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Family Factors as Predictors of Science Achievement Among Secondary School Students: A Study in Manipur State, India

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ABSTRACT This study investigates the influence of family-related factors, such as the family type, parents' occupation and their educational qualification, on the science achievement of secondary school students in Manipur, India. A descriptive-normative survey design was employed, involving a stratified random sample of 1,195 students from 20 secondary schools affiliated with the Board of Secondary Education, Manipur, during the 2022-2023 academic year. Data were collected using the Science Achievement Test, constructed and standardised by the researchers. Statistical tools such as mean, standard deviation, t-value, and p-value were applied to analyse and interpret the data. Results indicated varying degrees of influence of family-related factors on students' science achievement. It highlights the importance of considering socioeconomic and family background variables in understanding science achievement. The findings have implications for educators and policymakers aiming to design equitable and targeted interventions that support science education across diverse family settings.

INTRODUCTION

Science achievement refers to students' academic performance as measured through a standardised Science Achievement Test (SAT) based on learning objectives such as knowledge, understanding, and application. The study aims to explore how selected family-related factors influence students' science achievement at the secondary level. Specifically, it investigates the role of (a) family type, (b) parents' occupations and (c) parents' educational qualifications. These variables are critical indicators of the socioeconomic and emotional environment in which a child learns.

Family type, whether nuclear or joint, can significantly shape a student's academic journey by influencing resource availability, emotional support, and parental involvement. A nuclear family includes parents and children, while a joint family involves multiple generations living together, such as grandparents, parents, and children. Differences in family structure may contribute to variations in students' academic performance.

Parents' occupation is another important socioeconomic indicator. Fathers' and mothers' occupations are classified as *occupations with stable income*, including salaried and government occupations, and *occupations with unstable income*, such as farming or daily wage labour. These distinctions help reveal how financial stability and parental roles influence students' science achievement.

Parents' educational qualifications often correlate with a family's awareness, support for learning, and access to academic resources. In this study, parents' educational qualifications are categorised as *highly educated (HE)* if they have completed Class XII or higher, and *poorly educated (PE)* if their highest qualification is Class XI or below. Investigating this variable provides insights into how parents' educational qualifications impact students' science achievement.

By analysing these factors, the study seeks to understand how the family environment affects secondary students' science achievement, guiding targeted educational interventions and policies.

Review of Literature

Family-related factors influence students' academic achievement, particularly in science. Several studies have explored this relationship, though with varying outcomes.

The type of family structure has also been examined in relation to science achievement. While some researchers, such as Nidhi (2015), Pooja (2017) and Raj and Komalavalli (2021), reported no significant difference in science achievement between students from nuclear and joint families, Blake (1981) found that students from nuclear families tend to have higher science achievement.

Regarding parents' occupations, the results are also mixed. Studies by Nidhi (2015), Nithya (2018), and Raghu et al. (2022) did not find any significant difference in students' science achievement based on whether parents had stable or unstable sources of income. In contrast, studies by Comber and Keeves (1973), Sirin (2005), Cherlin (2010), Pooja (2017), and Bettaswamy and Kumar (2022) observed that students whose parents had stable sources of income performed better in science compared to those whose parents had unstable sources of income.

Parents' educational qualifications have emerged as a significant predictor of student outcomes. Abd-El-Fattah (2006), through structural equation modelling, identified parents' educational qualifications as the most important predictor of school disengagement. Schulze and Lemmer (2017) also found a connection between science achievement and parents' educational qualifications and school values. Gobena (2018) reported that while family income had no significant effect, parents' educational qualifications contributed 40.96 percent to students' academic achievement, leaving 59.04 percent of influencing factors unidentified. Similarly, Zhang (2018) found that parents' educational qualifications directly and indirectly influenced students' science achievement, although parent-child communication had only an indirect effect.

However, not all studies align with this finding. Nithya (2018) found no significant difference in science achievement between students of highly and poorly educated parents. On the contrary, a large body of research, Comber and Keeves (1973), Simpkins et al. (2005), Hanushek and Woessmann (2008), Dubow et al. (2009), Cherlin (2010), Nidhi (2015), Pooja (2017), and Bettaswamy and Kumar (2022), consistently shows that students with highly educated parents perform better in science.

Broadly, studies have also highlighted the influence of family environment on academic achievement. Rashmi (2016) found a positive correlation between academic achievement and family environment, while Pappattu and Vanitha (2017) reported no correlation specifically between family environment and science achievement. In the Finnish context, Harju-Luukkainen et al. (2020) emphasised that the impact of family background characteristics varies across regions and significantly affects students' future achievement in subjects like mathematics, indicating a similar possibility for science.

Despite these various studies, several critical gaps remain. Firstly, many studies emphasise overall academic achievement rather than focusing specifically on science. Secondly, limited studies investigate the influence of family-related demographic variables, such as family type, parents' occupations and educational qualifications, on science achievement. Thirdly, a regional gap is evident, with minimal studies conducted in the northeastern states of India, especially Manipur, where cultural and socioeconomic factors may uniquely affect educational outcomes. Lastly, existing science achievement tests are largely outdated and do not reflect the post-pandemic National Council of Educational Research and Training (NCERT) curriculum changes introduced in 2022.

In light of these gaps, the present study is designed to investigate the influence of family-related factors, namely, family type, parents' occupations and educational qualification, on science achievement among secondary school students in Manipur.

Objectives

The study aimed to examine the difference in science achievement of secondary school students with respect to: (i) family type, (ii) fathers' occupations, (iii) mothers' occupations, (iv) fathers' educational qualification, and (v) mothers' educational qualification.

Hypotheses

The study hypothesis is that there exists no significant difference in science achievement of

secondary school students with respect to (i) family type, (ii) fathers' occupations, (iii) mothers' occupations, (iv) fathers' educational qualification, and (v) mothers' educational qualification.

MATERIAL AND METHODS

Research Design

The study adopted a descriptive-normative survey design.

Population and Sample

The population comprised all Classes IX and X students enrolled in the Board of Secondary Education, Manipur (BSEM) affiliated secondary schools in Thoubal district, Manipur, during the 2022-2023 academic year. A stratified random sampling technique was employed to ensure representativeness, allowing balanced representation across key variables such as school type, gender, and location while minimising within-group variability.

A total of 20 secondary schools were selected for data collection. Although 1,232 students initially participated, only 1,195 students were included in the final analysis after excluding incomplete or invalid responses.

Tool

The Science Achievement Test (SAT) was constructed and standardised by the investigators to assess science achievement based on the revised 2022 NCERT class 8 science textbook, as no suitable existing test was available post-COVID-19.

The final test blueprint includes 60 items covering three science branches, Physics, Chemistry and Biology, which are distributed across three cognitive domains and one psychomotor domain, namely, knowledge, understanding, application, and skills as given in Table 1.

Reliability

The reliability of the test is measured using the odd-even split-half method and the test-retest method, where the retest is done after 28 days of the first test (Table 2).

Table 2: Reliability measures of the test

S. No.	*Reliability methods*	*Value*
1	Test-Retest method	0.89*
2	Split-Half method	0.83*

*Significant at 0.01 level of significance (two-tailed)
Source: Authors (November 2023)

Validity

The test items are evaluated based on certain criteria by experts from different fields to estimate the face validity and content validity of the test. The *Science Achievement Test* (2017), constructed by Dr Ali Imam, Dr Gyan Pratap Singh and Dr Shiventra Pratap Singh, was utilised to establish the concurrent validity of the test based on the scores of 200 students and the construct validity is established by evaluating the intercorrelations among the items of different dimensions of the test.

Table 1: Blueprint of the test (final draft)

S. No.	*Objectives→ Branches↓*	*Knowledge*	*Understanding*	*Application*	*Skills*	*Total*	*Branch %*
1	Physics	**5** (10, 22, 49, 55, 57)	**9** (1, 4, 13, 19, 25, 28, 34, 40, 60)	**5** (7, 16, 31, 43, 52)	-	**19**	31.67
2	Chemistry	**7** (11, 23, 32, 37, 38, 41, 46)	**9** (2, 8, 14, 26, 29, 44, 47, 50, 56)	**2** (5, 20)	**1** (35)	**19**	31.67
3	Biology	**8** (3, 17, 24, 27, 36, 45, 53, 59)	**9** (6, 12, 15, 30, 39, 42, 51, 54, 58)	**3** (9, 21, 33)	**2** (18.48)	**22**	36.66%
Total		**20**	**27**	**10**	**3**	**60**	100
Objective %		33.33	45	16.67	5	100	

Source: Authors (November 2023)

Data Collection Procedure

The investigators visited the selected schools and sought permission from the principals, headmasters, or headmistresses to conduct the study. The data was collected professionally, adhering to established ethical guidelines. Participants' identities were kept anonymous, and all responses were treated with strict confidentiality. The data were used solely for research purposes and reported in an aggregated form to ensure privacy and uphold ethical standards.

Statistical Techniques Used in Data Analysis

To ensure the suitability of parametric tests, the normality of the data was first assessed using a frequency polygon. Subsequently, statistical tools such as Mean, Standard Deviation (SD), Standard Error of Difference (SED), t-value, and p-value were applied to analyse and interpret the data.

Nature and Characteristics of Raw Scores

The raw scores from the SAT administered to the stratified random sample of 1,195 students represent quantitative data measured on an interval scale. Normality of the data is a key requirement for applying parametric statistical techniques. As per Hair et al. (2022), skewness and kurtosis values between "1 and +1 are considered excellent indicators of normality, while values between "2 and +2 are generally acceptable.

The skewness (0.501) and kurtosis (0.107) values of science achievement fall well within the acceptable range, confirming that the SAT scores follow a normal distribution (Table 3).

RESULTS

Hypothesis (i): There exists no significant difference in science achievement of secondary school students with respect to family type.

Interpretation

The mean SAT scores for nuclear and joint families' students are found to be 30.78 and 31.68, respectively. The calculated value of t at 0.05 level of significance (two-tailed) and 1,193 degrees of freedom is found to be 2.156, greater than the tabulated value of t, which is 1.962. So, the null hypothesis is rejected, that is, there is a significant difference in science achievement of secondary school students with respect to family type. The students of joint families have better science achievement than those of nuclear families (Table 4).

Hypothesis (ii): There exists no significant difference in science achievement of secondary school students with respect to fathers' occupations.

Interpretation

The mean SAT scores for students with fathers' occupations with unstable and stable incomes are 30.81 and 31.77, respectively. The calculated value of t at 0.05 level of significance (two-tailed) and 1,193 degrees of freedom is 2.171, higher than the tabulated value of t, which is 1.962. So, the null hypothesis is rejected' that is, a significant difference exists in the science achievement of secondary school students with respect to fathers' occupations. The students having fathers' occu-

Table 3: Descriptive statistical measures of the variable for checking the normality of the distribution of the data

Variables	*Minimum score*	*Maximum score*	*Mean*	*Standard deviation*	*Std. error (Mean)*	*Skewness*	*Kurtosis*
Science achievement	13	55	31.08	6.838	0.198	0.501	0.107

Source: Authors (November 2023)

Table 4: Mean difference of the SAT scores of students of nuclear and joint families

Family type	*N*	*Minimum score*	*Maximum score*	*Mean*	*SD*	*p-value*	*t-value*	*Remarks*
Nuclear family	796	13	54	30.78	6.985	0.031	2.156	Significant
Joint family	399	16	55	31.68	6.501			

Source: Authors (November 2023)

pations with stable incomes have better science achievement than the students having fathers' occupations with unstable incomes (Table 5).

Hypothesis (iii): There exists no significant difference in science achievement of secondary school students with respect to mothers' occupations.

Interpretation

The mean SAT scores for students with mothers' occupations with unstable and stable incomes are 31.20 and 30.32, respectively. The calculated value of t at 0.05 level of significance (two-tailed) and 1,193 degrees of freedom is 1.513, lower than the tabulated value of t, which is 1.962. So, the null hypothesis is not rejected' that is, there is no significant difference in science achievement of secondary school students with respect to mothers' occupations (Table 6).

Hypothesis (iv): There exists no significant difference in science achievement of secondary school students with respect to fathers' educational qualifications.

Interpretation

The mean scores of the SAT for students with poorly educated and highly educated fathers are 30.66 and 32.64, respectively. The calculated value of **t** at 0.05 level of significance (two-tailed) and 1,193 degrees of freedom is 4.118, much greater than the tabulated value of t, which is 1.962. So, the null hypothesis is rejected' that is, there is a significant difference in science achievement of secondary school students with respect to fathers' educational qualifications. The students who have highly educated fathers have better science achievement than the students who have poorly educated fathers (Table 7).

Hypothesis (v): There exists no significant difference in science achievement of secondary school students with respect to mothers' educational qualifications.

Interpretation

The mean scores of the SAT for students with poorly educated and highly educated mothers are 30.90 and 32.34, respectively. The calculated value of t at 0.05 level of significance (two-tailed) and 1,193 degrees of freedom is 2.408, greater than the tabulated value of t, which is 1.962. So, the null hypothesis is rejected' that is, there is a significant difference in science achievement of secondary school students with respect to mothers' educational qualifications. The students who have highly educated mothers have better science achievement than the students who have poorly educated mothers (Table 8).

DISCUSSION

The present study found a significant difference in the science achievement of students in relation to the family type. The students of joint families have higher science achievement than those of nuclear families. This may be attributed to the increased academic support, collaborative learning, and greater availability of guidance and

Table 5: Mean difference of the SAT scores of secondary school students with respect to fathers' occupations

Fathers' occupations	*N*	*Minimum score*	*Maximum score*	*Mean*	*SD*	*p-value*	*t-value*	*Remarks*
Unstable Income	863	13	54	30.81	6.793	0.030	2.171	Significant
Stable Income	331	20	55	31.77	6.923			

Source: Authors (November 2023)

Table 6: Mean difference of the SAT scores of secondary school students with respect to mothers' occupations

Mothers' occupations	*N*	*Minimum score*	*Maximum score*	*Mean*	*SD*	*p-value*	*t-value*	*Remarks*
Unstable income	1037	13	55	31.20	6.702	0.131	1.513	Insignificant
Stable income	158	16	52	30.32	7.651			

Source: Authors (November 2023)

Table 7: Mean difference of the SAT scores of secondary school students with respect to fathers' educational qualifications

Fathers' educational qualifications	*N*	*Minimum score*	*Maximum score*	*Mean*	*SD*	*p-value*	*t-value*	*Remarks*
Poorly educated	942	13	55	30.66	6.873	0.000	4.118	Significant
Highly educated	253	18	54	32.64	6.486			

Source: Authors (November 2023)

role models in joint family settings. This contradicts the results of the studies by Blake (1981), who found that students from nuclear families have higher science achievement than students from joint families. Again, the difference in science achievement between the students of nuclear and joint families is found to be non-significant by Nidhi (2015), Pooja (2017) and Raj and Komalavalli (2021). More recent evidence suggests that the relationship between family type and achievement is context-dependent, mediated by the quality of support and expectations at home. For instance, Duhon (2023) shows that parents' beliefs about children's performance strongly influence investments of time and money in learning; thus, joint families may confer advantages not only through resource pooling but also by reinforcing positive academic expectations.

The present study found a significant difference in the science achievement of secondary school students with respect to their fathers' occupations. The students having fathers' occupations with stable incomes have better science achievement than the students having fathers' occupations with unstable incomes, likely due to greater financial support, reduced household stress, and increased investment in education. This result is consistent with the results by Comber and Keeves (1973), Sirin (2005), Cherlin (2010), Pooja (2017) and Bettaswamy and Kumar (2022) that found the science achievement of students having parents with stable income is better than students having parents with unstable income. Rakesh et al. (2024) demonstrate that low socioeconomic status (SES) undermines cognitive and language development via stress and limited stimulation, while higher SES and stability buffer children by enabling richer home learning environments. In contrast, no significant difference was observed in relation to mothers' income stability, possibly because mothers, regardless of income, consistently provide emotional support, supervise studies, and manage household priorities to ensure their children's education remains unaffected. This echoes global findings that caregiving quality and involvement-rather than income stability alone-predict child outcomes (Rakesh et al. 2024).

The present study found a significant difference in the science achievement of secondary school students with respect to parents' educational qualifications. The students with highly educated parents have better science achievement than the students with poorly educated parents. This may be due to better academic support, higher expectations, access to resources, and a more stimulating learning environment provided by educated parents. This result is consistent with Comber and Keeves (1973), Simpkins et al. (2005), Hanushek and Woessmann (2008), Dubow et al. (2009), Cherlin (2010), Nidhi (2015), Pooja (2017), and Bet-

Table 8: Mean difference of the SAT scores of secondary school students with respect to mothers' educational qualifications

Mother's educational qualifications	*N*	*Minimum score*	*Maximum score*	*Mean*	*SD*	*p-value*	*t-value*	*Remarks*
Poorly educated	1046	13	55	30.90	6.855	0.016	2.408	Significant
Highly educated	149	20	49	32.34	6.602			

Source: Authors (November 2023)

taswamy and Kumar (2022), who found that science achievement of students of highly educated parents is better than poorly educated parents. However, it contradicts the result by Nithya (2018), who found no significant difference between the students' science achievements of poorly educated and highly educated parents. Besides, Maji et al. (2024) found that Indian secondary students' understanding of astronomy concepts was strongly shaped by exposure to resources and guided instruction, which are more available in educated households. Similarly, Gomez-Talal et al. (2025), analysing global PISA data, identified that access to books and higher parental education consistently predicted stronger mathematics and science performance across regions. These results suggest that parental education not only reflects socioeconomic capital but also embodies "science capital"-the ability to engage children in meaningful science discourse (Tan 2024).

Taken together, these findings underscore that family factors remain critical predictors of science achievement, but their effects are neither uniform nor static. They are mediated by expectations, resource availability, and the quality of home-based learning interactions. While joint families, stable paternal income, and higher parental education appear advantageous in the Manipur context, recent studies show that how families mobilise these resources-through science talk, fostering autonomy, or investing in learning opportunities-matters as much as the resources themselves. Future research should therefore examine not only structural family characteristics but also the micro-processes of parental belief, engagement, and science-specific socialisation that shape achievement outcomes.

CONCLUSION

The present study highlights the significant influence of family-related factors on the science achievement of secondary school students. It was found that students from joint families performed better in science than those from nuclear families, suggesting the possible advantages of shared responsibilities, support systems, and collaborative learning environments often present in joint family settings.

The occupations of the fathers, particularly the stability of incomes associated with them, were also found to significantly impact students' science achievement. A stable income appears to provide better access to learning resources, educational support, and a conducive study environment.

In addition, parents' educational qualification emerged as a strong predictor of science achievement. Students whose parents were highly educated consistently demonstrated higher levels of science achievement, indicating that educational background likely contributes to a more supportive academic environment at home and greater awareness of educational opportunities.

In summary, the findings emphasise that the type of family, parents' occupations, educational qualification, and economic stability play crucial roles in shaping students' science achievement. Educational policies and interventions to improve student achievement should consider these familial factors and work toward enhancing parental involvement and awareness to create a more equitable and supportive learning environment.

RECOMMENDATIONS

Based on the present study's findings, several important recommendations can be made. First, it is essential to promote parental awareness regarding their role in the academic development of their children, especially in science. Schools and educational authorities should organise awareness programs and workshops to guide parents, particularly those with lower educational qualifications, on how to support their children's learning at home. Secondly, schools should encourage greater family involvement in the learning process through regular communication, parent-teacher meetings, and home-based learning activities. Special attention should also be given to students from nuclear families, who may lack the broader support systems found in joint families, and this could be addressed through mentoring and peer-support programs. Additionally, efforts must be made to address the economic disparities affecting students' achievement by providing financial support, scholarships, and access to free or subsidised learning materials to students from economically unstable households. Lastly, educational interventions should be tailored to students' family backgrounds, ensuring that those with poor parental education or income instability receive the necessary academic and emotional support to succeed.

SUGGESTIONS FOR FURTHER STUDY

Future studies may consider several directions to enhance the understanding of how family-related factors influence science achievement. It is suggested that future research include larger and more demographically diverse samples across different regions and educational boards to improve the generalisability of the findings. Longitudinal studies would also be beneficial in tracing the long-term impact of family variables on academic achievement. Moreover, future investigations could incorporate additional family-related variables such as parental involvement, family income level, home learning environment, and number of siblings, which may also significantly affect science achievement. Comparative studies exploring differences between urban and rural students or between students in private and government schools could provide further insights into context-specific influences. Lastly, qualitative approaches such as interviews, focus groups, and case studies may be employed to gain a more nuanced understanding of how family dynamics and lived experiences shape students' science achievement.

LIMITATIONS AND GENERALIS ABILITY

While the findings across all hypotheses reveal statistically significant differences in science achievement based on factors such as family type, parents' occupation and educational qualifications, several limitations must be acknowledged. Firstly, in many cases, the actual mean differences are relatively small, indicating limited practical significance despite statistical significance. This suggests that while differences exist, their impact on real-world educational outcomes may be modest.

Secondly, the categorisation of variables such as "stable/unstable income" and "poorly/highly educated" is broad and lacks the granularity needed to capture the full scope of their influence. Nuanced classifications based on exact income levels, educational stages, or occupational roles would provide deeper insights. Additionally, unequal group sizes may limit the robustness of statistical comparisons and reduce generalisability.

Thirdly, the study does not control for confounding variables like socioeconomic status, parental involvement, household resources, cultural expectations, or school quality. These unaccounted factors may influence academic achievement and mediate or moderate the observed relationships. The absence of multivariate analysis limits the ability to draw causal inferences.

Finally, the context-specific nature of the sample, likely tied to a specific region, school system, or socio-cultural setting, restricts the generalisability of the findings. Results may not extend to students from different geographic, institutional, or demographic contexts. To enhance validity and applicability, future research should adopt diverse, representative samples, implement detailed variable categorisation, and consider multivariate statistical techniques to better understand the complex interplay between demographic factors and academic achievement.

AUTHORS' CONTRIBUTION

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

CONFLICT OF INTERESTS

The authors declare no conflict of interest.

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