

A STUDY OF ACHIEVEMENT IN MATHEMATICS IN RELATION TO MEDIUM OF INSTRUCTION AND MATHEMATICS ANXIETY OF 8TH GRADE STUDENTS OF HIMACHAL PRADESH

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ABSTRACT

This study examines the relationship between Achievement in Mathematics, Medium of Instruction and Mathematics Anxiety among 8th-grade students in District, Hamirpur, Himachal Pradesh. The primary objective is to explore how Mathematics Anxiety and Medium of Instruction, especially English and Hindi, impact Achievement in Mathematics. A sample of 162, 8th-grade students from various schools in Himachal Pradesh was selected. Data were collected using standardized mathematics achievement tests and a validated Mathematics Anxiety questionnaire. Contrary to common expectations, the findings reveal that students with higher levels of Mathematics Anxiety achieved higher scores. Furthermore, students taught in English medium outperformed their Hindi medium counterparts. These results suggest that while Mathematics Anxiety is generally perceived as detrimental, it may also drive certain students to achieve better results. Additionally, the Medium of Instruction plays a crucial role in shaping mathematics achievements, with English medium instruction providing a notable advantage in Achievement in Mathematics. The study concludes that educational strategies should consider both the Medium of Instruction and the complex role of Mathematics Anxiety in learning to enhance student Achievement in Mathematics.

Keywords: *Achievement in Mathematics, Medium of Instruction and Mathematics Anxiety.*

Introduction

Mathematics achievement is widely recognized as a cornerstone of academic success and a predictor of future professional opportunities. The educational value of mathematics lies in its capacity to encourage critical thinking, improve problem-solving proficiency, and support logical reasoning, making it an essential subject for developing vital life skills. However, students' performance in mathematics is influenced by a range of factors, among which the Medium of Instruction and Mathematics Anxiety are particularly significant. Understanding how these factors interact is crucial, especially in multilingual and multicultural contexts like Himachal Pradesh, India. The Medium of Instruction, defined as the language used to teach academic subjects, plays a crucial role in students' learning experiences and outcomes. It not only affects comprehension but also optimizes cognitive load (Launio, 2015). Research has consistently shown that students tend to perform better academically when taught in their first language, as it allows for better cognitive performance (Yip et al., 2003). This is particularly relevant in the context of mathematics, where the language of instruction can influence the way students grasp complex concepts and solve problems. In India, and specifically in Himachal Pradesh, the educational landscape is characterized by the use of both Hindi and English as mediums of instruction. This dual-language system presents unique challenges and opportunities for students. On the other hand, students who are more proficient in Hindi may struggle with English-medium instruction, which can hinder their comprehension and lead to lower academic achievement. The impact of the Medium of Instruction on

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mathematics achievement is a topic of growing interest, particularly in regions like Himachal Pradesh, where educational policies and practices must cater to a linguistically diverse student population. In addition to the Medium of Instruction, Mathematics Anxiety is another critical factor that significantly influences students' Achievement in Mathematics. Mathematics Anxiety is defined as a feeling of tension, apprehension, or fear that interferes with mathematical performance (Ashcraft & Moore, 2009). It is a widespread phenomenon that affects students across different age groups, genders, and cultural backgrounds, often leading to avoidance of mathematics-related tasks and a negative attitude towards the subject (Ashcraft & Krause, 2007). The consequences of Mathematics Anxiety can be far-reaching, impacting not only academic performance but also students' future educational and career choices (Dowker, Sarkar, & Looi, 2016).

Research has established a strong negative correlation between Mathematics Anxiety and mathematics achievement, with higher levels of anxiety being associated with lower performance (Hembree, 1990). This relationship is particularly concerning for 8th-grade students, who are at a critical stage in their education. At this level, students are expected to solidify their understanding of foundational mathematical concepts that will be crucial for their success in higher education and beyond. Addressing Mathematics Anxiety during this stage is essential to prevent long-term academic difficulties and to ensure that students are not deterred from pursuing mathematics-related fields in the future. The district Hamirpur in Himachal Pradesh provides a compelling context for studying the interplay between the Medium of Instruction, Mathematics Anxiety and Achievement in Mathematics. Hamirpur is known for its high literacy rate and strong educational infrastructure, which makes it an ideal setting for exploring these issues (Government of Himachal Pradesh, 2021). Despite the district's educational advantages, students in Hamirpur still face challenges related to language proficiency and anxiety, which can impact their performance in mathematics. Understanding how these factors interact can provide valuable insights into the specific needs of students in this region and inform targeted interventions to improve educational outcomes.

Review of Literature

Yip et al. (2003) explored that instruction in native-language led to better performance, reinforcing the cognitive benefits of studying in one's mother tongue.

Zakaria et al. (2012) indicated a substantial inverse correlation between mathematics achievement and Mathematics Anxiety. In addition to this the study indicated that students receiving instruction in a non-native language experienced higher Mathematics Anxiety, which adversely affected their mathematics achievement.

Singh and Imam (2013) discovered that students taught in their native language did better than those taught in a second language, showing the importance of linguistic familiarity in academic success.

Launio (2015) demonstrated that students who were taught in their mother tongue had considerably greater achievements than students who were taught in a second language. This indicates that learning in one's first language optimizes understanding and cognitive load.

Tok (2015) revealed that creative teaching methods substantially alleviated Mathematics Anxiety and improved academic achievement.

Sad et al. (2016) conducted a meta-analysis and revealed a consistent negative correlation between Mathematics Anxiety and mathematics achievement across various studies. Moreover, they found that the Medium of Instruction influenced the extent of Mathematics Anxiety in which non-native Medium of Instruction leads to heightened Mathematics Anxiety and lower mathematics achievement.

Maramag-Manalastas and Batang (2018) revealed that students who were taught using multiple languages had greater Achievement in Mathematics, suggesting that when students are comfortable and understand the language(s) used for teaching can significantly impact their learning outcomes.

Guita and Tan (2018) found that there was inverse relation between high levels of Mathematics Anxiety and students' academic achievement. Furthermore, they emphasized that, the Medium of Instruction could exacerbate or mitigate anxiety, depending on how comfortable students are with the language of instruction.

Research Gap

Despite significant findings in existing literature regarding the relationship between the Medium of Instruction, Mathematics Anxiety, and Achievement in Mathematics, several research gaps remain.

Previous studies, such as those by Yip et al. (2003), Zakaria et al. (2012), Singh & Imam (2013) and Launio (2015), have consistently highlighted the cognitive benefits and improved academic outcomes associated with native-language instruction. These studies suggest that linguistic familiarity plays a crucial role in optimizing comprehension and reducing cognitive load. Moreover, the relationship between Mathematics Anxiety and academic performance has been well-documented by researchers like Tok (2015), Sad et al. (2016), and Guita and Tan (2018). These studies reveal a significant negative correlation between Mathematics Anxiety and achievement, particularly when instruction is delivered in a non-native language. Maramag-Manalastas and Batang (2018) further emphasize the advantages of multilingual approaches, suggesting that students' comfort with the language of instruction can significantly impact their learning outcomes.

Need and Significance of the Study

Mathematics is a cornerstone of education, influencing cognitive development and future opportunities. However, factors such as the Medium of Instruction can significantly impact student achievement (**Guita and Tan, 2018**). In a linguistically diverse state like Himachal Pradesh, where students are exposed to different languages at home and in school, understanding the impact of the Medium of Instruction on Achievement in Mathematics is vital. Moreover, the role of Mathematics Anxiety as a potential barrier to learning cannot be overlooked (Ashcraft & Ridley, 2005). This study aims to explore the relationship between the Medium of Instruction and Mathematics Anxiety and how these factors influence Achievement in Mathematics among 8th-grade students in Hamirpur, Himachal Pradesh. The findings of this study are expected to contribute to the broader discourse on educational equity, particularly in multilingual contexts. By identifying the impact of Medium of Instruction and Mathematics Anxiety on Achievement in Mathematics, this research has the potential to influence the development of more effective educational policies and interventions. These policies and interventions would aim to ensure that all students, regardless of their Medium of Instruction or level of Mathematics Anxiety, have the opportunity to excel in mathematics.

Problem Statement

A study of Achievement in Mathematics in relation to Medium of Instruction and Mathematics Anxiety of 8th grade students of Himachal Pradesh

Objectives of the Study

- To investigate the main and interaction effects of Medium of Instruction and Mathematics Anxiety on Achievement in Mathematics among 8th-grade students.

Hypotheses of the Study

- There is no significant influence of Mathematics Anxiety on Achievement in Mathematics of 8th-grade students.
- There is no significant influence of Medium of Instruction on Achievement in Mathematics of 8th grade students.
- There is no significant interaction effect of Mathematics Anxiety and Medium of Instruction on Achievement in Mathematics of 8th-grade students.

Limitations

The study was confined to class 8th students from government schools in Hamirpur district, Himachal Pradesh.

Methodology of the Study

- **Research Method Employed:** The researchers opted for a descriptive survey method to efficiently gather quantitative data on both Mathematics Anxiety and Achievement in Mathematics from a sample of eighth-grade students. This methodological approach enabled to investigate into the interaction between these factors and pinpointing of potential areas for intervention to improve student outcomes in mathematics subject.
- **Population of the Study:** The target population for this study comprises all eighth-grade students enrolled in government schools within Hamirpur district, Himachal Pradesh.
- **Sample of the Study:** A random sample of 162 eighth-grade students was selected from Nadaun Block, Hamirpur district, Himachal Pradesh. The sample comprised 82 Hindi medium and 80 English medium students.

Variables of the Study

- **Dependent Variable:** Achievement in Mathematics
- **Independent Variable:** Medium of Instruction and Mathematics Anxiety

Operational Definitions of the Keywords

- **Medium of Instructions:** It is defined as the Hindi and English language used to teach mathematics subject in schools.
- **Mathematics Anxiety:** It is described as a condition of extreme fear and intense nervousness that hampered a student's ability to solve mathematics problems.
- **Achievement in Mathematics:** It is defined as the result of 8th grade students' performance on a standardized test of mathematics achievement, which indicates how well they grasp the concepts involved in mathematics.

Tools Used

- **Achievement Test in Mathematics:** A 26-item mathematics achievement test was developed to align with the FA-1 syllabus of the 8th-grade NCERT textbook. The test underwent rigorous development and validation. Content validity was established through expert review, and item analysis was conducted on a pilot sample of 35 students. The final test demonstrated high reliability, with a test-retest reliability coefficient of 0.96 and a Cronbach's alpha of 0.79, indicating strong internal consistency.
- **Mathematical Anxiety Scale:** The Mathematical Anxiety Scale, developed by Mahmood and Khaton (2012), is a well-established measure of Mathematics Anxiety. The scale has demonstrated strong psychometric properties, including high internal consistency (Cronbach's alpha = 0.87) and evidence of accuracy in measuring the intended construct (concurrent validity).

Statistical Techniques Used: Mean, standard deviation (SD) and two-way ANOVA.

Analysis and Interpretation of Results:

Table 1: Summary table for two-way ANOVA of Achievement in Mathematics of 8th Grade Students

Source of Variation	Sum of Squares	Df	Mean Square	F-values	Remark
Mathematics Anxiety (A)	323.88	2	161.94	3.97	P < 0.05
Medium (B)	170.56	1	170.56	4.18	P < 0.05
AXB	62.85	2	31.43	0.77	P > 0.05
Error	6365.31	156	40.80		
Total	46439.00	162			
Corrected Total	7020.92	161			

Main Effects

Mathematics Anxiety (A)

From Table 1, the F-value of 3.97 for the main effect of Mathematics Anxiety on Achievement in Mathematics among 8th-grade students is significant at the 0.05 level with degrees of freedom (df) of 2 and 161. This result leads to the rejection of the null hypothesis, which posits that "There is no significant influence of Mathematics Anxiety on Achievement in Mathematics of 8th-grade students." The data indicates that students with high Mathematics Anxiety have a mean achievement score of 17.16, and those with average Mathematics Anxiety have a mean score of 16.15. Both groups perform significantly better than students with low Mathematics Anxiety, whose mean achievement score is 11.73. This suggests that higher levels of Mathematics Anxiety are associated with better Achievement in Mathematics. In order to know which level of Mathematics Anxiety had significantly higher mean score of Achievement in Mathematics, the data were further analysed with the help of Tukey HSD Test and the results are given in Table 1.

Table 2 Tukey HSD Test Results for Differences for Achievement in Mathematics Scores by Mathematics Anxiety Levels

Comparison	Mean Difference	Standard Error	p-value	Significance
Low Anxiety vs. Average Anxiety	4.42	1.39	p<0.01	Significant
Low Anxiety vs. High Anxiety	5.43	1.79	p<0.01	Significant
Average Anxiety vs. High Anxiety	1.01	1.41	0.76>0.05	Not Significant

Based on Table 2, the Tukey HSD test reveals significant differences in mathematics achievement between students with high and low Mathematics Anxiety (mean difference = 5.43, $p < 0.01$) and between those with average and low Mathematics Anxiety (mean difference = 4.42, $p < 0.01$). However, there is no significant difference between students with high and average Mathematics Anxiety (mean difference = 1.01, $p = 0.76 > 0.01$). These results suggest that, higher levels of Mathematics Anxiety are associated with higher Achievement in Mathematics, while lower levels of anxiety correlate with lower achievement. The most significant improvement in achievement is observed when moving from low anxiety to high anxiety. As shown in Figure 1.

Figure 1: Depicting Mean Scores of Achievement in Mathematics Differentiated by Levels of Mathematics Anxiety

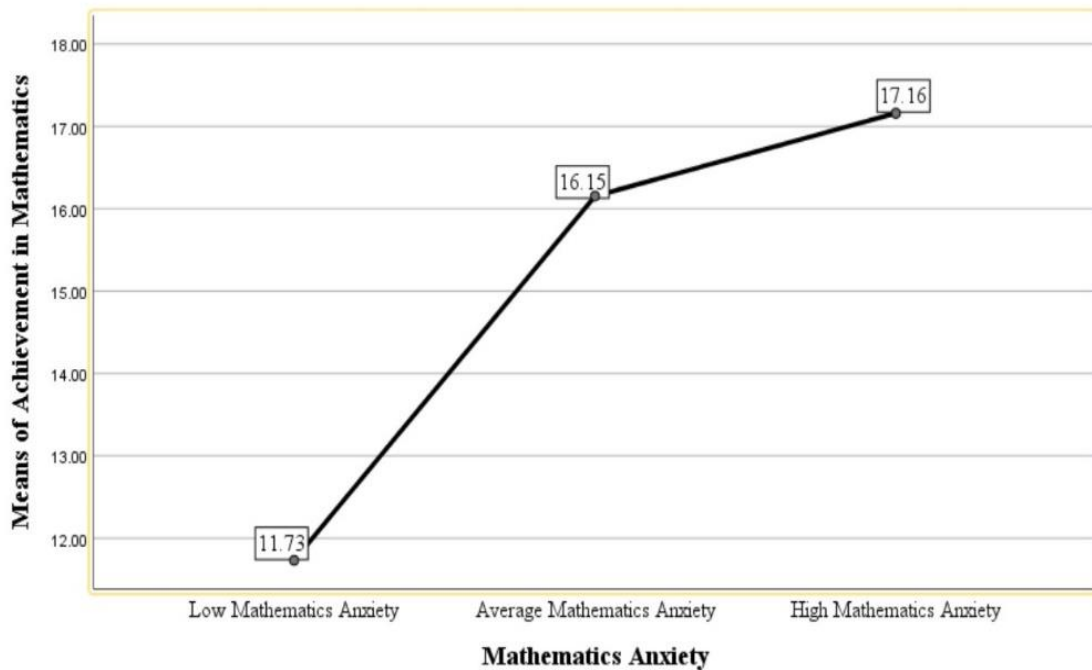


Figure 1 shows that students with high Mathematics Anxiety generally achieve higher scores compared to those with low anxiety, challenging the common belief that anxiety negatively impacts performance. The most notable improvement occurs between low and average anxiety levels, suggesting moderate anxiety might enhance performance through increased arousal and motivation. However, the increase from average to high anxiety is smaller, indicating a plateau effect where very high anxiety does not significantly boost performance beyond moderate levels. Overall, the results reveal that low anxiety is linked to lower achievement, while average and high anxiety levels have similar impacts on mathematics performance, highlighting the complex relationship between anxiety and academic achievement.

Medium of Instruction (B)

From Table 1, the F-value of 4.18 for the main effect of Medium of Instruction on Achievement in Mathematics among 8th-grade students is significant at the 0.05 level with degrees of freedom (df) of 1 and 161. This result leads to the rejection of the null hypothesis, which posits that "There is no significant influence of Medium of Instruction on Achievement in Mathematics of 8th-grade students." The analysis shows that students instructed in the English medium have a mean achievement score of 16.68, which is significantly higher than the mean score of 14.55 for students instructed in the Hindi medium. This indicates that the Medium of Instruction has a notable impact on students' mathematics achievement, with English medium instruction being more beneficial as shown in Figure 2.

Figure 2: Depicting Mean Scores of Achievement in Mathematics Differentiated by Medium of Instruction

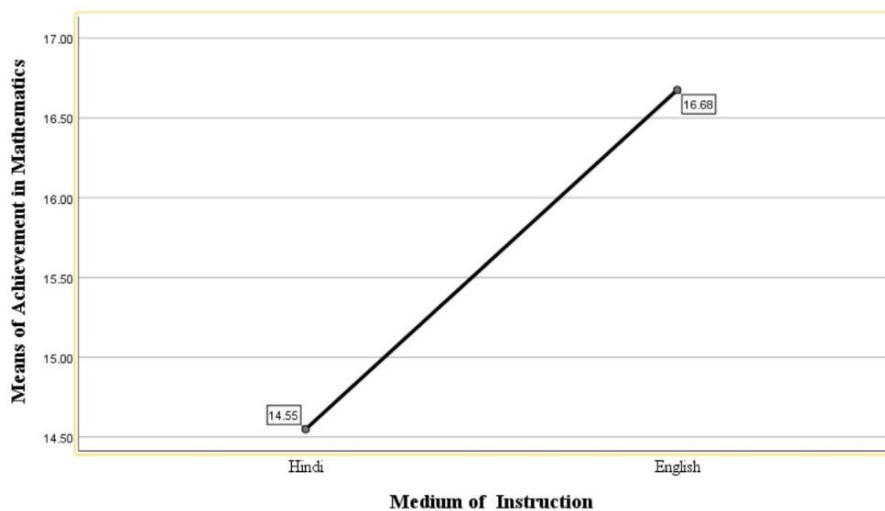


Figure 2 shows a significant difference in Achievement in Mathematics based on the Medium of Instruction. Students taught in English medium consistently outperform their Hindi medium counterparts. This disparity suggests that the Medium of Instruction may impact Achievement in Mathematics. This result highlights the importance of considering the Medium of Instruction in educational policies to enhance math outcomes.

Interactional Effect

From Table 1, the F-value of 0.77 for the interaction effect of Mathematics Anxiety and Medium of Instruction on Achievement in Mathematics among 8th-grade students is not significant at the 0.05 level with degrees of freedom (df) of 1 and 161. Therefore, the null hypothesis stating that "There is no interaction effect of Mathematics Anxiety and Medium of Instruction on Achievement in Mathematics of 8th-grade students" is not rejected. This indicates that, the relationship between Mathematics Anxiety and mathematics achievement is consistent regardless of whether the students are taught in Hindi or English.

Conclusion of the Results

The findings indicate that students with higher Mathematics Anxiety achieved higher scores, which contrasts with studies by Tok (2015), Sad et al. (2016), and Guita and Tan (2018), who found a negative correlation between math anxiety and academic performance. Additionally, English-medium students outperformed their Hindi-medium peers, opposing the conclusions of Yip et al. (2003), Zakaria et al. (2012), Singh and Imam (2013), and Launio (2015), who emphasized the cognitive benefits and academic advantages of native-language instruction. Moreover, the relationship between Mathematics Anxiety and mathematics achievement is consistent regardless of whether the students are taught in Hindi or English.

Educational Implications

The findings of this study have significant educational implications. Firstly, the positive relationship between higher levels of Mathematics Anxiety and better achievement suggests that a certain degree of anxiety may motivate students to perform better. Educators should consider this when developing interventions for Mathematics Anxiety, aiming to manage it rather than eliminate it entirely. Secondly, the significant impact of the Medium of Instruction on mathematics achievement highlights the importance of language in education. Students taught in English achieved higher scores than those taught in Hindi, suggesting that English medium instruction may provide an advantage in mathematics performance. This underscores the need for policymakers and educators to ensure that students have adequate support in their Medium of Instruction, particularly in contexts where multiple languages are used. Finally, the lack of a significant interaction effect between Mathematics Anxiety and Medium of Instruction indicates that the strategies for managing Mathematics Anxiety and optimizing instruction can be applied universally, regardless of the language of instruction.

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