawhna har deuh a awmin ka kal kân thin.</p>				
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APPENDIX-II

Mathematics Anxiety Scale for Secondary and Senior Secondary School Students (2012)

Sadia Mahmood & Dr. Tahira Khatoon

Sl. No.	ITEMS	Strongl	Agree	Undeci	Disagre	Strongl
1	Math makes me feel comfortable and easy.					
2	*Math is most dreaded subject for me.					
3	*I feel worried before entering the math class.					
4	I find math interesting.					
5	Math is one of my favourite subjects.					
6	*I am always afraid of math exams.					
7	Solving math problems is always pleasant for me.					
8	*I feel nervous when I am about to do math homework					
9	I feel happy and excited in a math class as compared to any other class.					
10	I would prefer math as one of my subjects in higher studies.					
11	*Math is a headache for me.					
12	*I am afraid to ask questions in math class.					
13	Math doesn't scare me at all					
14	*My mind goes blank when teacher asks math questions					

Note: 'Strongly Disagree', was given of weight 1, 'Disagree', a weight of 2, 'Undecided' a weight of 3, 'Agree', a weight of 4, and 'Strongly Agree', a weight of 5 for negative items and the positive effect items were reversed for scoring so that a high score indicates high anxiety; * represents negative items

APPENDIX-III

**OPINIONNAIRE TO FIND OUT THE REASON/REASONS FOR
MATHEMATICS ANXIETY AMONG
SECONDARY SCHOOL STUDENTS**

I. Circle the appropriate from a, b, c or d.

A hnuaiah hian a, b, c, d emaw hi thai bial rawh.

1. How would you rate your overall anxiety in mathematics?

Mathematics eng ang takin nge i huphurh/hlauh?

a.	Not anxious at all	Ka huphurh/hlauh lo hrim hrim
b.	Mildly anxious	Ka huphurh/hlauh ve deuh
c.	Highly anxious	Ka huphurh/hlauh viau mai
d.	Extremely anxious	Ka huphurh/hlauh lutuk tlat

2. When did you first experience mathematics anxiety?

Engtik atangin nge mathematics huphurhna/hlauhna i neih?

a.	Primary school
b.	Middle school
c.	High school

3. How do you cope with mathematics anxiety?

Engtin nge mathematics a huphurhna/hlahuhna i neihin i tih ðhin?

a.	Seeking help from teachers	Zirtirtute puihna ka zawng
b.	Takes private tuitions	Tution ka la ðhin
c.	Engage in self-study	Mahni in ka zir melh melh ðhin
d.	Avoid mathematics related tasks	Mathematics lam hawi hrim hrim tihtur pumpelh ka tum ðhin

II. The following has been prepared to find the reason/reasons for your mathematics anxiety. Please tick the appropriate option:

A hnuai ami hi mathematics i huphurh/hlahuh/tih chi-ai chhan che zawinna atana buatsaih a ni a, a dik zawnah i thai dawn ania.

A	PERSONAL EXPERIENCES	YES	NO
1	My poor concept in mathematics affects my ability in learning mathematics. Mathematics bul ðhut ka thiam lohna hian mathematics ka zirna kawngah nghawng a nei.		
2	I struggle with basic mathematical operations like addition, subtraction, multiplication and division. Mathematics bul ðhut heng, belh, paih, pun tir leh semah te hian ka buai ðhin.		
3	I struggle with understanding mathematical symbols and vocabularies. Mathematics subject a thu hman leh a symbol ho hi hriatthiam harsa ka ti.		

B	FAMILY ISSUES	YES	NO
1	Lack of encouragement from my family contributes to my fear of mathematics. Ka chhungte atanga mathematics sawi phurpuina ka dawn lem lohna hian mathematics hlauhna a siam tel ve bawkin ka hria		
2	My family's inability to help me study mathematics contributes to my fear of mathematics. Ka chhungte'n mathematics min zirpui theih lohna hian mathematics hlauhna a siam ve bawk.		

C	TEACHER CONCERNED	YES	NO
1	My mathematics teacher does not give clear explanation during class. Kan mathematics zirtirtu hian a hrihfiah tha tawk lo thin.		
2	My teacher does not have required qualification to teach mathematics in class. Kan zirtirtu hi mathematics zirtirtu ni tura qualification a nei lo (degree mamawhte a nei lo).		
3	My mathematics teacher is consistently unprepared. Kan mathematics zirtirtu hi a inbuatsaih ngai lo.		
4	Students find teachers' remarks about their mathematical abilities discouraging. Kan zirtirtu in mathematics thiam lo te a tawng khum dan hian zirlaite a tihnuat thin.		
5	My mathematics teacher does not show concern for slow learners. Kan mathematics zirtirtu hian zirlai man chak lote a		

	ngaihsak ngai lo.		
6	A very large teacher-student ratio affects our learning environment in mathematics. Zirtirtu pakhatin class khatah naupang a enkawl hnem lutuk having hian kan zirna duh angin a ða tawk lo.		

D	TRANSACTION	YES	NO
1	I find it hard to understand how my mathematics teachers teach in class. Kan mathematics zirtirtu in class a min zirtir dan hi hriatthiam har ka ti.		
2	My teacher never motivates me in mathematics class. Kan zirtirtu hian class ah min fuih ngai miah lo.		
3	I have problems in understanding the language/accent used by my teacher in mathematics class. Kan zirtirtu in mathematics class-a ðawng a hman leh a ðawng dan hi hriatthiam harsa ka ti.		

E	ECONOMIC CONCERNED	YES	NO
1	I believe I will not excel in mathematics without tuition. Tuition tel lo hian mathematics ah ka tih ðat ka ring ngai lo.		
2	I hope to improve in mathematics if I have a better space to study at home. In lamah zirna hmun nei ða ila chu tun ai hian mathematics ah hmasawn ka inring.		

F	MISCONCEPTION	YES	NO
1	I believe boys are better in mathematics than girls. Mipa hi hmeichhia aiin mathematics an thiamin ka hria.		
2	Mathematical intelligence is an inborn quality. Mathematics thiamna hi pianpui thil a niin ka hria.		

G	SYLLABUS	YES	NO
1	Our mathematics syllabus should be reduced. Kan mathematics syllabus hi tih tlem a ngai a ni.		
2	Solved problems in textbooks are too less. Textbook ah hian problems chawh sa a tlem mah mah a ni.		
3	The problems presented in mathematics textbooks lack interesting contents. Mathematics textbook a problems chawh tur ho ah hian min tiphur thei chi duh angin a awm lo		
4	There is typically never enough time to cover the syllabus thoroughly. Duhthusama syllabus zawhna hun hi a awm ngai lo		
5	The absence of connecting mathematics lessons with real-life experiences diminish my interest in mathematics. Mathematics kan zirte hi kan nitin nun a hman theih a awm lo lutuk hian min ti tui lo.		

H	INFRASTRUCTURE	YES	NO
1	<p>The noise from other classes makes it difficult to concentrate during mathematics class.</p> <p>Class thenawm aṭanga bengchheng hian mathematics class kan lâk a tibuai.</p>		
2	<p>Our congested classroom makes it hard to concentrate in mathematics.</p> <p>Kan classroom tawt lutuk avangin duh anga rilru pek a har.</p>		
3	<p>The poor quality of black board/white board affects our concentration in mathematics class.</p> <p>Kan black board/white board chhe lutuk hian mathematics class ah kan ngaihtuahna a la pêng.</p>		

APPENDIX IV

ITEM DISCRIMINATION TABLE

For item discrimination, the mean, standard deviation, and t-values for both groups in the final version of the tool on each of 38 statements are presented in the table:

Table No. 4.1.1

Mean, standard deviation and t-value of high and low groups on different items of the Mathematics Anxiety Scale

Item No.	HIGH GROUP		LOW GROUP		t-value	Significance
	Mean	Standard Deviation	Mean	Standard Deviation		
1	4.074074	0.780824	3.037037	1.125969	3.932665	*
2	2.925926	1.071517	2.111111	0.847319	3.099372	*
3	3.296296	1.137298	2	0.960769	4.524285	*
4	4	0.877058	2.37037	1.114525	5.970655	*
5	4.555556	0.697982	3.814815	1.272098	2.652647	NS
6	4.296296	0.6688	2.666667	1	7.038701	*
7	3.703704	1.137298	2.185185	1.075498	5.040879	*
8	3.814815	0.878681	2	0.480384	9.41665	*
9	3.333333	1.358732	1.962963	0.5175	4.897466	*
10	4.259259	0.813	3.555556	1.050031	2.753467	*
11	4.592593	0.500712	3.518519	0.975483	5.089949	*
12	4.444444	0.751068	2.851852	1.026709	6.50528	*
13	3.925926	0.780824	2.518519	1.087353	5.462984	*
14	4.666667	0.480384	3.444444	1.154701	5.078079	*
15	3.962963	0.807726	1.962963	0.649348	10.02755	*

16	3.703704	1.030863	2.37037	0.883531	5.102959	*
17	3.814815	1.110684	2.62963	1.079464	3.976176	*
18	4.666667	0.480384	3.185185	1.241495	5.782777	*
19	3.925926	1.14105	4	1.074172	-0.24561	NS
20	3.259259	1.227649	2.185185	1.001423	3.522749	*
21	3.037037	1.192331	1.740741	0.525693	5.16912	*
22	4.37037	0.741524	2.814815	1.039121	6.331738	*
23	4.185185	1.001423	1.666667	0.679366	10.81432	*
24	3.074074	1.174273	1.592593	0.572394	5.892753	*
25	3.074074	1.206582	1.740741	0.446576	5.385005	*
26	3.074074	1.106829	1.666667	0.480384	6.061008	*
27	3.666667	1.208941	2.074074	0.780824	5.750067	*
28	4.37037	0.564879	2.222222	1.120897	8.892771	*
29	3.259259	1.129758	2	0.877058	4.574971	*
30	3.962963	0.939782	2.703704	0.953327	4.887933	*
31	3.481481	1.155934	2.555556	1.187542	2.903175	*
32	4	1.176697	2.481481	0.935224	5.249512	*
33	3.148148	1.133534	2.037037	0.939782	3.921034	*
34	4.111111	1.120897	1.777778	0.800641	8.801873	*
35	3.074074	0.997147	1.777778	0.697982	5.533986	*
36	4.777778	0.423659	3.481481	1.251779	5.09694	*
37	4.296296	1.102962	2.222222	1.086042	6.962444	*
38	3.703704	1.030863	2.740741	1.059484	3.384912	*
39	3.703704	1.234592	2.148148	0.7698	5.555544	*
40	2.777778	1.281025	2	1	2.486859	NS
41	4	1.176697	2.962963	1.192331	3.216708	*

NS = not significant, * significant at 0.5 level (table value = 2.68)

APPENDIX V

Test-retest scores of the 103 students for determining the reliability of the Mathematics Anxiety Scale

Sl. No	Score on first test	Score on second test	Sl. No	Score on first test	Score on second test
1	115	126	54	118	97
2	143	144	55	98	98
3	108	106	56	120	127
4	136	144	57	104	95
5	107	115	58	100	99
6	170	173	59	93	82
7	105	97	60	109	92
8	172	182	61	89	98
9	124	113	62	129	122
10	135	131	63	122	119
11	129	131	64	100	92
12	110	100	65	103	104
13	120	142	66	139	136
14	94	84	67	90	101
15	116	108	68	91	86
16	138	139	69	108	101
17	82	83	70	138	116
18	61	82	71	129	132
19	138	145	72	121	122
20	167	106	73	95	96
21	160	146	74	113	110
22	111	110	75	84	78
23	158	177	76	121	121
24	158	166	77	127	120
25	100	100	78	102	92

26	117	106	79	111	119
27	131	138	80	103	112
28	110	119	81	48	82
29	129	131	82	121	119
30	126	138	83	75	86
31	94	100	84	119	129
32	126	109	85	106	124
33	83	82	86	103	106
34	89	93	87	104	114
35	74	74	88	78	83
36	98	95	89	108	86
37	100	100	90	107	126
38	148	166	91	114	111
39	107	103	92	104	94
40	121	118	93	116	124
41	98	81	94	119	142
42	106	105	95	124	123
43	106	89	96	102	96
44	103	102	97	121	109
45	124	110	98	163	126
46	161	137	99	113	144
47	123	129	100	151	139
48	121	141	101	129	119
49	149	144	102	106	104
50	80	87	103	117	109
51	109	96			
52	93	97			
53	75	90			

APPENDIX VI

The following table shows the scores of the concurrent test and the scores of the newly developed Mathematics Anxiety Scale.

Scores on two tests to compute criterion related validity

Sl. No.	Score on newly developed Mathematics Anxiety Scale	Score on criterion test
1	145	54
2	143	45
3	129	43
4	94	36
5	139	63
6	113	42
7	129	53
8	112	47
9	120	34
10	109	48
11	136	62
12	95	41
13	110	44
14	133	55
15	163	62
16	156	51
17	115	44
18	99	34
19	139	54
20	146	58
21	143	65
22	126	57

23	86	29
24	123	58
25	127	52
26	130	57
27	119	52
28	129	48
29	103	54
30	77	28
31	74	29
32	109	51
33	82	31
34	73	33
35	119	47
36	122	41
37	108	43
38	118	39
39	90	39
40	82	36
41	88	39
42	135	52
43	133	53
44	152	63
45	116	60
46	99	33
47	107	47
48	81	34
48	125	47
50	105	42

APPENDIX VII

Raw score with corresponding z-score

Raw score	Z-score						
190	2.887387	134	0.76251	114	0.003626	96	-0.67937
189	2.849443	134	0.76251	114	0.003626	96	-0.67937
184	2.659722	134	0.76251	114	0.003626	96	-0.67937
177	2.394112	133	0.72456	114	0.003626	96	-0.67937
174	2.280279	133	0.72456	114	0.003626	96	-0.67937
174	2.280279	133	0.724566	114	0.003626	96	-0.67937
174	2.280279	133	0.724566	114	0.003626	96	-0.67937
172	2.204391	133	0.724566	113	-0.03432	96	-0.67937
171	2.166447	133	0.724566	113	-0.03432	96	-0.67937
170	2.128502	133	0.724566	113	-0.03432	95	-0.71731
168	2.052614	132	0.686622	113	-0.03432	95	-0.71731
167	2.01467	132	0.686622	113	-0.03432	95	-0.71731
167	2.01467	132	0.686622	113	-0.03432	95	-0.71731
167	2.01467	132	0.686622	113	-0.03432	95	-0.71731
166	1.976726	132	0.686622	113	-0.03432	95	-0.71731
165	1.938781	132	0.686622	113	-0.03432	95	-0.71731
165	1.938781	132	0.686622	113	-0.03432	95	-0.71731
165	1.938781	132	0.686622	113	-0.03432	95	-0.71731
164	1.900837	132	0.686622	112	-0.07226	95	-0.71731

163	1.862893	132	0.686622	112	-0.07226	95	-0.71731
163	1.862893	132	0.686622	112	-0.07226	95	-0.71731
163	1.862893	132	0.686622	112	-0.07226	95	-0.71731
163	1.862893	132	0.686622	112	-0.07226	94	-0.75526
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134	0.76251	114	0.003626	97	-0.64143	44	-2.65247
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134	0.76251	114	0.003626	97	-0.64143	42	-2.72836
134	0.76251	114	0.003626	97	-0.64143	41	-2.7663
134	0.76251	114	0.003626	96	-0.67937	40	2.80388

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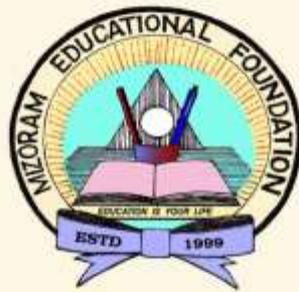
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Mathematics Anxiety among Secondary School Students in Aizawl City in Relation to Their Gender and Types of Schools

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Abstract

Mathematic is a subject of vital interest for any kind of endeavour. Its understanding has been linked positively with a number of abilities in individuals. Therefore, regardless of the kind of profession a person is likely to take up, an understanding of mathematics will go a long way in smooth conduction of a number of activities. Yet, it has also been found that, may be because of its abstract nature, a number of students have often shown dismal results in mathematics (based on examination results). With these thoughts in mind, the present study was conducted to measure the mathematics anxiety among secondary school students in Aizawl City in relation to their gender and types of schools. Descriptive survey method has been employed in which stratified random sampling has been adopted to collect a sample of 176 secondary school students. Mathematics Anxiety Scale developed by the investigator was used for collecting data. The result revealed that there was a significant difference in the mathematics anxiety of secondary school students in Aizawl City on the basis of both genders, i.e., between male and female and on the basis of types of schools i.e., Government, Government Aided and Private schools. Furthermore, it was found that there was a significant difference in the mathematics anxiety between Government schools and Government Aided secondary school students, as well as between secondary school students of Government and Private schools. However, there was no significant difference in the mathematics anxiety between students in Government Aided schools and Private schools.

Keywords: *Mathematics Anxiety, Gender, Types of schools*

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Introduction

Learning of mathematics is crucial as it has a wide range of application in our everyday lives. Mathematics aims to comprehend and explain the fundamental properties and principles that govern the world around us. It is a great concern for the government that mathematics subject is studied with clarity and measures have been taken over the history of time. In India, the new National Education Policy, NEP 2020 introduced innovative ideas in addressing issues such as rote learning, emphasizing quantitative growth rather than qualitative growth, and a lack of conceptual clarity. Students should develop strong foundational skills in language and mathematics. NEP 2020 strongly advocated the fostering of mathematical creativity in learners.

Given the nationwide emphasis on the importance of attaining excellence in mathematics and how it connects to success in various aspects of life, it is possible that students are subjected to tremendous pressure. If this pressure is not managed appropriately or productively, it may lead to anxiety among students. Such anxiety is detrimental, as it affects their academic performance and can even negatively impact the future of students and overall outlook on life.

Cambridge dictionary defined anxiety as an uncomfortable feeling of nervousness or worry about something that is happening or might happen in the future (Cambridge dictionary, n.d.). It is a psychological reaction to stress or unwanted situations that may affect the normal functioning of a person. Likewise, mathematics anxiety can simply be explained as a negative reaction towards mathematics, a feeling of tension a person has when encountered with any kind of mathematics related activity.

It describes worry or fear of performing mathematics calculations. A person with mathematics anxiety may feel panicked at the thought of working with numbers, which makes it even harder to think. Its symptoms are the same as other types of anxiety. They may include worry, panic, tense muscles, increased heart rate, sweaty palms, light-headedness, etc (West, 2022). Richardson and Suinn defined mathematics anxiety as feelings that involves tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations (Richardson & Suinn, 1972, as cited in Suinn & Winston, 2003, p.1).

Rationale

Secondary stage of education is a crucial age for students as it is a stage that greatly determines their future, both in career as well as overall perspectives in life. The level of interest or anxiety in any subject can have a lasting impact on how an individual student deals with problems in life. As mathematics was found to have the least pass percentage level at this stage, it was chosen as the main subject to study. Students must be made to understand

the level of interest they have in mathematics, and also the level of anxiety they have as it can affect their future in the long run. The new found result could enable stakeholders to take necessary measures to tackle the issue.

Furthermore, various research findings have found that gender and types of school matters when it comes to mathematics anxiety. Such research has not been conducted in Aizawl and the investigator found the need to conduct the study to find out how gender and types of schools relate to mathematics anxiety among secondary school students of Aizawl City.

Literature Review

The Reviews of the related literature are discussed in chronological order as below:

Studies conducted on mathematical anxiety, gender and types of schools

Srivastava and Imam (2016) conducted a study on mathematics anxiety among secondary school students in relation to personal and school related factors, in which 1000 secondary school students were taken as sample. Mathematics anxiety scale (MAS), An Intuition Background Assessment Questionnaire and A Personal Background Questionnaire were used as a tool. The data was analysed using computation of means and standard deviation, computation of standard error and use of t-test and f-test for measuring the significant of the difference between the means. It was found that there exists significant difference between male and female students in their anxiety in mathematics. It was also found that there exists significant difference among the types of schools and math anxiety, the result clearly showing that students of private school have lowest mathematics anxiety scores than the other three groups (government, Semi government, Muslim minority).

Sangral and Kumar (2023) studied Mathematical anxiety among secondary school students in relation to their gender, locality and types of schools. It was found that there is a significant difference in mathematical anxiety among the secondary school students with regard to their gender, i.e., between male and female. It is found there is a significant difference in the numerical anxiety of secondary school students with regard to their locality (rural & urban). The study also found that there is no significant difference in the mathematical anxieties of secondary school students with regard to their types of schools, i.e., although the mean score is larger among private school students more than government schools, concluding that the numerical anxiety of government and private secondary school students were found to have no significant difference.

Studies conducted on Mathematical Anxiety and types of schools

Mandal and Saha (2019) conducted a study on mathematics anxiety and prevention strategies with an attempt to improve mathematics performance of secondary school students

in West Bengal. Government and private schools from Kolkata and South 24 parganas district in the West Bengal were randomly selected where mathematics anxiety was measured using a standardized instrument whereas, students' mathematics performance was collected from the progressive report of the schools. It was found that there are significant differences in mathematics anxiety and performance in mathematics on gender and types of schools but there is no significant difference between habitat in mathematics anxiety and performance in mathematics.

Manikandan, Nair and Ajith (2022) in their study 'Math Phobia among School Students: A Comparative Design' found that level of Math Phobia/Mathematical Anxiety among the Private High School students were significantly higher than the Government High school students. The study was conducted among a total sample of 60 high school students. A Descriptive Comparative design was used to conduct the study and data analysis was done using Descriptive and Inferential statistics. The comparisons of the mean Mathematical Anxiety scores among the Government and Private High School students were done using the 'Student t test'. The computed 't value' at 3.27** (df=58) was statistically significant at $p < 0.01$.

Studies conducted on Mathematical Anxiety and gender

Yadav and Singh (2018) conducted a study to find out the relationship between achievement in Mathematics and Mathematics anxiety among secondary school students. Mathematics achievement as a cause for Mathematics anxiety and vice-versa was studied to find out the reciprocal relationship between Mathematics achievement and Mathematics anxiety. 374 students (302 male and 72 female students) were taken as samples in which self-constructed tools, Mathematics anxiety scale and Mathematics Performance Test, were applied to collect data. It was found that the relationship between achievement in Mathematics and Mathematics anxiety is negative and significant at 0.05 level of significance. It was also found that there was significant difference in mathematics anxiety between high and low achievers, and between high and low anxious students. It was also noted that that was no difference in Mathematics anxiety between male and female students.

Kumar and Srivastava (2021) conducted a study on Mathematics Anxiety and its effect on a set of independent variables (gender, school board, fathers' qualification, mothers' qualification and with respect to their types of family) of secondary school students in Pune. Survey method was adapted and the tool used for the data collection was Mathematics Anxiety Scale (MAS) developed by Dr. (Mrs.) SadiaMahmood and Dr. (Mrs.) Tahira Khatoon. 195 secondary school students were drawn randomly from two schools. Mean, standard deviation and 't' test was used for statistical analysis. It was found that there was no significant difference in Mathematics Anxiety of students with respect to their gender, school board, fathers' qualification and with respect to their types of family. It was also found that

students whose mothers' qualification is above intermediate were having high Mathematics Anxiety in comparison to those whose mothers' qualification is intermediate and below intermediate.

Objectives of the study

1. To compare the mathematics anxiety of secondary school students in Aizawl City on the basis of gender.
2. To compare the mathematics anxiety of secondary school students in Aizawl City on the basis of types of schools.

Research hypotheses

1. There is a significant difference in the mathematics anxiety of secondary school students in Aizawl City on the basis of gender.
2. There is a significant difference in the mathematics anxiety of secondary school students in Aizawl City on the basis of types of schools.

Methodology

In the present study, the investigator employed Descriptive Survey Method.

Population

The population of the present study comprised of all secondary school students in Aizawl City.

Sample

The sample constitutes 176 secondary school students in Aizawl City. Stratified Random Sampling was employed by the investigator where Government, Government Aided and Private secondary schools were the main strata and samples were randomly collected from there.

Table 1**Profile of secondary school students in Aizawl City**

Groups		No. of secondary school students	
Gender	Male	73	176
	Female	103	
Types of schools	Government	67	176
	Government Aided	59	
	Private	50	

Table 1 shows that out of the 176 secondary school students in Aizawl City, who are taken as sample for the present study, 73 are male and the rest 103 are female. 67 students are enrolled in Government schools, 59 in Government Aided and 50 are enrolled in Private schools.

Tool

For this study, Mathematics Anxiety Scale developed by the investigator was used for collection of data, which is a standardized tool to measure the mathematics anxiety of secondary school students. This scale is divided into three major dimensions: Cognitive dimension, Emotional dimension and Behavioral dimension of Mathematics anxiety. A total of 38 items are distributed in these dimensions. The scale is a five-point scale, which includes *Strongly Agree, Agree, Undecided, Disagree and Strongly Disagree*.

Statistical techniques used

Data was analysed with the help of descriptive statistics like mean and standard deviation along with parametric statistics like t-test and ANOVA.

Delimitation

Due to limitations in time and cost, the present study was delimited to secondary school students studying Class 10.

Data analysis and interpretation

The data collected were analysed and interpreted in accordance with the objectives as follows:

Objective No.1: To compare the mathematics anxiety of secondary school students in Aizawl City on the basis of gender.

To compare the mathematics anxiety of secondary school students with respect to their gender, students are categorized into male and female. The hypothesis which stated that ‘There is a significant difference in the mathematics anxiety of secondary school students in Aizawl City on the basis of gender’ was converted into a null hypothesis which states that, ‘There is no significant difference in the mathematics anxiety of secondary school students in Aizawl City on the basis of gender’.

To test this null hypothesis, a t-test was conducted and comparison was made between male and female. The Mean and the Standard Deviation were also calculated and t-test was used to test the Mean difference, the detail of which is shown in the following table.

Table 2

Comparison of mathematics anxiety between male and female secondary school students in Aizawl City.

Gender	No. of Students	Mean	Standard Deviation	SED	t-value	df	Significance level
Male	73	105.55	24.61	4.07	2.74	169	Significant at 0.05
Female	103	116.71	29.2				

Table 2 shows the comparison of mathematics anxiety between male and female secondary school students in Aizawl City.

The calculated t-value was found to be 2.74 with its degrees of freedom 169, which is larger to the critical value at 0.05 level of significance.

So, the null hypothesis, ‘There is no significant difference in the mathematics anxiety of secondary school students in Aizawl City on the basis of gender’ is rejected.

Therefore, there is a significant difference between male and female secondary school students in Aizawl City. The finding is in favour of female secondary school students showing larger mean score compared to male.

Objective No.2: To compare the mathematics anxiety of secondary school students in Aizawl City on the basis of types of schools.

In order to compare the mathematics anxiety of secondary school students in Aizawl City on the basis of types of school, the hypothesis which stated that ‘There is a significant difference in the mathematics anxiety of secondary school students in Aizawl City on the basis of types of schools’ was converted into a null hypothesis which states that, ‘There is no significant difference in the mathematics anxiety of secondary school students in Aizawl City on the basis of types of schools.’

To test this null hypothesis, ANOVA was used and comparison was made between secondary school students who are currently attending Government, Government Aided and Private type of schools.

Table 3

Comparison of mathematics anxiety of secondary school students in Aizawl City on the basis of types of schools

Source of variance	df	Sum of Squares	Mean Square	F-ratio	Significance
Between sets	2	15773.99	7886.99	11.36	Significant at 0.01
Within sets	173	120104.9	694.25		

The above table shows that the calculated F-ratio is 11.36 which is greater than the critical value 4.71 at 0.01 level of significance. So, the null hypothesis, 'There is no significant difference in the mathematics anxiety of secondary school students in Aizawl City on the basis of types of schools' is rejected.

Since the result indicated that there exists significant difference in mathematics anxiety on the basis of types of schools, t-test was further used to compare the difference between Government, Government Aided and Private schools.

Table 4

Comparison of mathematics anxiety between secondary school students in Government school and Government Aided schools.

Types of schools	No. of Students	Mean	Standard Deviation	SED	t-value	df	Significance
Government	67	100.96	24.97	4.77	2.86	124	Significant at 0.01
Government Aided	59	114.61	28.25				

From the above table, the mean score of students in Government school is 100.96 and the standard deviation is 24.97, while the mean and standard deviation of students studying in Government Aided is 114.61 and 28.25 respectively. The calculated t-value is 2.86 which is greater than the critical value at the required level of significance at 0.01 level i.e. 2.62.

Therefore, there is a significant difference in the mathematics anxiety between secondary school students of Government schools and Government Aided schools.

Table 5

Comparison of mathematics anxiety between secondary school students in Government aided school and Private type of school.

Types of schools	No. of Students	Mean	Standard Deviation	SED	t-value	df	Significance
Government Aided	59	114.61	28.25	5.19	1.81	107	Not significant
Private	50	124	25.83				

Table 5 shows the comparison of mathematics anxiety between students in Government Aided schools and Private schools in Aizawl City.

The calculated t-value was found to be 1.81 with its degrees of freedom 107, which is smaller than the critical value at the required levels of significance. Therefore, there is no significant difference in the mathematics anxiety between students in Government aided schools and Private schools in Aizawl City.

The mean score of students in Private schools is larger showing higher anxiety than of Government aided schools, however the deviation is higher in Government aided as compared to Private schools.

Table 6

Comparison of mathematics anxiety between secondary school students in Government schools and Private type of schools

TYPES OF SCHOOLS	No. of Students	Mean	Standard Deviation	SED	t-value	df	Significance
Government	67	100.96	24.97	4.84	4.76	115	Significant at 0.01
Private	50	124	25.83				

From the above table, the mean score of students in Government schools is 100.96 and standard deviation is 24.97, while the mean and standard deviation of students studying in Private schools is 124 and 25.83 respectively. The calculated t-value is 4.76 which is greater than the critical value at the required level of significance at 0.01 level i.e. 2.62.

Therefore, there is a significant difference in the mathematics anxiety between secondary school students of Government and Private schools. The finding is in favour of Government schools with larger mean scores showing higher anxiety as compared to Private schools.

Findings

1. There is a significant difference in the mathematics anxiety of secondary school students in Aizawl City on the basis of gender, i.e., between male and female.
2. There is a significant difference in the mathematics anxiety of secondary school students in Aizawl City on the basis of types of schools.
 - There is a significant difference in the mathematics anxiety between secondary school students of Government schools and Government Aided type of schools.
 - There is no significant difference in the mathematics anxiety between students in Government aided schools and Private schools.
 - There is a significant difference in the mathematics anxiety between secondary school students of Government and Private schools

Conclusion

As found in the study, while no significant differences lay in mathematics anxiety between schools that rely on the government funding, regardless of the kind and amount received, there was a significant difference when government managed schools and privately managed schools were compared with the latter having a more positive result. This shows that management does play a crucial role in students' anxiety and eventually affecting their academic performance. Since mathematics anxiety significantly impacts the academic performance and confidence of students, it is imperative that this problem is taken care of. Addressing this issue may involve diagnosing anxiety of students and creating supportive learning environments, implementing anxiety-reducing techniques, and encouraging growth mindset. Educators can integrate engaging, real-world applications of mathematics so as to make the subject more relatable and less intimidating.

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MATHEMATICS ANXIETY AND ACADEMIC ACHIEVEMENT IN MATHEMATICS AMONG SECONDARY SCHOOL STUDENTS

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Abstract : This study aims to assess the mathematics anxiety of secondary school students in Aizawl city and its relationship with the achievement in mathematics. Descriptive method was employed and the data was collected by Mathematics Anxiety Scale developed by the investigator. A total of 176 secondary school students were selected as a research sample. Analysis of the t-test results for gender show that there is a significant difference between the level of mathematics anxiety of female students compared to the male students at 0.01 level of significance. Pearson Product Moment Correlation test showed a negative relationship (-0.48) between mathematics anxiety and achievement in mathematics.

Keywords: Mathematics anxiety, compare, secondary students.

I. INTRODUCTION

Mathematics functions as both an abstract science and a practical tool applied across various fields. It is a foundational discipline that involves the study of numbers, quantities, shapes, and patterns. Mathematics is a compulsory subject at the secondary school level in India and is frequently considered one of the most challenging subjects. Since students are obliged to take mathematics examinations regardless of their subject preferences, this can create pressure, leading to feelings of anxiety when faced with, or even thinking about, mathematics-related tasks.

Mathematics anxiety (MA) has become a significant issue in education for many generations. It is characterized by feelings of stress, discomfort and fear when individuals encounter mathematical activities (Ashcraft & Ridley, 2005, as cited in Zhang, 2019). MA refers to the tension or uneasiness experienced during performing or when about to perform any mathematical tasks. According to Nandini and Subramanian (2021), mathematics anxiety is defined as a feeling of tension and anxiety that interferes with the manipulation of numbers and the solving of mathematical problems, both in everyday life and academic settings.

Numerous studies have shown that various factors such as parental occupation, age, school management styles, etc have significantly impact the level of mathematics anxiety. These factors can greatly determine whether or not a person develops an interest in the subject. Additionally, social psychologists even suggested that an individual's thoughts, feelings, and behaviors are strongly influenced by social contexts (Lumen Learning, n.d.). Studies in the past have shown that gender may also play a role in influencing students' levels of mathematics anxiety.

As an academic discipline, principles, mathematics involves numbers, abstract manipulations, and a variety of formulas. Individuals who experience mathematics anxiety, particularly during performance-based tasks, may underperform in mathematics. Anxiety can be caused by poor performance in previous tasks and negative experiences with mathematics, this can heighten anxiety in future tasks, which can challenge future performance. While a moderate level of anxiety may boost performance, excessive anxiety tends to have a negative impact.

II. RATIONALE

Mathematics is considered a vital subject at the secondary level of education. Many students approach it with the preconceived notion that it is difficult, sometimes before they even begin studying it. Thus, deeper studies of mathematics anxiety are important, as it influences academic performance, mental well-being, and most importantly, students' future opportunities in life.

Understanding our perspective on mathematics is crucial for identifying the necessary steps to improve mathematics education. Moreover, the investigator believes that exploring the link between mathematics anxiety and achievement is essential, as it can provide valuable insights into how the current teaching methods might be adjusted. Noticing a lack of similar studies in Aizawl, the investigator felt the need to conduct this research to assess the current perceptions of mathematics by secondary students in Aizawl City and examine its correlation with academic achievement in the subject.

III. REVIEW OF RELATED LITERATURE

Altakhneh (2020) studied the effect of mathematics anxiety on the achievement of middle school students in Amman. It also aims to investigate whether student gender plays a role. The study sample consists of 180 seventh grade students who are distributed into three levels of anxiety: low, middle, and high. Then, mathematics anxiety measurements are collected, the validity and reliability for which are verified. The results reveal that there are statistically-significant differences in achievement between the middle level of mathematics anxiety and the two other extremes. It is found that middle anxiety level has a positive effect on achievement, whereas for low and high math anxiety levels, no differences in achievement are perceived. In addition, no statistically significant differences ($\alpha \leq 0.01$) were found between males and females with regards to mathematics anxiety.

Acevedo et al. (2020) studied the relationship between mathematical anxiety and academic performance in mathematics in high school students. The objective of this correlational research is to identify the relation between mathematical anxiety and academic performance in the area of mathematics by analysing the answers to the Fennema – Sherman mathematical anxiety scale (.88 confidence level) given by 127 secondary school students (68 girls and 59 boys) with an average age of 14.34 years old. The GPA of students was 4.1, a high GPA according to the criteria of the Colombian Ministry of National Education. Furthermore, girls obtained a higher GPA than boys although their level of anxiety was higher too. Regarding the relation between mathematical anxiety and academic performance in the area of mathematics, this study shows that they are inversely related, that is, the greater the anxiety, the lower the academic performance.

Yadav and Singh (2018) studied Mathematics Anxiety and Mathematics Achievement of Secondary School Students. The effect of gender on Mathematics anxiety was also studied. Randomly selected sample consisted of 374 students (302 male and 72 female students) was used. Self-constructed tools, Mathematics anxiety scale and Mathematics Performance Test, were applied to collect data. It was found that the relationship between achievement in Mathematics and Mathematics anxiety is negative and significant at 0.05 level of significance. Mathematics anxiety of high and low achievers was significantly different at 0.05 level of significance, similarly a significant difference was observed between Mathematics achievements of high and low anxious students. It was also noted that difference in Mathematics anxiety of male and female students was not significant at 0.05 level of significance.

Puteh & Khalin (2016) in their study 'Mathematics anxiety and its relationship with the achievement of secondary students in Malaysia' aims to identify the mathematics anxiety and its relationship with the achievement of Form Four Students in Perak Tengah district, Malaysia. The design of the study is using quantitative method and the data was collected by using a questionnaire of Student Math Anxiety Scale (SKMP). A total of 190 Form Four students were selected as a research sample. The results showed that the level of mathematics anxiety of the students was at moderate level with $M = 2.55$, $SD = 0.72$. Analysis of the t test results for gender show that there is no significant difference with $t = -0.889$, $p < 0.05$ between the level of mathematics anxiety of female students compared to the male students. The correlation test showed a significant and negative relationship between student's achievement and their mathematics anxiety with correlation value $r = -0.237$.

From the above studies, it may be safely concluded that in some cases, gender affects the mathematics anxiety of students while it does not affect in other cases. In all of this highlighted literature, it can be observed that academic achievement has an effect on the performance of students in mathematics. This related literature studied has led to the following objectives-

IV. OBJECTIVES

1. To assess the mathematics anxiety of secondary school students in Aizawl City.
2. To compare the mathematics anxiety of secondary school students in Aizawl City with respect to gender.
3. To find out the relationship between mathematics anxiety and academic achievement in mathematics among secondary school students in Aizawl City.

V. RESEARCH HYPOTHESES

1. There is a significant difference in the mathematics anxiety of secondary school students in Aizawl City with respect to gender.
2. There is a significant relationship between mathematics anxiety and achievement in mathematics among secondary school students in Aizawl City.

VI. METHODOLOGY

Descriptive survey method was employed by the investigator.

POPULATION

The population of the present study comprised of all secondary school students in Aizawl City.

SAMPLE

The investigator employed Stratified Random Sampling method for collecting data in which the sample constitutes of 176 secondary school students from Aizawl City. The secondary school students categorized as male and female were put together with respect to the city. The profile of the sample is given in the following table.

Table No. 1:
Profile of sample students

Gender	
Male	Female
73	103
Total= 176	

Table 1 shows that 176 secondary school students in Aizawl taken as sample were categorized based on gender, i.e., male and female, in which there are 73 male and 103 female students.

TOOL

For the present study, data was collected by using Mathematics Anxiety Scale developed by the investigator, which is a standardized tool to measure the mathematics anxiety of secondary school students. The scale is divided into three dimensions: *Cognitive dimension, Emotional dimension and Behavioral dimension* of Mathematics anxiety, in which a total of 38 items are distributed. It is a five-point scale including Strongly Agree, Agree, Undecided, Disagree and Strongly Disagree.

Reliability and validity:

A reliability coefficient of 0.84 was found by using Test-Retest method. Validity of this Mathematics Anxiety Scale was assessed by Content validity ensured through logical analysis by experts, and by Criterion validity in which a coefficient of 0.82 was found. Pearson Product Moment Correlation method was used for finding the reliability and validity of the scale.

STATISTICAL TECHNIQUE USED

Data collected were analyzed with the help of statistical techniques namely: Mean, Standard deviation, t-test, Pearson Product Correlation test.

VII. DELIMITATION

Due to limitations in time and cost, the present study was delimited to secondary school students studying Class 10 only.

VIII. OPERATIONAL DEFINITION OF THE KEY TERMS USED

Mathematical anxiety: The feeling of tension or anxiety that interferes with the manipulation of numbers in all spheres of life

Aizawl: The capital city of the state 'Mizoram', India.

IX. DATA ANALYSIS AND INTERPRETATION

The data collected were analyzed and interpreted in accordance with the objectives

Objective No.1: To assess the mathematics anxiety of secondary school students in Aizawl City.

To assess the mathematics anxiety of secondary school students in Aizawl City, the Mathematics Anxiety Scale developed by the investigator was used. The investigator established specific norms tailored to the current population under investigation.

The raw scores of all 176 secondary students were transformed into z-score. Based on the range of z-score, the mathematics anxiety was classified into 5 levels as depicted in the following table no. 2.

Table 2:
Mathematics anxiety of secondary school students in Aizawl city

Sl No.	Range of z-score	Levels of Mathematics Anxiety	No. of students in Aizawl City	Percentage of anxiety experienced
1	(+1.51 and above)	High anxiety	12	Total=118 (67.05%)
2	(+0.51 to 1.50)	Above average anxiety	44	
3	(-0.50 to +0.50)	Average anxiety	62	Total=58 (32.95%)
4	(-1.50 to -0.51)	Below average anxiety	48	
5	(-1.51 and below)	Low anxiety	10	
		Total	176	100%

The table presents the distribution of 176 secondary school students in Aizawl City in the different mathematics anxiety level, categorized by Z-scores. In the high anxiety group (Z-scores of +1.51 and above), 12 students experience significant anxiety related to mathematics. A larger portion, 44 students, fall into the above average anxiety category (Z-scores between +0.51 and +1.50), indicating a considerable level of discomfort. The majority of students, 62, are in the average anxiety range (Z-scores between -0.50 and +0.50), suggesting that most students experience moderate anxiety. In the below average anxiety category (Z-scores between -1.50 and -0.51), 48 students report relatively low anxiety levels. Finally, 10 students fall into the low anxiety category (Z-scores of -1.51 and below).

Overall, a larger number of students in Aizawl City, i.e., 118 students out of 176 samples (67.04%) experience mathematics anxiety and a much lesser portion, i.e., 58 students, 32.95% do not exhibit anxiety.

Objective No.2: To compare the mathematics anxiety of secondary school students in Aizawl City with respect to gender.

To compare the mathematics anxiety with respect to gender, the students were categorized into male and female. The hypothesis which stated that 'There is a significant difference in the mathematics anxiety of secondary school students in Aizawl City with respect to gender.' was converted into a null hypothesis which stated that, 'There is no significant difference in mathematics anxiety of secondary school students in Aizawl City with respect to gender.'

To test this null hypothesis, a t-test was conducted and comparison was made between male and female secondary school students of Aizawl City. The Mean and the Standard Deviation were calculated and t-test was used to test the Mean difference, the detail is given in the following.

Table 3
Statistical results of mathematics anxiety among secondary school students in Aizawl City

No of students	Mean	Standard deviation
176	111.69	27.86

Table 4
Comparison of mathematics anxiety between male and female secondary school students of Aizawl City

Gender	No. of Students	Mean	Standard Deviation	SED	t-value	df	Significance level
Male	73	105.55	24.61	4.07	2.74	169	Significant at 0.01
Female	103	116.71	29.20				

The table compares the mathematics anxiety scores between male and female students. The mean anxiety score for male students is 105.55, while for females, it is higher at 116.71, indicating that, on average, female students experience more anxiety related to mathematics than their male. The standard deviation for females (29.20) is larger than for males (24.61), showing greater variability in anxiety levels among female students.

The t-value of 2.74, with 169 degrees of freedom (df), is significant at the 0.01 level. Thus, the null hypothesis 'There is no significant difference in mathematics anxiety of secondary school students in Aizawl City with respect to gender' is rejected.

Therefore, there is a significant difference in mathematics anxiety of secondary school students in Aizawl City with respect to gender.

Objective No.3: To find out the relationship between mathematics anxiety and academic achievement in mathematics among secondary school students in Aizawl City.

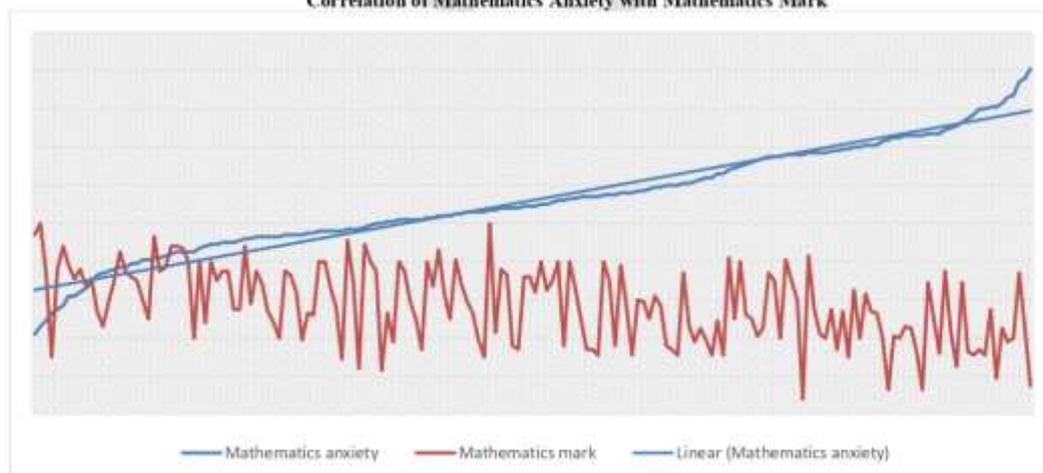
A correlation analysis was computed to determine the strength and direction of the relationship between Mathematics anxiety and Academic achievement in mathematics. The significance of correlation was also calculated.

	Mathematics anxiety	Mathematics mark
Mathematics anxiety	1	-0.48*
Mathematics mark	-0.48*	1

*Correlation is significant at 0.01 level.

The relationship between mathematics anxiety and achievement in mathematics is also visually depicted in Figure 1. The data score of the respondents collected using the Mathematics Anxiety Scale developed by the researcher and the mathematics mark (achievement in mathematics) scored by the respondents in their previous examination is plotted in a graph, as shown in the following.

Figure 1
Correlation of Mathematics Anxiety with Mathematics Mark



The pictorial representation in Figure 1 illustrates the correlation between mathematics anxiety and mathematics achievement (marks). The red zig-zag line represents the mathematics mark, while the blue line depicts the mathematics anxiety with a trendline added for clearer visualization of its direction.

It can be observed that as the blue line goes up, the red line goes down, i.e., as the anxiety increases, the mark decreases.

A correlation coefficient of **-0.48** was found by Pearson Product Moment Correlation method, indicating a *moderate negative relationship* between the two variables- Mathematics anxiety and Academic achievement in mathematics.

X. FINDINGS

1. A larger number of students in Aizawl City (67.04%) experience mathematics anxiety while a lesser portion (32.95%) do not exhibit anxiety.
2. There is a significant difference in mathematics anxiety of secondary school students in Aizawl City with respect to gender.
3. A moderate negative relationship between Mathematics anxiety and Academic achievement in mathematics.

XI. DISCUSSION OF FINDINGS

The findings of the study conducted revealed the anxiety faced by students in mathematics, thus proving the often speculation that mathematics is considered one of the most difficult subjects by students in Aizawl City. However, as majority have average anxiety, this proves the familiarity of the subject among the students hopefully to heighten the awareness of its importance. Average anxiety might result in motivation for greater effort.

The difference in anxiety scores between males and females is statistically significant. This suggests that gender plays a role in the level of mathematics anxiety, with females reporting higher anxiety than males.

The calculated negative value in the correlation is illustrated by general downward trend in the graph's direction, signifying that the variables are inversely related to some extent, although it should be noticed that the slope is not very steep. This moderate correlation indicates that mathematics anxiety has an influence on mathematics achievement although other factors may also affect the outcome.

XII. CONCLUSION

Considering the findings of the present study, it should be taken into great consideration that lessening the anxiety of students is important. This could be done so by putting effort on basic mathematics at foundational level of education. Efforts should be taken for gender biasness that has been considered to be in the society over the years. The prove of the correlation between mathematics anxiety and mathematics achievement also much be a motivating factor to pay more heed to the subject as it probably determines the future of every learner and even his whole life.

ONE DAY NATIONAL SEMINAR ON RECENT TRENDS IN EDUCATION



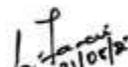
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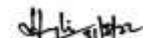
C. LALSANGPUII

RESEARCH SCHOLAR, DEPARTMENT OF EDUCATION, MZU

presented a paper on the topic
'Mathematics Anxiety and Academic Achievement in Mathematics among Secondary School Students of Mizoram and Meghalaya : A Brief Review of Related Literature'
on 31st August, 2022, held at the Auditorium of
Institute of Advanced Studies in Education, Aizawl, Mizoram.


(Dr. LALCHAWIMAWII NGENTE)
Co-ordinator


(Prof. LALLIANZUALI FANAI)
Principal


(LALRINFELI KHIANGTE)
Asst. Co-ordinator

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Certificate

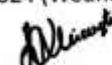


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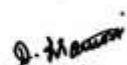
has successfully presented a paper on *Mathematical anxiety among secondary school students in Shillong in relation to their gender and types of schools*

in the One Day International Conference on LITERATURE, CULTURAL STUDIES, EDUCATION AND SOCIAL SCIENCES (ICLCSSESS) organized by IQAC, Govt. Saitual College and Centre for Humanities and Social Sciences Research (CHSSR) at Govt. Saitual College on 4th September, 2024 (Wednesday).


Lalsangpuii Kiangte
Convener,
ICLCSSESS


HK Vanlalhluti
Coordinator,
IQAC, Govt. Saitual College


Lalzarmawia
Principal,
Govt. Saitual College


Debbie Lalrinawmi
Director,
CHSSR

ANNEXURE - I

MIZORAM UNIVERSITY (A Central University)

Ph.D. Thesis Certificate on Plagiarism Check

Name of Research Scholar	Ms. C. Lalsangpuii	
Ph.D. Registration Number	MZU/Ph.D./1855 of 29.08.2021	
Title of PhD thesis	Mathematics Anxiety and Academic Achievement in Mathematics among Secondary School Students of Mizoram and Meghalaya	
Name & Institutional Address of the Supervisor	Prof. Lynda Zohmingliani, Department of Education, Mizoram University, Aizawl	
Name of the Department and School	Department of Education, School of Education	
Date of Submission	18.12.2014	
Date of Plagiarism check	17.12.2014	
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Percentage of similarity detected by the Turnitin software	Core Areas	00%
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Name, Signature & Seal of the Dean of the School:

PARTICULARS OF THE CANDIDATE

NAME OF CANDIDATE	: C. LALSANGPUII
DEGREE	: Doctor of Philosophy
DEPARTMENT	: Education
TITLE OF THESIS	: Mathematics Anxiety and Academic Achievement in Mathematics among Secondary School Students of Mizoram and Meghalaya
DATE OF ADMISSION	: 29.08.2021
APPROVAL OF RESEARCH PROPOSAL	
1. DRC	: 31.03.2022
2. BOS	: 19.05.2022
3. SCHOOL BOARD	: 10.06.2022
MZU REGISTRATION NO.	: 5697 of 2010-11
REGISTRATION NO. & DATE	: MZU/Ph.D./1855 of 29.08.2021
EXTENSION (If Any)	: NIL

(Prof. LOKANATH MISHRA)

Head of Department

Department of Education

Mizoram University

ABSTRACT

**MATHEMATICS ANXIETY AND ACADEMIC ACHIEVEMENT
IN MATHEMATICS AMONG SECONDARY SCHOOL
STUDENTS OF MIZORAM AND MEGHALAYA**

**AN ABSTRACT SUBMITTED IN PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF
PHILOSOPHY**

C. LALSANGPUII

MZU REGISTRATION NO.: 5697 of 2010-11

Ph.D. REGISTRATION NO.: MZU/Ph.D./1855 of 29.08.2021



**DEPARTMENT OF EDUCATION
SCHOOL OF EDUCATION
DECEMBER, 2024**

**MATHEMATICS ANXIETY AND ACADEMIC ACHIEVEMENT IN
MATHEMATICS AMONG SECONDARY SCHOOL STUDENTS OF
MIZORAM AND MEGHALAYA**

By
C. LALSANGPUII
Department of Education

Supervisor
Prof. LYNDIA ZOHMINGLIANI

Submitted

**In partial fulfillment of the requirement of the Degree of Doctor of Philosophy in
Education of Mizoram University, Aizawl.**

INTRODUCTION

Mathematics is a subject that occupies a central role, standing as one of the most essential subjects within the school curriculum. It spans a diverse range of disciplines and finds applications in all aspects of life. Mathematics in simple term refers to the science and area of study that deals with numbers, structure, pattern, space, logic, shapes and arrangement.

According to Cambridge dictionary, anxiety is an uncomfortable feeling of nervousness or worry about something that is happening, or might happen in the future (Cambridge dictionary, 2022). However, when anxiety begins to interfere with a person's ability to carry out routine activities and affects daily functioning, it becomes problematic. At this stage, it can eventually evolve into an anxiety disorder, which requires attention and management in order to prevent it from significantly diminishing the overall well-being of an individual.

Mathematics anxiety can simply be explained as a negative reaction towards mathematics. It is a negative emotion that may interfere in solving mathematical problems of any kind. Richardson and Suinn defined mathematics anxiety as feelings that involves tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations (Richardson & Suinn, 1972, as cited in Suinn & Winston, 2003).

According to Hoque (2017), the domains of learning can be categorized as cognitive domain (knowledge), psychomotor domain (skills) and affective domain (attitudes). This categorization is best explained by the Taxonomy of Learning Domains which was formulated by a group of researchers led by Benjamin Bloom in 1956. This domain of learning is commonly known among educators as Bloom's Taxonomy. Bloom's Taxonomy may serve as a comprehensive framework for anxiety studies as it covers the full range of learning, including cognitive, affective, and psychomotor domains. Thus, mathematics anxiety can be evident in cognitive, affective and behavioral expressions.

Academic achievement is the outcome of education and the extent to which a student, a teacher or an institution has achieved their various educational goals. Academic achievement is usually measured and taken from continuous

assessment or results in examinations, although there is no strict agreement on how it should be measured or in deciding which aspects should be given most importance. Furthermore, academic achievement refers to a person's excellent performance in a given academic field. The most well-known indicator is the student's 'score' in a specific period of studies such as the overall period of academic year, etc. (Paulpandi & Govindharaj, 2017). Academic achievement in mathematics therefore, refers to the achievement or accomplishment of students in mathematics subject. This may be measured from a specific period of time.

RATIONALE OF THE STUDY

The secondary stage of education is a critical period during which students are at the age of making decisions about their future and the possible career paths they will pursue. They are at the age of adolescence where the brain has an astonishing ability to adapt and respond to new experiences and situations (National Institute of Mental Health, n.d.). Understanding the levels of mathematics anxiety among secondary school students will help identify ways to address potential issues effectively. Comparative education is a field of education that assists in developing educational system of different regions. Furthermore, comparing education across different regions can rather be an intriguing endeavor.

Meghalaya has always been reputable to be the hub for education and higher educational facilities that is exemplary (RUSA Meghalaya, n.d). The investigator dug deep but found no studies that convey that the state has ever been subjected to comparison with other states in India, let alone any North-East states on account of mathematics anxiety among secondary school students. Additionally, enhancing both convenience and educational advantage, Mizoram as a neighbouring state which ranks the third in literacy rate in the country (Onmanorama, 2023), is one of the most suitable and intriguing state to compare with Meghalaya. The investigator felt a study such as mathematics anxiety among secondary school students between the two states would be an engaging and highly informative educational study with the hope that it will open the minds for positive furtherance in several fields.

Moreover, this research aims to identify and address the impact of differences among students from the two states on their mathematics anxiety, considering the

societal context. In which, the society in Mizoram follows a patriarchal society which is different from that of Meghalaya which follows a matriarchal society. No other study has been found that conducts a comparative study on mathematics anxiety of secondary students of different regions with such a societal situation over the past. So, the investigator felt the need to conduct the study to see if gender had an impact on the mathematics anxiety among secondary school students while taking into account the varying societal situations.

Various factors contribute to mathematical anxiety among students, including environmental influences, cognitive factors, inappropriate teaching methods, learner characteristics, parental factors, etc (Kour & Razaqi, 2024). Understanding and identifying these underlying reasons will definitely contribute to implementing effective strategies to minimise mathematical anxiety and improve students' experiences in mathematics.

The researcher thus recognized the necessity of conducting a study between the two states, with anticipation that it would reveal the current perceptions of mathematics among secondary school students in the said region and possibly lead to necessary actions for the advancement of mathematics subject in both the states, Mizoram and Meghalaya and potentially benefit others as well.

STATEMENT OF THE PROBLEM

The problem proposed to be investigated reads as,

‘Mathematics Anxiety and Academic Achievement in Mathematics among Secondary School Students of Mizoram and Meghalaya.’

OBJECTIVES OF THE STUDY

1. To standardize a scale to measure the mathematics anxiety of secondary school students.
2. To find out the level of mathematics anxiety among secondary school students of Mizoram.
3. To study the level of mathematics anxiety among secondary school students of Meghalaya.

4. To compare the level of mathematics anxiety between secondary school students of Mizoram and Meghalaya.
5. To compare the level of mathematics anxiety between male and female secondary school students of Mizoram and Meghalaya.
6. To compare the level of mathematics anxiety between male secondary school students of Mizoram and Meghalaya.
7. To compare the level of mathematics anxiety between female secondary school students of Mizoram and Meghalaya.
8. To compare the level of mathematics anxiety between male and female secondary school students of Mizoram.
9. To compare the level of mathematics anxiety between male and female secondary school students of Meghalaya.
10. To compare the level of mathematics anxiety between secondary school students of rural and urban origin.
11. To compare the level of mathematics anxiety between rural and urban origin secondary school students of Mizoram.
12. To compare the level of mathematics anxiety between rural and urban origin secondary school students of Meghalaya.
13. To compare the level of mathematics anxiety between rural origin secondary school students of Mizoram and Meghalaya.
14. To compare the level of mathematics anxiety between urban origin secondary school students of Mizoram and Meghalaya.
15. To analyse the reason or reasons for mathematics anxiety among secondary school students.
16. To find out the relationship between mathematics anxiety and achievement in mathematics.
17. To examine the impact of mathematics anxiety on academic achievement in mathematics among secondary school students.

HYPOTHESES OF THE STUDY

1. There is significant difference in the level of mathematics anxiety among secondary school students of Mizoram and Meghalaya.

2. There is significant difference in the level of mathematics anxiety between male and female secondary school students of Mizoram and Meghalaya.
3. There is significant difference in the level of mathematics anxiety between male secondary school students of Mizoram and Meghalaya.
4. There is significant difference in the level of mathematics anxiety between female secondary school students of Mizoram and Meghalaya.
5. There is significant difference in the level of mathematics anxiety between male and female secondary school students of Mizoram.
6. There is significant difference in the level of mathematics anxiety between male and female secondary school students of Meghalaya.
7. There is significant difference in the level of mathematics anxiety between secondary school students of rural and urban origin.
8. There is significant difference in the level of mathematics anxiety between rural and urban origin secondary school students of Mizoram.
9. There is significant difference in the level of mathematics anxiety between rural and urban origin secondary school students of Meghalaya.
10. There is significant difference in the level of mathematics anxiety between rural origin secondary school students of Mizoram and Meghalaya.
11. There is significant difference in the level of mathematics anxiety between urban origin secondary school students of Mizoram and Meghalaya.
12. There is a significant relationship between mathematics anxiety and achievement in mathematics among secondary school students of Mizoram and Meghalaya.
13. Mathematics anxiety has an impact on the academic achievement in mathematics among secondary school students.

OPERATIONAL DEFINITIONS OF THE KEY TERMS USED

Mathematics: For the present study, mathematics refers to the subject studied by secondary school students.

Anxiety: It refers to a feeling of pressure and worries which affect a person's life.

Mathematics anxiety: For the present study, it is the negative reaction that secondary school students show when encountering any mathematics related situations.

Academic Achievement: For the present study, it is the mark obtained by secondary students in mathematics subject in their previous class, i.e., Class IX.

Secondary school students: Secondary school students in this present study includes students in 10th grade.

RESEARCH APPROACH

The present research was descriptive in nature. A mixed research approach in which both qualitative and quantitative approaches were employed. Furthermore, explanatory sequential design was adopted for the qualitative part of research. Data was collected from two main sources by the researcher -

Primary sources: Secondary school students from Mizoram and Meghalaya made up the primary sources for the present study.

Secondary sources: In order to realize the research objectives, data from School Education Department of the two states, Government records, research reports from within the country and outside, books, articles from journals and records about the two states on education were considered as secondary sources.

POPULATION, SAMPLE AND SAMPLING DESIGN

The population for the present study consisted of all secondary school students in Mizoram and Meghalaya. However, to meet different objectives, samples were categorised into three groups. The first samples were taken from the general population using the most appropriate sampling method. The other two samples emerged from this bigger sample to meet the requirement of specific objectives.

i) In order to find out the level of Mathematics anxiety among secondary students from each state, a total of 900 students, 450 from each state were considered as samples using stratified systematic random sampling method. As shown in table No. 3.1, five districts, representing the four directions i.e., north, east, west, south and the centre were selected from Mizoram, where 90 students each were randomly selected as sample from the selected districts to get a total of 450 students.

From the three main hills of Meghalaya, i.e., Khasi hills, Garo hills and Jaintia hills, one district each, was randomly selected and out of each district, a sample of 150 students were selected so as to obtain the desired sample of 450 secondary

school students. Furthermore, as reflected in Table No. 3.2, the selected samples were categorised in terms of gender and origin.

Table No. 3.1
No. of selected samples

STATE	Districts	No. of samples taken	Total no. of samples in each state	Total no. of samples
MEGHALAYA	Khasi Hills	150	450	900
	Jaintia Hills	150		
	Garohills	150		
MIZORAM	Aizawl	90	450	900
	Lunglei	90		
	Champhai	90		
	Mamit	90		
	Kolasib	90		

Table No. 3.2
Sample students to find out the mathematics anxiety level among secondary school students of Mizoram and Meghalaya

STATE	No. of male students	No. of female students	Students of urban origin	Students of rural origin
MIZORAM	203	247	343	107
MEGHALAYA	208	242	281	169
TOTAL	411	489	624	276

ii) To analyse the reason(s) for mathematics anxiety among secondary school students, the sample of 266 secondary students were selected purposively from sample students with average or higher levels of anxiety, as indicated by their mathematics anxiety scores. The sample students were then divided into male and female groups as presented in Table 3.3.

Table No. 3.3
No. of students with average or higher-level anxiety

No. of male students	No. of female students
143	123
Total: 266	

iii) For the *focus group discussion*, a sample of 10 students from Mizoram and Meghalaya who exhibited average and above average levels of mathematics anxiety were selected by means of purposive stratified sampling method. However, as depicted in Table 3.4, only 8 students turned up for the discussion.

Table No. 3.4
Detailed nature of sample students for Focus group discussion

STATE	No. of male students	No. of female students
MIZORAM	2	3
MEGHALAYA	1	2
TOTAL	3	5

TOOLS/TECHNIQUES USED FOR DATA COLLECTION

1. Mathematics Anxiety Scale (2024):

The researcher developed Mathematics Anxiety Scale using Likert's Method. This scale consisted of 38 items which were all framed as negative statements; thus, the pattern of scoring was consistent across all items. The scale was organized into three major dimensions by which mathematics anxiety is expressed: *Cognitive dimension, Emotional dimension and Behavioral dimension*, with the 38 items distributed across these categories. It used a five-point rating system, which included Strongly Agree, Agree, Undecided, Disagree, and Strongly Disagree. The reliability and the validity were established as explained in the following. Additionally, norms for the scale were established and presented in the form of z-scores.

Reliability

Reliability of Mathematics Anxiety Scale developed by the researcher was calculated by using the scores of 103 subjects on 38 items on the final form. The

reliability of the Mathematics Anxiety Scale was assessed, with a reliability coefficient of 0.84 using the Pearson's Product Moment Correlation method.

Validity

Validity of the Mathematics Anxiety Scale was assessed by content validity which was ensured through logical analysis by experts.

Concurrent validity of the developed scale was also established by comparing it with the Mathematics Anxiety Scale created by Sadia Mahmood and Dr. Tahira Khatoon. A correlation coefficient of 0.82 was found using Pearson's Product Moment Correlation method.

2. Mathematics Anxiety Scale for Secondary and Senior Secondary School Students (2012):

The Mathematics Anxiety Scale for Secondary and Senior Secondary School Students had 14 statements. It was bi-dimensional and a shorter instrument in which among the items, 7 were worded positively and the remaining 7 items worded negatively. It is a 5-point Likert type instrument assessing positive and negative dimensions of mathematics anxiety. Both reliability and validity were established as explained in the following.

The reliability of the Mathematics Anxiety Scale (MAS) was established with a coefficient of 0.81 using the split-half method, which increased to 0.90 after applying the Spearman-Brown Prophecy Formula. Additionally, Cronbach's alpha was 0.87, indicating strong internal consistency. For validity, the MAS was validated using teachers' judgment, where a t-test confirmed a significant difference between high- and low-anxiety groups ($t = 14.50, p < 0.01$). Concurrent validity was also supported through a negative correlation of -0.41 with the Fennema-Sherman Attitude Scale, indicating that students with a more positive attitude towards mathematics experienced less anxiety.

3. Opinionnaire:

In order to find the reason(s) why secondary school students face mathematics anxiety, the researcher prepared an opinionnaire. The opinionnaire included three multiple-choice questions aimed at assessing the students' level of

anxiety, the level of education when they first encountered mathematics anxiety, and how they coped with the anxiety.

Additionally, the opinionnaire also included a multiple-choice question structured as a Yes/No inquiry. It consisted of 26 questions which were organized into eight categories: Personal experiences, family issues, teacher related factors, classroom interactions, economic concerns, misconceptions, syllabus, and infrastructure.

4. Focus Group Discussion:

A Focus Group Discussion (FGD) was conducted in which a sample of 10 students were randomly selected from each state among students who exhibited average or higher levels of mathematics anxiety, as determined by their scores on the Mathematics Anxiety Scale developed by the researcher. However, only 8 students consisting of three males and five females turned up for the discussion. All participants were 15 to 16-year-old students from Class 10. To ensure confidentiality, participants were coded as B1, B2, B3, G1, G2, G3, G4 and G5 where 'B' represents 'Boy' and 'G' represents 'Girl.' The purpose of FGD was to provide the researcher with a more comprehensive understanding of the issue at hand, complementing the quantitatively gathered data. This discussion allowed for a deeper exploration of the topic from the participants' perspectives.

ADMINISTRATION OF TOOLS AND COLLECTION OF DATA

The Mathematics Anxiety Scale and the opinionnaire developed by the researcher were administered to more than 900 secondary school students, so as to achieve the goal of having a sample of 900. Primary data from both the states, Mizoram and Meghalaya were collected by the researcher. When the data were collected, a minor data cleaning was conducted in order to filter out the responses which were not complete. Each response was assigned a number and the first 900 responses emerged as the final sample.

The objectives and guidelines of the study for marking the chosen responses of students in the Mathematics Anxiety Scale and Opinionnaire were effectively communicated to all the participants. Participants were provided ample time to

reflect on the statements to ensure genuine responses. They were assured that their answers would be kept confidential and solely utilized for research purposes. Great care was taken during the administration of the tools and conduct of the discussion meeting to ensure that all questions and required personal information were properly addressed.

Both the opinionnaire and Focus Group discussion (FGD) was employed for qualitative assessment. Since the opinionnaire aimed to identify the causes of mathematics anxiety, only the responses from students performing average and above level of anxiety (as per the established norm) were analysed.

The FGD was held online via Zoom Meet since the participants were located in different regions. The meeting was recorded for analysis. The researcher, who also served as the moderator of the focus group discussion carefully presented the questions and discussion topics to the participants.

TABULATION OF DATA

The information collected from 900 secondary school students were carefully examined, categorized, and evaluated using established protocols. Following the evaluation of responses from the Mathematics Anxiety Scale as well as the opinionnaire, a tabulation process was conducted. The obtained scores were recorded in an Excel spreadsheet and subjected to statistical analysis using the specified statistical methods for the analysis. SPSS was also used for tabulation. Furthermore, data from the focus group discussion were analysed and thoroughly examined to address the specific objectives of the study.

PROCEDURES ADOPTED FOR DATA ANALYSIS

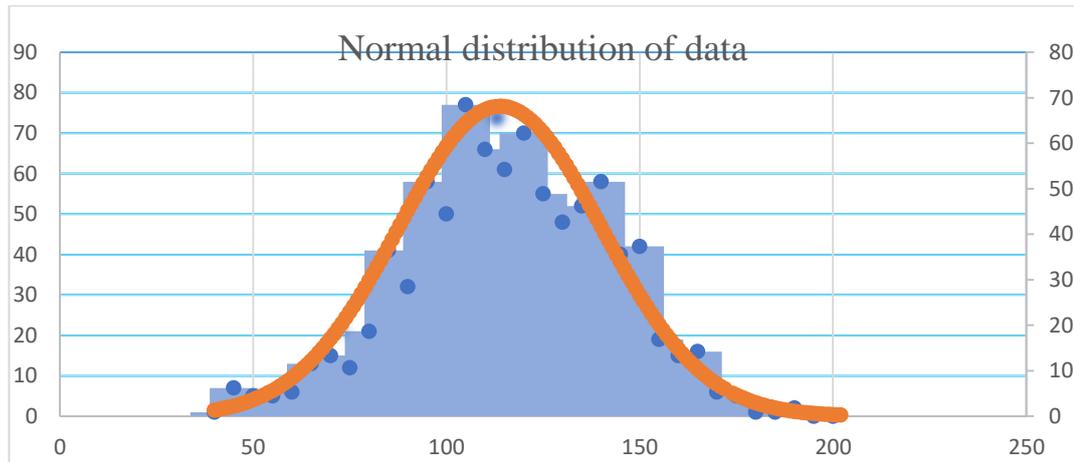
1. Quantitative data analysis

Normality test is necessary so as to decide the kind of test to be used for data analysis, whether parametric or non-parametric. The data in the present study showed a skewness of **-0.14** and a kurtosis of **-0.13**, indicating that normality assumptions were met and the data was normally distributed (Orcan, 2020). To further validate this normality, the data was presented by a histogram, and a normal distribution curve (bell-shaped) was plotted to visually represent the data's normal distribution.

Therefore, with normality established, further steps were taken using parametric tests.

Fig 3.1
Bell curve showing normal distribution of data for the present study

Mean=113.9, Standard deviation=26.36



Considering the nature of the data which has established normality, and in accordance with the objectives, the researcher employed the following statistical methods for data analysis:

1. *Descriptive statistics measures:* Various measures of central tendency, standard deviation which is a measure of variability, percentage and z-scores, were employed to understand the distribution of scores and to classify students into different categories based on the nature of their scores.
2. *Inferential statistics:*
 - A t-test was applied to determine the significance of differences in mean scores between different groups categorized by gender (male and female) and by origin (urban and rural).
 - The Pearson's Product Moment Correlation method was used to investigate the relationship between mathematics anxiety and academic achievement in mathematics.
 - Regression analysis was used for predicting the impact of mathematics anxiety on academic achievement in mathematics.

In summary, these statistical techniques were selected based on the characteristics of the data and the specific research objectives. Each technique was carefully chosen to address key variables, interpret relationships within the data, test hypotheses, and eventually contributing to the overall rigor and reliability of the findings in the present study.

2. *Qualitative data Analysis*

The researcher adopted an explanatory sequential design in which qualitative data was collected by a *focus group discussion* based on the quantitative data already collected and analysed (Cresswell & Cresswell, 2018, as cited in Gonzaga University Library, 2023).

Therefore, methodological triangulation was applied by using quantitatively analysed data from the Mathematics Anxiety Scale and qualitatively analysed data from the focus group discussion. The method of triangulation aimed to enhance the credibility and validity of the findings in the present research.

MAJOR FINDINGS

1. Standardization of Mathematics Anxiety Scale

A Likert type Mathematics Anxiety Scale had been constructed and standardized.

2. Study on the level of Mathematics Anxiety among secondary school students of Mizoram

- 1) 39.56% of the students experienced average anxiety in mathematics.
- 2) 25.33% of the students felt below-average anxiety in mathematics.
- 3) 22.67% of the students faced above-average anxiety in mathematics.
- 4) 7.11% of the students had high anxiety in mathematics.
- 5) 5.33% of the students encountered low anxiety in mathematics.

Focus group discussion: The focus group discussion revealed that all participants from Mizoram who shared their experiences expressed having mathematics anxiety. This aligned with the quantitative findings which showed that the highest percentage of students (39.56%) falls in the average level of mathematics anxiety. Comments made by some of the participants indicated that their anxiety could be addressed and reduced through specific actions.

3. Study on the level of Mathematics Anxiety among secondary school students of Meghalaya

- 1) 38.89% of the students experienced average anxiety in mathematics.
- 2) 28% of the students had above-average anxiety in mathematics.
- 3) 20.44% of the students felt below-average anxiety in mathematics.
- 4) 8% of the students faced low anxiety in mathematics.
- 5) 4.67% of the students encountered high anxiety in mathematics.

Focus group discussion: Participants of the discussion expressed their feelings towards mathematics, in which negative statements made by students from Meghalaya revealed mathematics anxiety among the students. This explains why majority (38.89%) are in average mathematics anxiety level.

4. Comparison on the level of Mathematics Anxiety between secondary school students of Mizoram and Meghalaya

• Comparison based on levels of Mathematics Anxiety

- 1) Average anxiety was most common among the two states.
- 2) 7.11% of students in Mizoram and 4.67% of students in Meghalaya experienced high anxiety in mathematics.
- 3) 22.67% of students in Mizoram and 28% of students in Meghalaya encountered above average anxiety in mathematics.
- 4) 39.56% of students in Mizoram and 38.89% of students in Meghalaya felt average anxiety in mathematics.
- 5) 25.33% of students in Mizoram and 20.44% of students in Meghalaya had below average anxiety in mathematics.
- 6) 5.33% of students in Mizoram and 8% from Meghalaya faced low anxiety in mathematics.

• Comparison by test of significance

There was no significant difference in the level of mathematics anxiety between secondary school students of Mizoram and Meghalaya.

Focus group discussion: According to the statements made by participants, not all students experienced severe mathematics anxiety; rather, they felt only mild

anxiety when faced with more difficult problems. The qualitative discussion helped explain the quantitative findings in which a larger number of students experienced average mathematics anxiety. Not much difference was observed in the intensity of mathematics anxiety between the two states based on their statements, which also explained the insignificance found by t-test.

5. Comparison on the level of Mathematics Anxiety between male and female secondary school students of Mizoram and Meghalaya

• Comparison based on levels of Mathematics Anxiety

- 1) Average anxiety was most common among both genders.
- 2) 7.54% of males and 6.34% of females experienced high anxiety in mathematics
- 3) 21.41% of males and 24.34% of females had above average anxiety in mathematics.
- 4) 40.63% of males and 35.79% of females encountered average anxiety in mathematics.
- 5) 24.57% of males and 27.20% of females had below average anxiety in mathematics.
- 6) 5.84% of males and 6.34% of females faced low anxiety in mathematics.

• Comparison by test of significance

There was a significant difference in the level of mathematics anxiety between male and female secondary school students of Mizoram and Meghalaya, with females exhibiting higher anxiety scores compared to males. (Significant at 0.01).

Focus group discussion: The qualitative findings indicated that male students showed a more positive strategy for addressing challenges in willing to seek help from others. In contrast, many female students tended to avoid challenges and were stressed by mathematical problems. Although male students also experienced anxiety about the subject, they were more inclined to seek assistance and complete their tasks, rather than leaving them unfinished. This explains why females had higher mathematics anxiety as compared to males.

6. Comparison on the level of mathematics anxiety between male secondary school students of Mizoram and Meghalaya.

- **Comparison based on levels of Mathematics Anxiety**

- 1) Average anxiety was most common among male students in both states.
- 2) 6.90% male students of Mizoram and 6.25% male students of Meghalaya experienced high anxiety in mathematics.
- 3) 24.14% male students of Mizoram and 25.48% male students of Meghalaya had above average anxiety in mathematics.
- 4) 38.92% male students of Mizoram and 40.38% male students of Meghalaya encountered average anxiety in mathematics.
- 5) 24.14% male students of Mizoram and 20.19% male students of Meghalaya felt below average anxiety in mathematics.
- 6) 5.91% male students of Mizoram and 7.69% male students of Meghalaya faced low anxiety in mathematics.

- **Comparison by test of significance**

There was no significant difference in the level of mathematics anxiety between male secondary school students of Mizoram and Meghalaya.

Focus group discussion: The qualitative research, gathered through focus group discussion, showed that male students who shared their anxiety-related issues reported similar levels of degree in their negative experiences with mathematics.

7. Comparison on the level of Mathematics Anxiety between female secondary school students of Mizoram and Meghalaya.

- **Comparison based on levels of Mathematics Anxiety**

- 1) Average anxiety was most common among female students in both states.
- 2) 12.96% female students of Mizoram and 2.89% female students of Meghalaya experienced high anxiety in mathematics.
- 3) 17.41% female students of Mizoram and 31.40% female students of Meghalaya had above average anxiety in mathematics.
- 4) 37.25% female students of Mizoram and 33.88% female students of Meghalaya encountered average anxiety in mathematics.

- 5) 27.94% female students of Mizoram and 23.55% female students of Meghalaya felt below average anxiety in mathematics.
- 6) 4.45% female students of Mizoram and 8.26% female students of Meghalaya faced low anxiety in mathematics.

- **Comparison by test of significance**

There was a significant difference in the level of mathematics anxiety between female secondary school students of Mizoram and Meghalaya, with female students of Meghalaya exhibiting higher anxiety in mathematics. (Significant at 0.05).

Focus group discussion: The findings of the discussion concurred with the quantitative findings in which female students of Meghalaya had higher anxiety in mathematics as compared to female secondary students of Mizoram. The students of Meghalaya expressed feeling nervous with the encouragement of their teachers and parents which is indicative of their negative perception towards mathematics. Struggles with basic mathematical operations would definitely result in anxiety as well. However, the problems mentioned by female students from Mizoram appeared to be manageable as they also mentioned not requiring assistance from others to help them understand mathematics.

8. Comparison on level of Mathematics Anxiety between male and female secondary school students of Mizoram

- **Comparison based on levels of Mathematics Anxiety**

- 1) Average anxiety was most common among both genders
- 2) 5.42% of males and 4.45% of females experienced high anxiety in mathematics.
- 3) 24.63% of males and 27.94% of females had above average anxiety in mathematics.
- 4) 40.39% of males and 37.25% of females encountered average anxiety in mathematics.
- 5) 25.12% of males and 21.05% of females felt below average anxiety in mathematics.
- 6) 4.43% of males and 9.31% of females faced low anxiety in mathematics.

- **Comparison by test of significance**

There was a significant difference in the level of mathematics anxiety between male and female secondary school students of Mizoram, with females exhibiting higher mean scores compared to their males. (Significant at 0.01).

Focus group discussion: The findings of the discussion revealed that female students expressed their mathematics anxiety with more emotional intensity, indicating higher anxiety. In contrast, male students adopted a more detached, resigned attitude, choosing to complete the work rather than avoid it. This difference in how they talked about their experiences with mathematics have indicated a deeper sense of unease and self-doubt among females, which explained their higher anxiety as compared to the males.

9. Comparison on level of Mathematics Anxiety between male and female secondary school students of Meghalaya

- **Comparison based on levels of Mathematics Anxiety**

- 1) Average anxiety was the most prevalent level for both genders.
- 2) 7.69% of males and 8.26% of females experienced high anxiety in mathematics.
- 3) 20.19% of males and 23.55% of females had above average anxiety in mathematics.
- 4) 40.38% of males and 33.88% of females encountered average anxiety in mathematics.
- 5) 25.48% of males and 31.40% of females had below average anxiety in mathematics.
- 6) 6.25% of males and 2.89% of females faced low anxiety in mathematics.

- **Comparison by test of significance**

There was a significant difference in the level of mathematics anxiety between male and female secondary school students of Meghalaya, where females experienced greater mathematics anxiety compared to males. (Significant at 0.01).

Focus group discussion: A male participant's statement reflected frustration and comparison but lacked long-term self-doubt about his ability in mathematics. In contrast, female students expressed deeper feelings of hopelessness and inadequacy

in mathematical abilities, contributing to higher anxiety. While males focused on external comparisons, females struggled more with self-doubt at the cognitive level by which their higher anxiety levels in mathematics was explained.

10. Comparison on level of Mathematics Anxiety between secondary school students of rural and urban origin

- **Comparison based on levels of Mathematics Anxiety**

1. A significant percentage of students fell in the average level of anxiety in both groups, i.e., rural origin and urban origin.
2. 4.71% students of rural origin and 9.29% students of urban origin experienced high anxiety in mathematics.
3. 26.45% students of rural origin and 23.40% students of urban origin encountered above average anxiety in mathematics.
4. 36.23% students of rural origin and 34.46% students of urban origin had average anxiety in mathematics.
5. 27.54% students of rural origin and 24.04% students of urban origin felt below average anxiety in mathematics.
6. 5.07% students of rural origin and 8.81% students of urban origin faced low anxiety in mathematics.

- **Comparison by test of significance**

There was a significant difference in the level of mathematics anxiety between secondary school students of rural and urban origin, where rural originated students reported higher levels of mathematics anxiety indicated by larger mean scores.

11. Comparison on level of mathematics anxiety between rural and urban origin secondary school students of Mizoram

- **Comparison based on levels of Mathematics Anxiety**

- 1) The highest percentage of students of both rural origin and urban origin were in the average level of anxiety.
- 2) 3.74% students of rural origin and 4.96% students of urban origin experienced high anxiety in mathematics.

- 3) 23.36% students of rural origin and 26.82% students of urban origin encountered above average anxiety in mathematics.
- 4) 47.66% students of rural origin and 37.03% students of urban origin had average anxiety in mathematics.
- 5) 16.82% students of rural origin and 24.20% students of urban origin felt below average anxiety in mathematics.
- 6) 8.41% students of rural origin and 7% students of urban origin faced low anxiety in mathematics.

- **Comparison by test of significance**

There was a significant difference in the level of mathematics anxiety between rural and urban origin secondary school students of Mizoram where rural origin students were found to have greater mathematics anxiety indicated by larger mean scores. (Significant at 0.05).

12. Comparison on level of mathematics anxiety between rural and urban origin secondary school students of Meghalaya

- **Comparison based on levels of Mathematics Anxiety**

- 1) 11.24% students of rural origin and 7.12% students of urban origin experienced high anxiety in mathematics.
- 2) 14.79% students of rural origin and 22.42% students of urban origin encountered above average anxiety in mathematics.
- 3) 20.71% students of rural origin and 39.50% students of urban origin had average anxiety in mathematics.
- 4) 44.97% students of rural origin and 24.91% students of urban origin felt below average anxiety in mathematics.
- 5) 8.28% students of rural origin and 6.05% students of urban origin faced low anxiety in mathematics.

- **Comparison by test of significance**

There was a significant difference in the level of mathematics anxiety between rural and urban origin secondary school students of Meghalaya where rural origin students were found to have greater mathematics anxiety indicated by larger mean scores. (Significant at 0.01)

Focus group discussion: The quantitative analysis of the data in Objectives 10, 11 and 12 had revealed similar findings in which students of rural origin had higher mathematics anxiety than students of urban origin. This finding concurred with the qualitative findings obtained by the focus group discussion. Students of rural origin expressed stronger sense of fear and avoidance toward mathematics, especially in performance situations such as solving problems in front of others. In contrast, urban-origin students' expressed frustration and lack of focus, but without similar intensity of emotional distress. This reflected that rural-origin students experienced greater mathematics anxiety compared to urban-origin students.

13. Comparison on level of mathematics anxiety between rural origin secondary school students of Mizoram and Meghalaya

- **Comparison based on levels of Mathematics Anxiety**

- 1) 8.41% students of rural origin and 3.55% students of urban origin experienced high anxiety in mathematics.
- 2) 34.58% students of rural origin and 30.77% students of urban origin encountered above average anxiety in mathematics.
- 3) 29.91% students of rural origin and 34.32% students of urban origin had average anxiety in mathematics.
- 4) 15.89% students of rural origin and 24.26% students of urban origin felt below average anxiety in mathematics.
- 5) 11.21% students of rural origin and 7.10% students of urban origin faced low anxiety in mathematics.

- **Comparison by test of significance**

There was a significant difference in the level of mathematics anxiety between rural origin secondary school students of Mizoram and Meghalaya where rural origin students of Meghalaya were found to have greater mathematics anxiety indicated by larger mean scores. (Significant at 0.01).

Focus group discussion: The findings of the quantitative analysis concurred with the findings of the focus group discussion. Students of rural origin from both Mizoram and Meghalaya expressed challenges with mathematics. However, rural-origin students from Mizoram demonstrated a more positive attitude towards

learning mathematics and focusing on self-improvement and continuing to study despite procrastination. Meanwhile rural origin students of Meghalaya seemed to be showing a more emotional distress towards mathematics by addressing their fear and avoidance of the subject.

14. Comparison on level of mathematics anxiety between urban origin secondary school students of Mizoram and Meghalaya

- **Comparison based on levels of Mathematics Anxiety**

- 1) 7% students of rural origin and 6.05% students of urban origin experienced high anxiety in mathematics.
- 2) 24.20% students of rural origin and 24.91% students of urban origin encountered above average anxiety in mathematics.
- 3) 37.03% students of rural origin and 39.50% students of urban origin had average anxiety in mathematics.
- 4) 26.82% students of rural origin and 22.42% students of urban origin felt below average anxiety in mathematics.
- 5) 4.96% students of rural origin and 7.12% students of urban origin faced low anxiety in mathematics.

- **Comparison by test of significance**

There was a significant difference in the level of mathematics anxiety between urban origin secondary school students of Mizoram and Meghalaya where urban origin students of Mizoram were found to have greater mathematics anxiety indicated by larger mean scores. (Significant at 0.01).

Focus group discussion: The quantitative findings aligned with the qualitative results, showing that urban-origin students from Mizoram experienced higher levels of anxiety compared to students of Meghalaya. Students from Mizoram voiced strong frustrations with mathematics, abandoning problems without attempting to solve them. In contrast, students from Meghalaya demonstrated a more passive approach to the subject in which they expressed willingness to engage with mathematics despite their dislike for the subject.

15. Reasons for mathematics anxiety among secondary school students.

➤ *Findings on level of education at which students started experiencing mathematics anxiety and coping strategies of secondary students*

The opinionnaire aimed to analyse the reasons for mathematics anxiety among secondary school students by first assessing the level of education at which they began to experience anxiety and how they coped with it. The findings were as follows:

1. 45.49% started experiencing mathematics anxiety at Secondary level of education.
2. 39.47% started experiencing mathematics anxiety at Middle level of education.
3. 13.91% started experiencing mathematics anxiety at Primary level of education.
4. 1.13% are not sure when they first experienced mathematics anxiety.

Focus group discussion: The focus group discussion found that most students started experiencing mathematics anxiety at the secondary level of education.

Secondary school students have different coping strategies.

1. 37.22% sought help from tutors.
2. 34.59% engaged themselves in self-study.
3. 18.42% sought help from others.
4. 9.02% simply avoid mathematics related tasks.
5. Only 0.7% are unaware of how they cope with mathematics anxiety.

Focus group discussion: The qualitative discussion found that students dealt with their anxiety in mathematics by seeking help from tutors and solving problems on their own. Participants of the discussion shared that self-study and peer support played a significant role in managing their mathematics anxiety.

➤ *Findings on Opinion of secondary school students*

A. Findings on Opinion of secondary school students in relation to personal experiences:

Majority (52.55%) of the students agreed mathematics anxiety is caused by difficulty faced at a personal level of experience in mathematics. (Poor concept, struggles with basic mathematical operations, symbols and vocabularies).

Focus group discussion: The focus group upon discussion agreed that mathematics anxiety was largely caused by personal level of experiences. Some students identified weak conceptual understanding and omission of certain topics at previous levels of education as contributors to their anxiety in mathematics.

B. Findings on Opinion of secondary school students in relation to family issues:

Majority (56.02%) of the students did not agree that the cause of mathematics anxiety is concerned with the welfare of the family in which the student belongs (Lack of encouragement from family).

Focus group discussion: The qualitative group discussion revealed that parents' high expectations caused students to feel nervous and stressed, leading to increased anxiety in mathematics.

C. Findings on Opinion of secondary school students in relation to teacher concerned:

73.68% of students found teachers' remarks about their mathematical abilities discouraging. 65.41% found teacher-student ratio affected their anxiety as well.

Focus group discussion: The participants of the focus group discussion revealed that negative comments and harsh criticisms about their weaknesses in the subject discouraged and hurt them. This lack of positive reinforcement made them feel incapable thus creating anxiety in mathematics.

D. Findings on Opinion of secondary school students in relation to transaction of lesson in mathematics class:

Majority (50.75%) of the students find it hard to understand *how* their mathematics teachers teach in class, thus agreeing that transaction of lessons in mathematics class contributed to mathematics anxiety.

Focus group discussion: Participants of the focus group expressed feeling bored or disengaged with how teachers teach, thus failing to hold their attention. Therefore, transaction of lessons caused anxiety in mathematics.

E. Findings on Opinion of secondary school students in relation to economic concerned:

Majority of students (66.90%) students regarded economic condition of students as one of the anxiety factors.

Focus group discussion: Participants of the discussion mentioned that tutoring helped reduce their anxiety, as it provided extra support. Thus, failing to attend to anxiety in a way of seeking help from tutors contributed to anxiety in mathematics.

F. Findings on Opinion of secondary school students in relation to misconception on mathematics learning:

Most students (53.63%) do not believe the cause of mathematics anxiety is concerned with misconceptions in mathematics learning. (Innate ability, gender biased beliefs).

Focus group discussion: The discussion showed that the cause of mathematics anxiety was not related to misconceptions about gender or innate ability. The statements taken from both male and female students described experiencing similar levels of anxiety.

G. Findings on Opinion of secondary school students in relation to syllabus:

Majority of the students (56.77%) students agreed that most students believe the cause of mathematics anxiety is concerned with the syllabus. (Huge syllabus, less solved problems in textbooks, rushed pace of finishing syllabus, absence of real-life experiences within the syllabus, absence of real-life experiences).

Focus group discussion: The discussion revealed that syllabus cause students' anxiety. Many students pointed out the inadequacy of textbooks, which they felt did not provide enough solved examples and explanations for difficult concepts. The rushed pace of needing to complete the syllabus also contributed to their stress eventually causing anxiety in the subject.

H. Findings on Opinion of secondary school students in relation to infrastructure:

Majority of the students (68.55%) did not believe the cause of mathematics anxiety is concerned with infrastructure of their schools. (Noise because of poor condition of the buildings, congested rooms, poor quality of black board).

Focus group discussion: The discussion on how infrastructure could affect mathematics anxiety revealed that students disagreed infrastructure of their institutions contributed to their anxiety. Thus, infrastructure was not a factor in their struggles with mathematics.

16. Relationship between mathematics anxiety and achievement in mathematics.

A moderate negative correlation with coefficient of -0.48 was found between mathematics anxiety and academic achievement in mathematics among secondary school students of Mizoram and Meghalaya. The correlation was significant at 0.01 level.

17. Mathematics anxiety impact on academic achievement in mathematics (indicated by mathematics mark)

Mathematics anxiety significantly predicted academic achievement in mathematics ($R = -0.48$, $p < 0.01$). Mathematics anxiety was accounted for 23% of academic achievement in mathematics. ($R^2 = 0.23$).

The estimated regression equation is given as $\hat{y} = 97.54 + (-0.40)x$, i.e., $\hat{y} = 97.54 - 0.40x$, where \hat{y} is the predicted value of mathematics mark and x is the mathematics anxiety of secondary students.

SUMMARY OF FINDINGS

Significance found:

1. Within the population studied, i.e., Mizoram and Meghalaya as well as in each of the two states, the highest proportion of secondary students reported experiencing an average level of mathematics anxiety.
2. Within the population studied, i.e., Mizoram and Meghalaya, as well as in each of the two states, female secondary students were found to have greater mathematics anxiety their male counterparts.

3. Within the population studied, i.e., Mizoram and Meghalaya, as well as in each of the two states, rural origin secondary students were found to have greater mathematics anxiety than urban origin secondary students.
4. Rural origin students of Meghalaya had greater mathematics anxiety than rural origin secondary students of Mizoram.
5. Urban origin students of Mizoram had greater mathematics anxiety than urban origin secondary students of Meghalaya.
6. A moderate negative correlation was found between mathematics anxiety and academic achievement in mathematics.
7. Mathematics anxiety significantly predicted academic achievement in mathematics anxiety accounted for 23% of academic achievement in mathematics.

No significance found:

1. There was no significant difference in the level of mathematics anxiety between secondary school students of Mizoram and Meghalaya.
2. There was no significant difference in the level of mathematics anxiety between male secondary school students of Mizoram and Meghalaya.

Starting Level of experiencing mathematics anxiety and coping strategy

1. Most students started experiencing mathematics anxiety at the secondary level of education.
2. Most students cope with mathematics anxiety by seeking help from tutors.

Reasons for mathematics anxiety among secondary school students

1. Personal level of experience in mathematics such as poor concept, difficulty faced in basic mathematical operations, mathematical symbols and vocabularies.
2. Teacher concerned such as teachers' negative remarks on students' mathematical abilities and a large teacher-student ratio.
3. Transaction of lesson in mathematics class.
4. Economic concerned such as not having to afford tuition and limited study space at home.

5. Syllabus concerned such as heavy syllabus, less solved examples and lack of interesting topics in mathematics text-books, rushed pace to finish syllabus and absence of connection between syllabus with real-life situations.

RECOMMENDATIONS

Based on the findings of the present study, the researcher made several recommendations to reduce mathematics anxiety and prevent future issues related to it among secondary school students.

1. It is recommended to give targeted support to students at different levels of anxiety. For average students, fostering a more enriching classroom with proper mentorship could be helpful so as to improve their anxiety. Students with above average and high level of anxiety may be offered counselling or one-to-one help arranged by parents or teachers.
2. The findings in the present study indicated that females tended to experience higher levels of anxiety than males. To prevent the reinforcement of possible stereotypes that may have given such results, such as males are innately more capable to excel in mathematics, etc., it is important to educate teachers and parents on how to support students without promoting these misconceptions. Workshops or meetings addressing this issue can be held for this purpose. Additionally, students should be made aware of these myths, supported by research findings that challenge them.
3. The findings in the present study indicated that urban secondary students were more anxious compared to rural secondary students. Research findings (Rani & Rani, 2024) have reported that many factors such as the financial weakness of family, previous background of mathematical understanding, etc are reasons contributing to the anxiety of rural students. To address these issues and mitigate their potential effects, it is essential for the Government to ensure that qualified mathematics teachers are recruited who can meet the specific needs of students. Continuous supervision and support for teachers are crucial to ensure that capable mathematics teachers are always available to assist students effectively.

4. Mathematics is a highly sequential subject, making prior knowledge crucial. Therefore, it is recommended that the mathematics curriculum include regular assessments to ensure students are reminded of, or even re-taught, the necessary concepts before starting each new lesson. It is also essential to design assessment tools and techniques that are both accurate and appropriate. The curriculum should ensure that such assessments are consistently implemented.
5. It is recommended that textbooks and other resources in the mathematics curriculum be closely connected to real-life situations. This connection will help students understand the relevance of what they are learning and enable them to apply classroom knowledge effectively in practical contexts.
6. It is recommended that the Government implement a strict and thorough process for recruiting qualified and competent mathematics teachers. Additionally, regular in-service teacher training should be conducted so as to keep teachers at pace with the latest teaching methods and trends, helping them maintain effective teaching practices. Well-trained and qualified teachers are less likely to engage in negative behaviors towards students, such as making discouraging comments, showing favouritism, making unrealistic comparisons, or setting excessively high expectations, etc.
7. The NEP 2020 has planned to emphasize the development of essential literacy and numeracy skills during early years of education. Given the importance of these skills and their role in addressing issues stemming from weak mathematical foundations, it is recommended that the Government take proactive steps to ensure the effective teaching and reinforcement of foundational mathematics concepts. This will also help ensure confidence in students and avoid unnecessary frustration and anxiety in the future.
8. The Government must ensure that the teacher-student ratio requirement is effectively implemented in both Government-run and Private secondary schools. Effective communication between teachers and students, which is achievable only through individualized attention and care, is essential to meet students' needs, particularly for excelling in subjects like mathematics.
9. It is also recommended that the Government organize activities at different levels of education within the curriculum to raise students' awareness on the importance

of mathematics. Mathematics clubs, laboratories, and other initiatives should be encouraged and implemented across schools, providing students with engaging activities and learning platforms.

By implementing these recommendations, secondary schools in Mizoram and Meghalaya can significantly reduce mathematics anxiety, leading to improved performance in mathematics and overall academic success.

SUGGESTIONS FOR FURTHER RESEARCH

The investigator offers the following suggestions for further research:

1. A comparative study on mathematics anxiety among secondary students from different districts in Mizoram could be conducted. The same study may be conducted in Meghalaya as well.
2. A study on the relationship between attitude towards mathematics and mathematics anxiety may be conducted among secondary students of Mizoram and Meghalaya.
3. A comparative study of mathematics anxiety among secondary school students in North East India may be conducted.
4. A comparative study of mathematics anxiety among secondary school students in India and other foreign Country known for mathematics proficiency may be conducted.
5. A study on mathematics anxiety among mathematics teachers in Mizoram and Meghalaya may be conducted to identify the specific in-service training needs.
6. A qualitative study may be conducted to explore the reasons behind mathematics anxiety among adults who reported having experienced it in the past and may still be experiencing it.

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