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Examining the association Between Teachers' Mathematics Attitudes and Students' Achievement in Mathematics

Gannoju Nagamani
Connected to Department of Education, Osmania University, Hyderabad, Telangana State, India

Ananthula Raghu
Department of Education (CIE), University of Delhi, Delhi, India-110007.
raghu.education@gmail.com

Abstract

This study aims to determine the relationship between the attitude of mathematics subject teachers in secondary school and the academic achievement in mathematics of their students. Since factors pertaining to the teacher have a major effect on student achievement, it is imperative to understand further the attitude of the mathematics subject teacher in secondary school in terms of its effect on student achievement in mathematics in secondary school. To answer this problem, a non-experimental research method was adopted in this study, whereby a total of 50 mathematics subject teachers and 300 students from rural and urban areas in Telangana state are addressed as the sample in this study. Teachers' Attitude Survey Scale was the tool in this study to determine the attitude of the mathematics subject teachers in secondary school in terms of their self-confidence, motivation, and commitment in teaching mathematics in secondary school, as measured by the achievement of students in mathematics in school through the marks obtained by the students from Summative Assessment II in mathematics in school.

On analyzing the data, teachers had an average moderately to very positive attitude towards teaching math, and confidence while in the class was the most important factor among all the factors considered for the study. Coming to student performance, close to 43% teachers had students classified as moderate performers ranging from 57 to 78%. Further, correlation was conducted and proved that teachers' attitudes had a positive correlation with student performance, i.e., teachers being more confident in class had good-performing students as well. It is important to ensure that teachers have a much more positive attitude and that changes are made to improve student performance. Some recommendations include attitude change and innovative teaching strategies for teachers mainly for math teachers.

Keywords: Teachers' Attitudes, Mathematics Achievement, Secondary School Students, Quantitative Research

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Introduction

Mathematics plays an important role in the development of students' logical reasoning and problem-solving skill (Kilpatrick et al., 2001). Despite its importance, many students experience difficulties in mathematics, resulting in consistently low levels of academic achievement in several central role educational contexts(Hiebert & Grouws, 2007) . Numerous factors have been identified as influencing students' performance, including teacher related variables. Among these, teachers' attitudes towards mathematics which reflect their beliefs, confidence, and perceptions of mathematics are believed to have a significant effect on the classroom climate and on students' learning (Philipp, 2007). While the influence of teacher attitudes is widely acknowledged, limited empirical attention has been directed toward examining the extent to which teachers' mathematics attitudes are associated with students' academic achievement. Further research is needed to explore the relationship between teachers' mathematics attitudes and students' academic achievement. Therefore, the present study seeks to examine the relationship between teachers' mathematics attitudes and students' achievement in mathematics

Recent studies have demonstrated that teachers' attitudes towards mathematics influence student performance and classroom behaviors(Evans & Field, 2020),(Ober et al., 2021). Researchers have found that mathematics educators with more positive attitudes toward teaching the subject have students who are more engaged and perform better in mathematics than those with neutral or negative feelings toward mathematics(Uwitonze & Andala, 2024). In addition, researchers have conducted systematic investigations of affective variables as they relate to how well students learn math by understanding the way teachers act and the way teachers implement instructional strategies that enhance their students' success in mathematics (Wen & Dubé, 2022). These findings shows that the relationship between teachers' mathematics attitude and their students' achievement in mathematics should be considered when examining the performance of students in mathematics.

The importance of the relationship between teachers' attitudes and students' achievement has already been emphasized by Brady (2020), who conducted a meta-analysis of studies which reported positive relationship between them. The results of this meta-analysis indicated that teachers' attitudes are associated with the teaching so that it correlates to student success. The findings of AlAbdulaiz(2023) regarding mathematics teaching in Saudi Arabia were based on an analysis of 2019 TIMSS. According to that, high job satisfaction and positive attitudes toward mathematics teaching were shown to be positively associated with higher levels of student achievement within the study. Moreover, it was determined that maths teachers who are motivated and confident to carry out effective teaching strategies will positively affect how well students learn.

Zhao & He (2024) conducted a study in which they analyzed findings of the international OECD TALIS survey carried out in 38 countries in 2018 and revealed that confident and highly satisfied math educators are more inclined to use 'higher-order teaching. Eklöf et al. in a comparative study based on the PISA report found measurable outcomes such as "teacher passion" and "teaching quality," among others. They emphasized the need to have a good learning environment for the students to achieve well in mathematics. According to another

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report in Ghana, the effectiveness of the teacher in managing the classroom had a positive effect on the students' performance in mathematics. It also noted the serious effects of the teachers not being trained.

Yeung et al. (2023), using the PISA data, found that the performance of the students was higher when the teachers invested their emotions in building the relationship that enhance student engagement and motivation. Such findings indicated that emotional investment by the teacher has a significant influence on students' motivation towards the mathematics. Putwain et al. (2020) highlighted the significance of the emotions exhibited by the teachers and the quality of teacher-student relationship in learning processes particularly enjoyment of the teachers while teaching mathematics.

Research Questions

1. What are the attitudes of secondary school mathematics teachers towards the mathematics teaching?
2. What is the level of achievement of secondary school students in mathematics?
3. Is there a significant correlation between teachers' attitudes towards mathematics and secondary school students' achievement in the subject?

Objectives of the study

1. To determine the attitudes of secondary school mathematics teachers towards mathematics.
2. To assess students' achievements in mathematics at the secondary level.
3. To identify the correlation between mathematics teachers' attitudes and students' mathematics achievements.

Methodology

This research used a non-experimental quantitative design, specifically the descriptive-correlational method, as the data involved naturally occurring variables without manipulation (Belli, 2008; Gehle, 2013). The study aimed to explore the correlation between secondary school mathematics teachers' attitudes and their students' academic performance in mathematics. Data were collected from 50 mathematics teachers in government and private secondary schools across rural and urban areas of Telangana State. Additionally, 300 secondary school students taught by these teachers were selected through random sampling to assess their performance in mathematics.

The Teacher Attitude Survey developed by Race (2001) was adopted to measure the attitude of secondary school mathematics teachers. The tool originally had 49 Likert-scale questions, though it was modified to 30 questions to ensure it was more applicable to the larger target group. In addition to this, questions forming the entire tool had to be modified to suit the context of our study group. All questions in the tool were rated using a Likert scale from 1 to 5, strongly disagree to strongly agree respectively, to determine how positive or negative an attitude was. The modified tool has mainly four constructs, which are Confidence of a

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Teacher in Teaching (TC), Inquiry-Based Instructional Strategy (IIS), Traditional Approaches to Pedagogy (TAP), and the Use of Information Communication Technology in mathematics teaching.

The modified scale showed very strong internal consistency, indicating good reliability, with a Cronbach's alpha of 0.90. To interpret the results, the mean score for each participant was calculated. Scores that ranged from 4.20 to 5.00 showed very strong attitudes, meaning these attitudes were always present. Scores ranging from 3.40 to 4.19 indicated strong attitude, meaning such attitude was often present. Scores ranging from 2.60 to 3.39 represented moderate attitude, indicating such attitude sometimes appeared. A score ranging from 1.80 to 2.59 indicated low attitude, meaning that attitude rarely appeared. Scores ranging between 1.00 and 1.79 depicted very low attitudes, indicating that such attitude were never present.

The achievement in Mathematics was measured using scores attained in the SA-II examinations. The students were classified into four grades on the basis of their performance in Mathematics using the grading system of SCERT Telangana State. The students who attained scores between 79 and 100 were classified as A-grade performance or high achievement. The students who attained scores between 57 and 78 were classified as B-grade performance or average achievement. The students who attained scores between 35 and 56 were classified as C-grade performance or basic achievement. The students who attained scores between 0 and 34 were classified as D-grade performance or low Achievement.

It enabled a standardized method of evaluating students, measuring student performance in Mathematics. It provided an effective method to explore links with other factors like attitudes of teachers and teaching methods. After seeking consent from the students as well as the school authorities regarding the participation of teachers and students in the research, the participants were individually solicited. They were briefed about the research study, including complete confidentiality and anonymity. Booklets were also utilized as an information-gathering medium from the teachers. These were varied, allowing teachers to convey personal attitudes and opinions regarding the teaching of Mathematics as a subject. Similarly, basic demographic information, including the final test scores in Mathematics corresponding to class IX (SA II), were sought from the students. It was also verified through other examination reports maintained by the teachers or school authorities. To interpret the findings accurately, the collected data were analyzed using the Statistical Package for the Social Sciences (SPSS). Various statistical methods, including mean, standard deviation, and correlation, were applied.

Results and Analysis

Result-1: Teachers' Attitude towards Mathematics

The attitudes of secondary school Mathematics teachers towards teaching were identified by analyzing their responses on four key dimensions. The mean score and standard deviation were calculated based on the expressed attitudes. The findings are shown in Table 1.

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Table 1: Attitude of Teachers towards Mathematics

Sr. no	Dimension	SD	Mean	Remarks
1	Teachers' understanding of confidence in the classroom (TC)	0.61	4.48	Very High
2	Inquiry-based Instructional strategies (IIS)	0.45	4.01	High
3	Traditional approaches of teaching pedagogy (TAP)	0.59	4.0	High
4	Usage of computer and technology in the classroom teaching (ICT)	1.00	3.01	Moderate
5	Overall	0.46	3.89	High

As revealed from Table 1, teachers are quite confident in teaching mathematics, the mean is 4.48 with an SD of 0.61. This reflects their self-confidence and views combined with consistent efforts. Teachers make good use of inquiry-based learning methods both in the classroom, with a mean of 4.01 and an SD of 0.45, and traditional learning methods, with a mean of 4.00 and an SD of 0.59. This reflects that they effectively use innovative and traditional teaching methods. However, the use of ICT is moderate, with a mean of 3.01 and an SD of 1.00. This implies that some teachers make effective use of and integrate ICT into their teaching, while others do not or perhaps have no access to it. In general, teachers view their teaching activities quite positively, with a mean of 3.89 and an SD of 0.46. This means that there is good consistency and positivity in their approach. Yet, the moderate use of ICT indicates further development based on support and training.

Result-2: Students' Mathematics Achievement

Academic achievement is defined as the skills or knowledge gained through a study process under an education setup. In this study, the mathematics achievement of the students was evaluated according to their examination result (SA-II). In order to assess the achievement level, following the suggestions of SCERT, Telengana, students were divided into four grades based on their examination marks, i.e., those whose marks lie between 79-100 fall under Grade A (high achievers), those whose exam marks lie between 57-78 fall under Grade B (above average achievers), those whose exam marks lie between 35-56 fall under Grade C (basic students), and those whose exam marks are lower than 35 fall under Grade D (fail students). By doing so, the frequency of the students under each class has been computed as shown in Table 2.

Table 2 : Achievement In Mathematics Of Students

Sr. No.	Grade/Marks	Frequencies	Percentage	Result	Level of Achievement
1	A (79-100 marks)	68	22.6 %	Pass 85%	High level
2	B (57-78 marks)	129	43 %		Average level
3	C (35-56 marks)	58	19.4 %		Low level
4	D (0-34 marks)	45	15 %	Fail 15%	Very low level

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Looking at the academic performance among students with regard to mathematics, our major focus was based on how their performance was evaluated based on the final examination score (SA-II). This was based on the rules provided by SCERT, Telangana. As shown in Table 2, among the 300 students, 68 students had an A grade, and each student's scores ranged from 79 to 100. Looking at the students' performance, 129 had B grade performance, and scores ranged from 57 to 78. Further, among the same number of students, 58 (that is, 4 percent) had grade C, and the score ranged from 35 to 56, which is basically considered very low performance among the student populace at large. Further, among these students, 45 (that is, 5 percent) had very high scores lower than 35, and each student was classified as D grade, which is considered to be failed performance among the student populace as regards mathematics performance among the same student populace, where 85 percent passed and 15 percent failed mathematics.

Result-3: Relationship Between Teachers' Attitudes Toward Mathematics and Students' Achievement in Mathematics

In order to examine the relationship between the attitude of secondary school teachers towards mathematics and their students' performance in mathematics, a null hypothesis was developed in the following form:

H0 – There is no significant relationship between factors of mathematics held by secondary school teachers and their students' performance in mathematics.

Pearson Correlation Test was applied in order to examine this hypothesis regarding scores of various aspects of mathematics held by secondary school teachers and their students' performance in mathematics; however, results of this test are presented in table 3.

Table 3: Correlation between Teachers' Attitudes toward Mathematics and Students' Achievement in Mathematics

Variables	TC - Teachers' understanding of Confidence in the classroom	IIS - Inquiry based Instructional Strategies)	TAP - Teaching approaches and Pedagogy	ICT - usage of computer of technology in teaching	ALL (Overall Attitude Score)
AM (Achievement in Mathematics)	0.989**	0.358**	0.943**	0.348**	0.381**

***Significant at 0.01 level*

As can be seen from Table 3 below, a statistically significant positive relationship exists with all the aspects of a teacher's attitude towards mathematics with the students' performance in the subject. Also worthy of note is the fact that all the values of the correlation coefficient are highly significant. That is, the confidence level is 0.01. Thus, the relationships are not incidental or on a fleeting basis. As can be deduced from the table below, the highest value of the positive correlation coefficient among the two sets of variables is the coefficient

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between the variable Teacher Confidence (TC) and the variable Attitude towards Mathematics (AM) with a value of r is 0.989.

Similarly, the positive correlation between the Teaching Approaches and Pedagogy (TAP) factor and student achievement was high. This result confirmed that the correlation between Adopting Innovative Practices in Pedagogy (AIPP) and student achievement was very high with 'r' value 0.943. Meaning that when varied student-friendly strategies are used in class by the teacher, the outcome for the student will be positively affected. Inquiry-Based Instructional Strategies (IIS) achieved a moderate correlation, where 'r' value is 0.358 between the factor and the student achievement. This means that when the students get to inquire or ask questions through the strategies used by the teacher, the student achieves to some extent in math class.

The role of Information and Communication Technology (ICT) in math learning has a positive correlation, where 'r' value is 0.348, indicating that this factor could play a role in improving student achievement, perhaps more so in a manner that could be influenced through better understanding in the learning process. Lastly, a measure of the overall attitude of teaching faculty, referred to as ALL, was related, 'r' value is 0.381, as a medium positive correlation, indicating a significant role of teacher attitude in student success.

Discussion

The outcomes of this research emphasize the importance of teachers' opinion and attitudes, as well as the methods that instructors employ, regarding their influence on student performance in math class. Teachers were also confident (M = 4.48, SD = 0.61) and had a positive attitude (M = 3.89, SD = 0.46) when it comes to teaching math. These outcomes match other researchers, including Ernest (1989) and Hattie (2009). They revealed that there is a correlation between teachers' self-assurance, good attitudes, and good teaching methods. Teachers applied mixed methods namely, the method of inquiry (M = 4.01, SD = 0.45) along with traditional instruction (M = 4.00, SD = 0.59) when educating students. Mixed instruction plays a crucial part in improving not just conceptual but also procedural skills (Boaler, 2002; Zhao & He, 2024). However, teachers also showed a mediocre and inconsistent use of ICT (M = 3.01, SD = 1.00). It shows that there seems to be no equity between access to, as well as readiness levels in, information technology, a problem faced in different nations, whether developed (Selwyn, 2016) or developing (Alabdulaziz, 2023).

The results indicated achievement scores revealing high pass rates in which 85% of those assessed pass while 15% failed to accomplish their goals in class. Moreover, worth pointing out in this case are findings of 22.6% achieving grade A (high), 43% achieving grade B (medium), while 19.4% achieved grade C (low). As a result of diversity in achievement scores, teaching ought to be conducted at various levels to cater to diverse learning requirements as mostly indicated in equity studies. (Darling-Hammond, 2000)

Statistical correlations are consistently showing the frequent importance of teacher variables. Furthermore, the high correlation between teacher confidence levels and student achievement (r = 0.989) explains how students in more confident classrooms experience more motivating learning environments (Bandura, 1997; Coleman & Miller, 2014). Likewise, the correlation between teaching styles and student achievement (r = 0.943) confirms how important high

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quality in teaching can affect achievement levels in students; this is in line with existing global testing trends in studies such as TIMSS and PISA (Eklöf et al., 2023).

This could also be identified with the small to relatively higher correlation values between inquiry-based strategies and student achievement (r = 0.358), the use of ICT and student achievement (r = 0.348), and student achievement and the factors related to teacher attitude (r = 0.381). It could be identified from these findings that student achievement is affected by more factors. There exists an agreement that teaching strategies and teacher attitudes create an impact on student involvement and achievement (Putwain et al., 2020; Asare et al., 2024).

Such findings have also been supported by previous studies. It has been shown in previous studies by Aiken (1970) and Ernest (1989) that there is indeed a relationship between what teachers believe about math, how they teach it, and how their students learn it. The findings of Bishop & Nickson (1983) also proved that students who find their teachers interesting in math and confident in teaching it will perform better.

According to the current study's findings, there is a connection between teachers' beliefs about their students and the academic success of their students in math. As stated earlier in meta-analytic review by Hattie (2009), teachers' expectations, clarity of instruction, and relationships with students have been shown to be the primary influences on the success of children. Therefore, the findings of this study support the conclusion that teachers' beliefs are reflected through their expectations of their students, clarity of instruction, as well as their relationships with students, which correspond to students' math performance.

Nevertheless, some studies have presented contradictory findings, implying that the correlations may not universally apply. Stipek, Dearing, Book, Seeley, and Harte (2001) have argued that even when reflective teaching methods were used, the effectiveness of teachers might still not realize itself properly, especially in circumstances characterized by lower teacher confidence. Similarly, Selwyn (2016) argued that overdependence on ICT might prove to be distracting. Nonetheless, this study concurs that teacher-related factors such as teachers' self-efficacy beliefs, pedagogy, and attitudes play an essential role in connecting with student outcomes in math.

Conclusion

This study re-establishes the significance of teacher confidence and attitudes in students' achievement in math classes. The significance of teacher self-efficacy and a moderate use of both conventional and inquiry-based teaching approaches lies in ensuring students' success. The use of ICT and inquiry-based teaching showed moderate results. The significance of these two approaches in enhancing students' learning environment is imperative. The findings revealed students' success is positively affected by teacher attitudes towards teaching math. The majority of teachers exhibited moderate and high levels of positive attitudes. A teacher's disposition is vital since it influences students' attitudes towards enhancing a positive learning environment. This is seen as important in enhancing students' success. A correlation between teacher comfort with using ICT and teacher engagement was noted. This suggests it is vital to acknowledge its significance in enhancing teaching success. To conclude this study, it is vital to note that teacher perspectives significantly affect students' learning in math classes. The best approach is to concentrate on enhancing a

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positive attitude among math-based teacher trainees to enhance students' success or achievement. Additionally, it is vital to note some underlying aspects and barriers to students' comprehension and answering of some math questions.

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