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Gender, Family Structure and School Characteristics Influencing Mathematics Achievement Among Secondary Students

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ABSTRACT Mathematics plays an integral role in daily life and contributes significantly to a society's socioeconomic and technological development. As a core component of the school curriculum, assessing the factors influencing mathematics achievement has become essential. This study examines the impact of gender, family structure and school characteristics on the mathematics achievement of secondary school students in Thoubal District, Manipur, India. A descriptive research design was employed, involving a sample of 1200 students of classes 9 and 10, selected using a stratified random sampling method. Data were collected using a Mathematics Achievement Test developed by the researchers, covering five major branches of mathematics. The findings reveal that gender, school type and school locality significantly affect students' mathematics achievement. However, the type of family does not show significant correlation with mathematics achievement. The study underscores the need for targeted interventions to address disparities related to gender and school characteristics in mathematics education.

INTRODUCTION

Everybody, irrespective of their caste, religion, gender or profession, uses mathematics in their daily life consciously or subconsciously. Mathematics is expected to help accelerate any society's social, economic, and technological progress. So, mathematics is regarded as one of the basic and compulsory subjects in the educational curriculum and checking the effectiveness of teaching and learning mathematics in schools has become increasingly important. According to Anastasi (1968), "Achievement tests are designed to measure the effects of a specific programme of instruction or training. Achievement tests in the field of education are commonly used to assess the attainment of major, long-term educational goals".

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Gender differences in education are well-documented, with societal norms and expectations influencing how male and female students approach mathematics learning. By examining these differences, researchers can identify potential gaps and develop strategies to support both genders in achieving high levels in mathematics, ensuring equitable learning opportunities. The type of family plays a significant role in a student's educational journey. It affects the availability of resources, emotional support, and parental involvement in education. Understanding how these factors influence mathematics achievement can help educators tailor interventions that address the specific needs of students from diverse family backgrounds. Different types of schools offer varying levels of resources, teaching quality, and support systems. The type of school can significantly impact a student's mathematics achievement by influencing the quality of their education. Researching this factor helps identify disparities and inform policies aimed at providing equitable educational experiences across different school types. The geographical location of a

school affects access to educational resources, technology and extracurricular opportunities. Researching the impact of school locality on mathematics achievement is essential for addressing educational inequalities and ensuring that all students, regardless of where they live, have the opportunity to achieve high levels in mathematics. By studying mathematics achievement through the lenses of these factors, researchers can uncover the underlying causes of disparities and develop targeted strategies to improve educational outcomes for all students.

Regarding gender, different studies found insignificant differences between the scores of male and female secondary school students in mathematics achievement (Bala and Shaafiu 2016; Bhowmik 2017; Ganihar and Wajiha 2008; Hannula 2002; Mehera 2004; Mohd. and Tengku 2011; Prema and Sathiskumar 2021; Rajashekara et al. 2012; Vijaylakshmi and Lavanya 2006). However, some studies found that males performed better than females in mathematics achievement (Anjana 2018; Ishfaq 2022; Khatoon 1988; Mahmood and Khatoon 2011; Memon 2013; Singh and Singh 2007). Some studies also found that females performed better than males in mathematics achievement (Arslan et al. 2012; Mareesh 2017; Nataraj and Manjula 2012; Sarsani and Maddini 2010).

Recent studies have suggested that an active-learning intervention significantly improved girls' mathematics performance, reducing the gender gap by about 40 percent without disadvantaging boys (Di Tommaso et al. 2024). Similarly, school effectiveness has been shown to moderate gender differences, suggesting that institutional quality shapes achievement patterns (Oregui-González et al. 2024). However, recent reports indicate that post-COVID disruptions widened the gender gap, with boys outperforming girls in many regions (Associated Press 2025).

Regarding the type of families, Prema and Sathiskumar (2021) found no significant difference between the mathematics achievement scores of secondary school students of nuclear and joint families. Recent studies have shown that students from single-parent families tend to perform significantly lower in mathematics compared to those from intact families, highlighting family structure as a strong predictor of achievement (Lasisi et al. 2024). In addition, higher family socioeconomic status (SES) is positively linked with mathematics performance, confirming SES as a key determinant of student outcomes (Byiringiro 2024). Importantly, parental involvement—such as monitoring homework and engaging in school activities—has been shown to enhance mathematics achievement, thereby mediating the effects of SES and family background (Akindipe and Adeyemi 2025).

Regarding the type of schools, different studies found that private school students performed better than government school students in mathematics achievement (Anjana 2018; Devi 2015; Mareesh 2017; Ganihar and Wajiha 2008; Ishfaq 2022; Sarsani and Maddini 2010). However, Rajashekara et al. (2012) found no significant difference in mathematics achievement scores between government and private school students.

Regarding the types of localities of the schools, Anjana (2018) and Prema and Sathiskumar (2021) found no significant difference in mathematics achievement scores between rural and urban school students. However, Ishfaq (2022), Mehera (2004), Mareesh (2017), Sarsani and Maddini (2010), Singh and Singh (2007), and Vijaylakshmi and Lavanya (2006) found that urban school students have higher mathematics achievement scores than rural students.

Again, opportunity to learn and school socioeconomic composition have been identified as strong predictors of mathematics achievement, underscoring the importance of institutional factors beyond individual traits (Womack 2025). Similarly, analyses of PISA 2022 data revealed that student, teacher, and school-level factors- including resources, teacher quality, and school climate—significantly shaped mathematics outcomes across countries (Wu et al. 2025). Evidence from Cambodia further shows that both student characteristics and school resources strongly influence mathematics performance, particularly in resource-constrained contexts, reinforcing the need for school-level investment (Lay et al. 2025).

The literature review reveals that previous studies on the mathematics achievement of secondary school students have yielded inconsistent findings. There is a lack of consensus regarding the influence of variables such as gender, family structure, school type and locality. While some studies report no significant differences based on these correlates, others indicate statistically significant effects. However, even among the studies that found significant differences, the direction and nature of these effects vary considerably, making it difficult to gener-

alise the results. Furthermore, there is a noticeable paucity of research focusing on mathematics achievement in the northeastern states of India, particularly in Manipur. This gap in the literature provided the impetus for the present study, which aims to contribute to the limited empirical evidence available in this regional context. Therefore, this investigation is both timely and relevant, as it seeks to offer deeper insights into the factors influencing mathematics achievement among secondary school students.

Objectives

The objective of this study was to compare the mean scores of the mathematics achievement of the secondary school students with regard to gender, type of family, type of school and locality of school.

Hypotheses

The research hypotheses were as follows:

Hypothesis 1: There exists no significant difference in the mean scores of the mathematics achievement of the secondary school students with regard to gender.

Hypothesis 2: There exists no significant difference in the mean scores of the mathematics achievement of the secondary school students with regard to type of family.

Hypothesis 3: There exists no significant difference in the mean scores of the mathematics achievement of the secondary school students with regard to type of school.

Hypothesis 4: There exists no significant difference in the mean scores of the mathematics achievement of the secondary school students with regard to locality of school.

MATERIAL AND METHODS

Method

The study was conducted in a natural setting without manipulating variables to examine the mathematics achievement of the students. It aimed to describe the current status of students in terms of their mathematics achievement using a descriptive survey method that is cross-sectional in nature.

Population and Sample

The population of the study consisted of classes 9 and 10 students from secondary schools affiliated to the BSEM (Board of Secondary Education Manipur) in the Thoubal District, Manipur. The stratified random sampling technique was used to collect a sample of 1,200 students. Gender (male/female), type of family (nuclear/joint), type of school (private/government), and the locality of school (urban/rural) of the students form the different strata of the study.

The sample size of the study was determined using Yamane's Simplified Formula (1967), which took N (population) = 9,529 and e (margin of error) = 2.64 percent. Thus, the initial sample size calculated was 1,247. However, only 1,200 students were considered as the study sample since the data of some students could not be used in the final analysis despite the proper and clear instructions given to the students. Table 1 shows the distribution of the students in the sample in different strata.

Tool and Data Collection

In this study, mathematics achievement refers to the scores of secondary school students obtained

Table 1: Number of selected students and their percentages of the variables

S. No.	*Variable*	*Sub-variables*	*No. of students*	*Percentage (%)*
1	Gender	Male	600	50
		Female	600	50
2	Type of family	Nuclear	794	66.17
		Joint	406	33.83
3	Locality of school	Rural	600	50
		Urban	600	50
4	Type of school	Private	600	50
		Government	600	50

Source: Authors (October, 2023)

in the Mathematics Achievement Test (MAT) constructed by the researchers. For the test, the items were constructed based on the five branches of school mathematics, that is, arithmetic, algebra, geometry, mensuration and statistics. Again, four educational objectives, three from the cognitive domain and one from the psychomotor domain, for teaching mathematics at the secondary stage, namely knowledge, understanding, application and skills objectives, were partly adapted from the Pedagogy of Mathematics (NCERT 2012). There were 40 items, and 60 minutes were given to complete the test. The aims of the test were discussed in detail with the principals and authorities of the schools, and the students were informed of them. The students were briefed on how to answer the items, and they were promised that their replies would be kept confidential and utilised for research purposes only.

RESULTS

The raw scores obtained in the MAT were quantitative data and measured on an interval scale. The skewness and the kurtosis of the MAT scores were 0.654 and 0.132, respectively. These values are within –1 and +1 range of kurtosis and skewness, which are considered excellent for assuming the normality of the distribution. Then, statistical techniques like mean, standard deviation, and t-tests were used to analyse the collected data.

Regarding Hypothesis 1

Hypothesis 1: There exists no significant difference in the mean scores of the mathematics achievement of the secondary school students with regard to gender.

Interpretation

The mean scores of the MAT for male and female students are 22.33 and 20.67, respectively. The calculated value of t at 0.05 level of significance (two-tailed) and 1198 degrees of freedom is found to be 5.091, greater than the tabulated value of t, which is 1.962, as shown in Table 2. So, the null hypothesis is rejected. The male students performed better than the female students on the MAT.

Regarding Hypothesis 2

Hypothesis 2: There exists no significant difference in the mean scores of the mathematics achievement of the secondary school students with regard to type of family.

Interpretation

The mean scores of the MAT for students of nuclear and joint families are found to be 21.47 and 21.56, respectively. The calculated value of t at 0.05 level of significance (two-tailed) and 1198 degrees of freedom is found to be 0.257, less than the tabulated value of t, which is 1.962, as shown in Table 3. So, the null hypothesis is not rejected, that is, there is no significant difference in the mean scores of students of nuclear and joint families in the MAT.

Regarding Hypothesis 3

Hypothesis 3: There exists no significant difference in the mean scores of the mathematics achievement of the secondary school students with regard to type of school.

Interpretation

The mean scores of the MAT for private and government school students are 23.43 and 19.57, respectively. The calculated value of t at 0.05 level of significance (two-tailed) and 1198 degrees of freedom is 12.500, much greater than the tabulated value of t, which is 1.962, as shown in Table 4. So, the null hypothesis is rejected. The students of private schools performed better than the students of government schools in the MAT.

Regarding Hypothesis 4

Hypothesis 4: There exists no significant difference in the mean scores of the mathematics achieve-

Table 2: Mean difference of the MAT scores of male and female students

Gender	*N*	*Mean*	*SD*	*p-value*	*t-value*	*Remarks*
Male	600	22.33	5.937	0.000	5.091	Significant
Female	600	20.67	5.319			

Source: Authors (October, 2023)

Table 3: Mean difference of the MAT scores of students of nuclear and joint families

Type of family	*N*	*Mean*	*SD*	*p-value*	*t-value*	*Remarks*
Nuclear	794	21.47	5.575	0.797	0.257	Insignificant
Joint	406	21.56	5.927			

Source: Authors (October, 2023)

Table 4: Mean difference of the MAT scores of students of private and government schools

Type of school	*N*	*Mean*	*SD*	*p-value*	*t-value*	*Remarks*
Private	600	23.43	5.877	0.000	12.500	Significant
Government	600	19.57	4.783			

Source: Authors (October, 2023)

ment of the secondary school students with regard to locality of school.

Interpretation

The mean scores of the MAT for urban and rural school students are 21.98 and 21.02, respectively. The calculated value of t at a 0.05 significance level (two-tailed) and 1198 degrees of freedom is 2.919, higher than the tabulated value of t, which is 1.962, as shown in Table 5. So, the null hypothesis is rejected. The students from schools located in urban areas performed better on the MAT than the students in schools located in rural areas.

DISCUSSION

Gender and Mathematics Achievements

The findings of the present study reveal that male students performed significantly better than female students in the MAT. This aligns with several earlier studies such as those by Anjana (2018), Associated Press (2025), Di Tommaso et al. (2024), Ishfaq (2022), Khatoon (1988), Mahmood and Khatoon (2011), Memon (2013), and Singh and Singh (2007), which have consistently reported a gender gap in mathematics achievement favouring male students. These studies highlight a recurring trend across diverse contexts and educational settings, suggesting that the issue is both widespread and complex.

At the same time, the result stands in contrast with the findings of Arslan et al. (2012), Mareesh (2017), Nataraj and Manjula (2012), and Sarsani and Maddini (2010), who found either no significant gender differences or, in some cases, better performance among female students. This contradiction indicates that gender differences in mathematics achievement may not be universal but are influenced by contextual variables such as culture, socioeconomic background, pedagogical practices, and societal attitudes toward gender roles.

Probable Reasons

The gender differences in mathematics achievement may be attributed to a combination of social, cultural, and psychological factors rather than innate ability. Mathematics is often stereotyped as a male domain, leading to mathematics anxiety and low confidence among female students. Parents and teachers may hold higher expectations for boys, providing them with greater encouragement and support, while the lack of female role models in STEM further discourages girls from aspiring to mathematics-related careers. Deeply ingrained sociocultural norms and traditional gender roles also influence

Table 5: Mean difference of the MAT scores of students in urban and rural schools

Locality of school	*N*	*Mean*	*SD*	*p-value*	*t-value*	*Remarks*
Urban	600	21.98	5.733	0.004	2.919	Significant
Rural	600	21.02	5.620			

Source: Authors (October, 2023)

girls' self-perceptions and educational choices. Moreover, classroom practices and unequal participation opportunities may reinforce these disparities. Together, these factors create an environment where male students are more motivated and confident to excel, highlighting the need for equitable learning conditions that challenge stereotypes and support both genders equally.

Type of Family and Mathematics Achievement

The findings of the present study reveal that although students from joint families scored slightly higher in the MAT compared to their counterparts from nuclear families, the difference was not statistically significant. This result resonates with the observations of Prema and Sathiskumar (2021), who also reported minimal or no significant effect of family structure on academic achievement. However, it contrasts with the findings of Akindipe and Adeyemi (2025), Byiringiro (2024), and Lasisi et al. (2024), who emphasized that family type, along with socioeconomic status and parental involvement, plays a vital role in influencing students' academic outcomes, including mathematics performance. The conflicting evidence suggests that the impact of family structure on achievement may vary across cultural, economic, and social contexts.

Probable Reasons

Students from joint families tend to perform slightly better in mathematics as they often benefit from the presence of multiple caregivers or elder members who can provide academic support, and parents may have more time to devote to their children since household responsibilities are shared. In contrast, children in nuclear families may face additional domestic duties and receive less direct supervision due to parents' busy schedules, which can affect their study time and focus. However, family type alone does not determine achievement, as factors such as parental involvement, socioeconomic conditions, and educational aspirations play a more critical role. Supportive environments in both joint and nuclear families can equally foster students' success in mathematics.

Type of School and Mathematics Achievement

The findings of the present study show that students of private schools significantly outperformed those of government schools in the MAT. This is consistent with earlier studies by Anjana (2018), Devi (2015), Mareesh (2017), Ganihar and Wajiha (2008), Ishfaq (2022), Sarsani and Maddini (2010), Womack (2025), and Wu et al. (2025), which have also highlighted the advantage of private school students in mathematics achievement. However, it stands in contradiction to the findings of Rajashekara et al. (2012), who reported no significant differences in achievement between students of government and private schools, suggesting that contextual and regional variations may influence outcomes.

Probable Reasons

Private school students performed better than government school students likely due to differences in resources, family background, and support systems. Private schools often provide better infrastructure, smaller class sizes, and closer monitoring of teaching, creating a more effective learning environment than government schools, which may face challenges like overcrowding and limited resources. Many private school students also come from affluent families, giving them access to learning materials, tutoring, and stronger academic support at home. Moreover, parents of private school students tend to have higher expectations and greater involvement in their children's studies, motivating them to excel. The social perception of private schools as prestigious further boosts student confidence and achievement. These factors collectively explain the observed performance gap, highlighting the need to strengthen government schools to ensure equity in mathematics learning.

Locality of School and Mathematics Achievement

The findings of the present study indicate that students from urban schools performed significantly better in the MAT than those from rural schools. This result is in line with the studies of Ishfaq (2022), Lay et al. (2025), Mehera (2004), Mareesh (2017), Sarsani and Maddini (2010), Singh and Singh (2007), and Vijaylakshmi and Lavanya (2006), which have also documented higher mathematics achievement among urban school students compared to their rural school counterparts. The pattern highlights the persistent educational divide between rural and

urban areas, influenced by access to resources, quality of schooling, and socioeconomic conditions.

Probable Reasons

Students from urban schools generally perform better in mathematics because they have access to better infrastructure, well-equipped classrooms, libraries, and laboratories, along with greater exposure to technology such as computers, the internet, and educational software that enhance learning. Urban schools also tend to attract more qualified teachers and provide a more competitive academic environment. Families in urban areas usually enjoy higher incomes, enabling them to invest in private tutoring, reference materials, and extracurricular enrichment activities that strengthen mathematics achievement. In contrast, students in rural schools often face inadequate facilities, limited technological access, and financial constraints, which restrict their academic opportunities. Additionally, rural students may be burdened with household chores or agricultural work, reducing the time available for study, while their parents—due to economic pressures or lack of awareness—may hold lower educational aspirations. Together, these factors explain the significant achievement gap observed between urban and rural school students.

CONCLUSION

The study found significant differences in mathematics achievement based on gender, school type and school locality. Male students outperformed female students, likely influenced by gender stereotypes, societal expectations, and the presence of male role models in STEM fields. Although students from joint families scored slightly higher than those from nuclear families, the difference was not statistically significant, possibly due to shared responsibilities and support structures in joint families. Students in private schools performed significantly better than their counterparts in government schools, which may be attributed to better resources, greater parental involvement, and higher academic expectations. Similarly, students from urban schools showed higher achievement than those from rural schools, likely due to better academic facilities, access to technology, and supportive home environments.

RECOMMENDATIONS

To bridge these disparities, it is recommended that educational policies and practices actively challenge gender stereotypes in mathematics and encourage equal participation among boys and girls. Government schools and rural schools should be strengthened with improved infrastructure, teaching quality, and access to learning resources, including digital tools. Parental involvement should be promoted across all school types and family structures, emphasising the role of family support in academic success. Interventions must be context-specific, addressing the unique challenges faced by students in different school settings and localities to ensure equitable mathematics achievement for all learners.

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AUTHORS' CONTRIBUTIONS

- Study Conception: Laishram Nirtish Singh and Laisom Sharmeswar Singh
- Study Design: Laishram Nirtish Singh and Laisom Sharmeswar Singh
- Data Collection: Laishram Nirtish Singh, Laishram Arjun Singh and Jocyline Thokchom
- Analysis and Interpretation of Results: Laishram Nirtish Singh and Jocyline Thokchom
- Manuscript Preparation: Laishram Nirtish Singh, Laishram Arjun Singh and Laisom Sharmeswar Singh
- All authors reviewed the results and approved the manuscript.

CONFLICTS OF INTEREST

The authors have no competing interests to declare relevant to this article's content.

ETHICS APPROVAL

Not applicable

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