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A STUDY ON ACADEMIC ENGAGEMENT AND MATHEMATICAL COMMUNICATION SKILLS OF HIGH SCHOOL TEACHERS

M. GOWRISHANKAR[1], DR. J. JOHNSI PRIYA[2]

[1]RESEARCH SCHOLAR, MESTON COLLEGE OF EDUCATION (AUTONOMOUS), CHENNAI – 14.
[2]ASSISTANT PROFESSOR, MESTON COLLEGE OF EDUCATION (AUTONOMOUS), CHENNAI – 14.

Abstract

The present study investigates the academic engagement of high school teachers in relation to their mathematical communication skills. The study aims to examine differences in teacher engagement and mathematical communication skills with respect to gender, type of management, teaching experience, employment status, and utilization of learning resources, and to explore the relationship between these two variables. The survey method was adopted, and a sample of 600 high school teachers from Chennai district was selected using simple random sampling. Data were collected using a Teacher Academic Engagement Scale and a Mathematical Communication Skills Scale. The data were analysed using mean, standard deviation, t-test, one-way ANOVA, and Karl Pearson's correlation. The findings revealed that female teachers exhibit higher academic engagement than male teachers, while no significant gender difference was observed in mathematical communication skills. Significant differences were found based on type of management, teaching experience, employment status, and utilization of learning resources. Government school teachers showed higher engagement, whereas self-finance school teachers demonstrated better mathematical communication skills. Teachers with 10–20 years of experience exhibited higher engagement, while those with more than 20 years showed stronger communication skills. Permanent teachers were found to be more engaged than temporary teachers, though both groups demonstrated similar communication skills. Teachers using math laboratories showed higher engagement, whereas those using library resources demonstrated better communication skills. A significant positive relationship was found between teacher engagement and mathematical communication skills. The study concludes that higher levels of teacher engagement contribute to improved mathematical communication, thereby enhancing overall teaching effectiveness.

Keywords: Teacher engagement, Mathematical communication skills, High school teachers, Mathematics education, Classroom interaction

INTRODUCTION

In the contemporary educational landscape, the effectiveness of teaching is increasingly shaped by the extent to which teachers are actively involved in the teaching-learning process. Beyond subject knowledge and instructional techniques, the level of a teacher's psychological and professional involvement plays a crucial role in shaping classroom outcomes. In this regard, teacher engagement has gained recognition as an important construct, referring to the degree of a teacher's emotional commitment, cognitive investment, and active participation in instructional activities. At the high school level, mathematics teaching presents distinct challenges due to the abstract, symbolic, and often complex nature of the subject. Students' understanding of mathematical concepts largely depends on how effectively these ideas are communicated in the classroom. This brings attention to the importance of mathematical communication skills, which include the ability to explain concepts clearly, interpret mathematical symbols, engage students in meaningful discussions, and use appropriate representations such as graphs, diagrams, and equations.

Teacher engagement plays a significant role in strengthening these communication processes. Teachers who are actively engaged tend to create more interactive and student-centred learning environments. Their emotional involvement helps build positive classroom relationships, while their cognitive engagement supports careful lesson planning and clarity of explanation. Behavioural engagement, reflected through active teaching practices, questioning strategies, and responsiveness to students' needs, further enhances the communication of mathematical ideas. Moreover, engaged teachers are more likely to adopt flexible instructional approaches, provide constructive feedback, and encourage student participation in mathematical discourse. Such practices not only improve conceptual understanding but also foster a deeper engagement with mathematical content. In this way, teacher engagement contributes indirectly to students' learning by enhancing the quality of communication within the classroom.

Although teacher engagement has been widely studied in relation to teaching effectiveness and student achievement, its connection with teachers' mathematical communication skills has not been sufficiently explored, particularly at the high school level. Considering the importance of effective communication in mathematics education, it becomes essential to examine how teacher engagement influences these skills. Therefore, the present study aims to investigate the relationship between teacher engagement and mathematical communication skills among high school teachers.

REVIEW OF RELATED LITERATURE

In recent years, increasing attention has been given to the role of teachers' psychological and professional involvement in improving classroom effectiveness. One of the key constructs in this regard is teacher engagement, which reflects the degree to which teachers are emotionally, cognitively, and behaviourally invested in their teaching roles. The concept of engagement was originally articulated by William A. Kahn (1990), who described it as the harnessing of individuals' physical, cognitive, and emotional energies into their work roles. In educational settings, this translates into teachers demonstrating enthusiasm, dedication, and active participation in instructional practices.

Further theoretical support is provided by the work of Arnold B. Bakker and Evangelia Demerouti (2008) through the Job Demands–Resources (JD-R) model, which explains how engaged teachers exhibit higher levels of energy, commitment, and resilience. Studies based on this model indicate that teacher engagement is positively associated with instructional quality, classroom climate, and student outcomes (Bakker & Demerouti, 2008; Klassen et al., 2012; Hakanen, Bakker, & Schaufeli, 2006). Research also suggests that engaged teachers are more likely to adopt innovative teaching strategies, maintain effective classroom management, and respond adaptively to students' learning needs (Bakker & Bal, 2010; Klassen et al., 2013; Skaalvik & Skaalvik, 2014).

Recent empirical studies further reinforce the importance of engagement in mathematics classrooms. A study by Jansen (2023) examined how secondary mathematics teachers conceptualize student engagement and found that engagement is multidimensional, including behavioural, cognitive, and emotional components, all of which influence classroom interaction and learning processes. Additionally, D'Ambrosio (2025) reported that teachers strongly perceive engagement as a critical factor contributing to student success in mathematics, emphasizing the importance of interactive learning, real-life connections, and active participation.

Parallel to this, mathematical communication skills have been widely recognized as a central component of effective mathematics teaching and learning. The National Council of Teachers of Mathematics (2000) identified communication as one of the key process standards, highlighting that students learn mathematics more effectively when they are encouraged to express, interpret, and discuss mathematical ideas. Mathematical communication involves multiple dimensions such as reading, writing, speaking, listening, and representation, which collectively contribute to conceptual understanding.

Several researchers have emphasized the importance of these components. Gerald A. Goldin (2002) highlighted that the use of multiple representations—such as graphs, symbols, and diagrams—enhances learners' ability to understand abstract mathematical concepts. Similarly, Marilyn Burns (2004) emphasized that writing in mathematics supports clarity of thought, reasoning, and reflection. Research has also shown that reading mathematical texts and engaging in discussions improve students' comprehension and analytical abilities (Pimm, 1987; Sfard, 2008; O'Connor, Michaels, & Chapin, 2015).

Recent empirical evidence also supports the strong linkage between communication and engagement in mathematics learning. A study by Chianson-Akaa, Achor, and Rott (2025) found that teachers' communication skills significantly influence students' behavioural and emotional engagement in mathematics classrooms. This finding highlights that effective communication not only improves understanding but also enhances students' involvement in the learning process. Similarly, studies on teacher-student interaction (Baker, 1999) indicate that positive communication and interaction patterns contribute to improved classroom engagement and satisfaction.

Despite the substantial body of research on teacher engagement and mathematical communication skills as separate constructs, limited studies have examined their direct relationship, particularly among high school teachers. Existing literature suggests that engaged teachers are more likely to communicate effectively, use diverse instructional strategies, and facilitate meaningful classroom discussions. However, there is a lack of empirical evidence explicitly linking teacher engagement with mathematical communication skills in the context of secondary education.

Given the multidimensional nature of both constructs, it is essential to explore how teacher engagement influences the development and application of mathematical communication skills. Such an investigation is particularly important at the high school level, where students encounter more complex and abstract mathematical concepts. Therefore, the present study aims to examine the relationship between teacher engagement and mathematical communication skills among high school teachers, thereby contributing to the existing body of knowledge in mathematics education.

SIGNIFICANCE OF THE STUDY

The present study holds considerable significance in the field of mathematics education, particularly in understanding the role of teachers' active involvement in enhancing classroom effectiveness. In recent years, the focus has shifted from merely adopting instructional techniques to examining the extent to which teachers are psychologically and behaviourally engaged in their teaching roles. By emphasizing teacher engagement among high school teachers, the study provides valuable insights into how emotional commitment, cognitive involvement, and active participation contribute to effective instructional practices. The study also highlights the importance of mathematical communication skills, which include reading, writing, listening, speaking, and the use of appropriate representations. These skills are essential for conveying mathematical ideas clearly, facilitating conceptual understanding, and minimizing students' misconceptions. At the high school level, where mathematical concepts become increasingly abstract and complex, effective communication plays a critical role in promoting meaningful learning and developing students' analytical and problem-solving abilities.

A key contribution of this study lies in examining the relationship between teacher engagement and mathematical communication skills. While previous research has often treated these constructs independently, the present study attempts to integrate them, thereby offering a more comprehensive understanding of teaching effectiveness in mathematics classrooms. It provides evidence on how engaged teachers are better able to communicate mathematical ideas, encourage student participation, and create an interactive learning environment. The findings of the study are expected to be beneficial for teacher educators, curriculum developers, and policymakers. It can inform the design of professional development programs aimed at enhancing teacher engagement alongside strengthening communication competencies. Such initiatives can support teachers in adopting more interactive, student-centered approaches that improve both teaching quality and learning outcomes. Overall, the study contributes to the improvement of educational quality by emphasizing the importance of engaged teaching and effective communication in mathematics education. As the demands of education continue to evolve, fostering teacher engagement and strengthening mathematical communication skills become essential for preparing students to think critically and succeed in complex learning environments.

Teacher Academic Engagement

Teacher academic engagement is defined as the measurable level of a high school teacher's emotional, cognitive, and behavioural involvement in the teaching-learning process. It reflects the extent to which teachers demonstrate enthusiasm, commitment, and active participation in instructional activities, classroom interactions, and professional responsibilities.

Teacher engagement is assessed through a standardized Teacher Academic Engagement scale developed by Robert Klasssen & Tracy Durksen (2013) that measures the teacher's level of engagement across its key dimensions, namely emotional engagement, cognitive engagement, and social engagement. The cumulative score indicates the overall level of teacher engagement, which is categorized into high, moderate, and low levels.

Mathematical Communication Skill

Mathematical communication skill is defined as the measurable ability of a higher secondary school teacher to understand, interpret, express, and convey mathematical ideas effectively using appropriate language, symbols, and representations. It involves both verbal and non-verbal modes of communication that facilitate conceptual understanding in mathematics.

Mathematical communication skill is assessed through a Mathematical Communication Skills Inventory developed and standardised by the investigators that measures the teacher's proficiency across these dimensions. The cumulative score indicates the overall level of mathematical communication skill, categorized into high, moderate, and low levels.

High School Teachers

High school teachers are defined as those teaching professionals who are currently working in recognized schools and handling classes at the high school level (generally classes IX and X). These teachers are responsible for delivering subject content, facilitating learning, assessing student performance, and managing classroom activities in accordance with the prescribed curriculum.

OBJECTIVES OF THE STUDY

The present study aims at the following objectives

- To explore the differences in teacher's academic engagement owning to differences in gender, type of management, years of experience, employment status and utilisation of learning resources.
- To examine the differences in mathematical communication skill owning to differences in gender, type of management, years of experience, employment status, and utilisation of learning resources.
- To investigate the relationship between teacher's academic engagement and mathematical communication skills of high school teachers.

Hypotheses

The following hypotheses have been formulated.

- There is no significant difference between male and female high school teachers in their academic

engagement and mathematical communication skills.

- There is no significant difference among high school teachers teaching in government, government aided and self-financing schools in their academic engagement and mathematical communication skills.
- There is no significant difference among high school teachers who are having less than 10 years, 10 to 20 years and above 20 years of teaching experience in their academic engagement and mathematical communication skills.
- There is no significant difference between permanent and temporary high school teachers with respect to their academic engagement and mathematical communication skills.
- There is no significant difference among high school teachers who are using learning resources such as library, math laboratory, and digital tools with respect to their academic engagement and mathematical communication skills.
- There is no significant relationship between teachers' academic engagement and mathematical communication skills among high school teachers.

METHODS AND PROCEDURES

The present study employed the survey method of research to investigate the variables under consideration. A total of 600 high school teachers (300 male and 300 female) were selected from various schools in Chennai district using the simple random sampling technique. Data were collected using two instruments: (i) Teacher Academic Engagement Scale Robert Klasssen & Tracy Durksen (2013) and (ii) Mathematical Communication Skills Scale constructed and standardized by the investigators. These tools were administered to the selected sample to obtain relevant data pertaining to the study variables. The responses obtained were scored in accordance with the prescribed scoring procedures, and the data were systematically organized for analysis. Statistical techniques such as mean, standard deviation, independent samples t-test, one-way ANOVA, and Karl Pearson's product moment correlation were employed to analyse the data using SPSS (Version 22.0). The results of the analysis were presented in tabular form and interpreted in relation to the formulated hypotheses.

Hypothesis Testing

$H_0$1: There is no significant difference between male and female high school teachers in their academic engagement and mathematical communication skills.

Table - 1 showing the significant difference between male and female high school teachers in their academic engagement and mathematical communication skills

Variables	Gender	N	Mean	SD	't' - Value	Level of Significance
Teacher's Academic Engagement	Male	276	49.38	5.624	2.197	0.05
	Female	324	50.23	5.719		
Mathematical Communication Skills	Male	276	102.54	7.756	0.587	NS
	Female	324	102.90	7.332		

NS – Not Significance, 0.05 – 5% Level of Significance

The table presents the comparison of Teacher's Academic Engagement and Mathematical Communication Skills of high school teachers based on gender. With regard to Teacher's Academic Engagement, male teachers (Mean = 49.38, SD = 5.624) and female teachers (Mean = 50.23, SD = 5.719) show a slight difference in their mean scores. The obtained *t*-value (2.197) is significant at the 0.05 level. This indicates that there is a statistically significant difference between male and female high school teachers in their academic engagement. Since the mean score of female teachers is higher than that of male teachers, it can be inferred that female teachers exhibit relatively higher academic engagement compared to their male counterparts. In the case of Mathematical Communication Skills, male teachers (Mean = 102.54, SD = 7.756) and female teachers (Mean = 102.90, SD = 7.332) have nearly similar mean scores. The calculated *t*-value (0.587) is not significant (NS). This indicates that there is no significant difference between male and female high school teachers in their mathematical communication skills.

$H_0$2: There is no significant difference among high school teachers teaching in government, government aided and self-financing schools in their academic engagement and mathematical communication skills.

Table 2 showing the significant difference among high school teachers teaching in government, government aided and self-financing schools in their academic engagement and mathematical communication skills

Variables	Type of Management	N	Mean	SD	'F' - Value	Level of Significance
Teacher's Academic Engagement	Government	206	50.40	5.993	4.268	0.05
	Government-Aided	181	49.06	5.487		
	Self-Finance	213	48.85	6.014		
Mathematical Communication Skills	Government	206	105.29	9.398	20.681	0.01
	Government-Aided	181	104.27	9.239		
	Self-Finance	213	106.75	11.276		

0.01 - 1% Level of Significance, 0.05 – 5% Level of Significance

The table presents the comparison of Teacher's Academic Engagement and Mathematical Communication Skills of high school teachers based on the type of school management (Government, Government-Aided, and Self-Finance). With regard to Teacher's Academic Engagement, the mean scores of teachers working in Government (Mean = 50.40, SD = 5.993), Government-Aided (Mean = 49.06, SD = 5.487), and Self-Finance schools (Mean = 48.85, SD = 6.014) show slight variations. The obtained F-value (4.268) is significant at the 0.05 level. This indicates that there is a statistically significant difference in teacher's academic engagement among high school teachers based on the type of management. Among the three groups, Government school teachers exhibit relatively higher academic engagement compared to Government-Aided and Self-Finance school teachers. In the case of Mathematical Communication Skills, the mean scores for Government (Mean = 105.29, SD = 9.398), Government-Aided (Mean = 104.27, SD = 9.239), and Self-Finance schools (Mean = 106.75, SD = 11.276) indicate noticeable differences. The calculated F-value (20.681) is significant at the 0.01 level, showing a highly significant difference among the three groups. It is observed that teachers from Self-Finance schools have higher mathematical communication skills, followed by Government school teachers, while Government-Aided school teachers have comparatively lower mean scores.

$H_0$3: There is no significant difference among high school teachers who are having less than 10 years, 10 to 20 years and above 20 years of teaching experience in their academic engagement and mathematical communication skills.

Table 3 showing the significant difference among high school teachers who are having less than 10 years, 10 to 20 years and above 20 years of teaching experience in their academic engagement and mathematical communication skills.

Variables	Type of Management	N	Mean	SD	'F' - Value	Level of Significance
Teacher's Academic Engagement	Less than 10 Years	235	49.71	5.974	3.606	0.05
	10 – 20 Years	211	49.93	6.093		
	More than 20 Years	154	48.36	5.329		
Mathematical Communication	Less than 10 Years	235	105.81	10.110	24.805	0.01

Skills	10 – 20 Years	211	106.17	10.019		
	More than 20 Years	154	112.96	12.074		

0.01 - 1% Level of Significance, 0.05 – 5% Level of Significance

The table presents the comparison of Teacher's Academic Engagement and Mathematical Communication Skills of high school teachers based on their years of teaching experience (Less than 10 years, 10–20 years, and more than 20 years). With regard to Teacher's Academic Engagement, the mean scores of teachers with less than 10 years of experience (Mean = 49.71, SD = 5.974), 10–20 years (Mean = 49.93, SD = 6.093), and more than 20 years (Mean = 48.36, SD = 5.329) show slight differences. The obtained F-value (3.606) is significant at the 0.05 level. This indicates that there is a statistically significant difference in teacher's academic engagement based on years of experience. Among the groups, teachers with 10–20 years of experience show slightly higher engagement, while those with more than 20 years show comparatively lower engagement. In the case of Mathematical Communication Skills, teachers with less than 10 years of experience (Mean = 105.81, SD = 10.110), 10–20 years (Mean = 106.17, SD = 10.019), and more than 20 years (Mean = 112.96, SD = 12.074) exhibit noticeable differences in their mean scores. The calculated F-value (24.805) is significant at the 0.01 level, indicating a highly significant difference among the groups. It is observed that teachers with more than 20 years of experience demonstrate the highest level of mathematical communication skills, followed by those with 10–20 years, while teachers with less than 10 years of experience have comparatively lower scores.

$H_0$4: There is no significant difference between permanent and temporary high school teachers with respect to their academic engagement and mathematical communication skills.

Table 4 showing the significant difference between permanent and temporary high school teachers with respect to their academic engagement and mathematical communication skills

Variables	Gender	N	Mean	SD	't' - Value	Level of Significance
Teacher's Academic Engagement	Permanent	304	50.21	6.389	3.241	0.01
	Temporary	296	48.66	5.212		
Mathematical Communication Skills	Permanent	304	107.97 10	11.515	0.454	NS
	Temporary	296	107.56	10.528		

0.01 - 1% Level of Significance, NS – Not Significance

The table presents the comparison of Teacher's Academic Engagement and Mathematical Communication Skills of high school teachers based on their type of employment (Permanent and Temporary). With regard to Teacher's Academic Engagement, permanent teachers (Mean = 50.21, SD = 6.389) have a higher mean score compared to temporary teachers (Mean = 48.66, SD = 5.212). The obtained *t*-value (3.241) is significant at the 0.01 level. This indicates that there is a statistically significant difference between permanent and temporary high school teachers in their academic engagement. Hence, it can be inferred that permanent teachers exhibit higher academic engagement than temporary teachers. In the case of Mathematical Communication Skills, permanent teachers (Mean = 107.97, SD = 11.515) and temporary teachers (Mean = 107.56, SD = 10.528) show very similar mean scores. The calculated *t*-value (0.454) is not significant (NS). This indicates that there is no significant difference between permanent and temporary teachers in their mathematical communication skills.

$H_0$5: There is no significant difference among high school teachers who are using learning resources such as library, math laboratory, and digital tools with respect to their academic engagement and mathematical communication skills.

Table 5 showing the significant difference among high school teachers who are using learning

Resources such as library, math laboratory, and digital tools with respect to their academic engagement and mathematical communication skills

Variables	Type of Management	N	Mean	SD	'F' - Value	Level of Significance
Teacher's Academic Engagement	Library	193	49.95	6.842	16.001	0.01
	Math Laboratory	108	53.91	8.743		
	Digital Tools	299	49.59	6.324		
Mathematical Communication Skills	Library	193	109.68	11.700	4.280	0.05
	Math Laboratory	108	105.81	11.644		
	Digital Tools	299	109.13	11.709		

0.01 - 1% Level of Significance, 0.05 – 5% Level of Significance

The table presents the comparison of Teacher's Academic Engagement and Mathematical Communication Skills of high school teachers based on the type of teaching resources used (Library, Math Laboratory, and Digital Tools). With regard to Teacher's Academic Engagement, teachers using Library resources (Mean = 49.95, SD = 6.842), Math Laboratory (Mean = 53.91, SD = 8.743), and Digital Tools (Mean = 49.59, SD = 6.324) show noticeable differences in their mean scores. The obtained F-value (16.001) is significant at the 0.01 level. This indicates that there is a highly significant difference in teacher's academic engagement based on the type of resources used. Among the groups, teachers using the Math Laboratory exhibit the highest level of engagement, followed by those using Library resources, while teachers using Digital Tools show comparatively lower engagement. In the case of Mathematical Communication Skills, the mean scores for Library (Mean = 109.68, SD = 11.700), Math Laboratory (Mean = 105.81, SD = 11.644), and Digital Tools (Mean = 109.13, SD = 11.709) indicate variation across groups. The calculated F-value (4.280) is significant at the 0.05 level, showing a statistically significant difference among the groups. It is observed that teachers using Library resources have slightly higher mathematical communication skills, closely followed by those using Digital Tools, whereas teachers using Math Laboratory show comparatively lower scores.

$H_0$6: There is no significant relationship between teachers' academic engagement and mathematical communication skills among high school teachers.

Table 6 – showing the significant relationship between teachers' academic engagement and mathematical communication skills among high school teachers

Variables	N	'Y'
Teacher's Academic Engagement and Mathematical Communication Skills	300	0.412**

** - Significant at 0.01 level

It is inferred from the above table that there is a significant and positive correlation between teacher's academic engagement and mathematical communication skills among high school teachers.

FINDINGS AND DISCUSSION

The present study examined teacher academic engagement and mathematical communication skills among high school teachers with respect to selected demographic and institutional variables and explored the relationship between these constructs. The findings revealed a significant gender difference in teacher

engagement, with female teachers demonstrating higher engagement than male teachers, while no significant difference was found in mathematical communication skills. This finding aligns with studies by Klassen et al. (2013), which indicate that female teachers often exhibit higher emotional and professional commitment. However, the absence of gender difference in communication skills supports earlier findings (Zhu, 2018), suggesting that professional competencies are not influenced by gender.

The analysis based on type of school management indicated that government school teachers exhibited higher engagement, whereas self-finance school teachers demonstrated better mathematical communication skills. This partially supports the findings of Muralidharan and Sundararaman (2011), who reported differences in teacher effectiveness across school types due to institutional factors such as accountability and infrastructure. The higher communication skills observed in self-finance schools may be attributed to better resources and exposure. With respect to teaching experience, teachers with 10–20 years of experience showed higher engagement, while those with more than 20 years demonstrated superior mathematical communication skills. This finding is consistent with Huberman (1989), who noted that experienced teachers develop stronger pedagogical expertise over time, and also supports the idea that mid-career teachers tend to be more actively engaged in their professional roles.

The results also revealed that permanent teachers exhibit higher engagement compared to temporary teachers, while no significant difference was observed in communication skills. This finding is supported by Skaalvik and Skaalvik (2014), who emphasized that job stability contributes to higher motivation and engagement among teachers. Further, the analysis based on the use of learning resources showed that teachers using math laboratories demonstrated higher engagement, whereas those using library resources exhibited better mathematical communication skills. This suggests that experiential and activity-based teaching enhance engagement; while reading and reflective practices strengthen communication abilities. Finally, the study found a significant positive relationship between teacher engagement and mathematical communication skills. This indicates that teachers who are more emotionally, cognitively, and behaviourally involved in teaching are better able to communicate mathematical concepts effectively. This finding is consistent with the theoretical perspectives of Kahn (1990) and Bakker and Demerouti (2008), which emphasize the role of engagement in improving professional performance. Overall, the findings highlight that both personal and contextual factors influence teacher engagement and communication skills, and that these constructs are closely interconnected in the teaching-learning process.

Educational Implications

The findings of the study have important implications for educational practice and policy. The significant relationship between teacher engagement and mathematical communication skills indicates that increasing teachers' active involvement in classroom processes can substantially improve instructional quality. Therefore, teacher education programmes need to emphasize the development of engagement through reflective practices, collaborative learning approaches, and active teaching strategies that promote meaningful classroom interaction. The observed higher level of engagement among female teachers suggests the need to strengthen motivation and professional commitment among all teachers. Professional development initiatives should focus on enhancing teachers' well-being, job satisfaction, and emotional involvement in teaching. At the institutional level, the differences identified across types of school management highlight the necessity of improving support systems in government and government-aided schools. Providing adequate infrastructure, access to resources, and continuous training opportunities can contribute to better engagement and communication practices.

The variation in engagement and communication skills based on teaching experience underscores the importance of differentiated training programmes. Less experienced teachers require support in developing effective communication strategies and classroom interaction skills, while experienced teachers need opportunities to sustain their engagement and adapt to evolving teaching practices. Similarly, the higher engagement observed among permanent teachers points to the significance of job security and a supportive work environment. Improving the working conditions of temporary teachers can help enhance their level of engagement and overall effectiveness. The findings related to the use of learning resources suggest that a balanced and purposeful integration of instructional resources is essential. While activity-based approaches such as math laboratories can enhance engagement, the use of library resources can strengthen communication and conceptual clarity. Therefore, schools should encourage the effective utilization of diverse teaching resources to support both engagement and communication. In addition, educational administrators should foster a collaborative professional culture where teachers actively share best practices, participate in professional learning communities, and continuously upgrade their pedagogical skills to meet the changing demands of education.

CONCLUSION

The present study examined teacher academic engagement and mathematical communication skills among high school teachers and identified a significant positive relationship between the two variables. The findings indicate that teacher engagement plays a crucial role in enhancing the effective communication of mathematical concepts. The study revealed that gender influences teacher engagement but not communication skills, while type of management, teaching experience, employment status, and use of

learning resources significantly affect both constructs. Government school teachers demonstrated higher engagement, whereas self-finance school teachers showed better communication skills. Mid-career teachers were more engaged, while highly experienced teachers exhibited stronger communication abilities. Permanent teachers were more engaged than temporary teachers, and the use of instructional resources influenced both engagement and communication in different ways. Overall, the study highlights that improving teacher engagement can lead to better communication practices in mathematics classrooms, thereby enhancing teaching effectiveness and student learning outcomes. It emphasizes the need for continuous professional development, supportive institutional environments, and effective use of instructional resources to strengthen both teacher engagement and mathematical communication skills.

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