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Investigation of Teachers' Mathematics Teaching Self-Efficacy in Teaching Geometry at the Grade 11 Level in Secondary Schools: A Case Study from Guyana

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Abstract: Teacher self-efficacy is a crucial factor in the use of instructional practices and student learning outcomes, especially with challenging concepts like geometry. This research examines the self-efficacy of Grade 11 mathematics teachers in Guyana, focusing on their confidence in teaching geometry and how individual and environmental factors influence this level of self-efficacy. Using a qualitative, literature-based approach grounded in Social Cognitive Theory, the study synthesises research from different regions to explore the relationship between teacher self-efficacy, pedagogical practices, and student engagement. Findings show that teachers' self-efficacy is strongly influenced by mastery experiences, professional development, available resources, and socio-economic conditions. Persistent challenges include limited training, inadequate technology integration, and systemic inequalities that hinder quality geometry teaching. The study proposes several recommendations to enhance teacher confidence and instruction: targeted professional development, technology integration, and collaborative learning frameworks. These findings have implications for policy and practice within Guyana's education system and similar contexts in the Global South.

Keywords: *Teacher self-efficacy, Geometry teaching, Mathematics Education, Guyana, Social Cognitive Theory, Secondary School*.

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I. INTRODUCTION

➢ *Current State of Mathematics Education in Guyana*

Mathematics education in Guyana still experiences constant structural and pedagogical challenges particularly at secondary level. Despite continuous reforms, student performance in regional examinations such as the Caribbean Secondary Education Certificate CSEC continues to be an issue, especially in areas where higher-order thinking is required (geometry, for example). These difficulties have a strong historical underpinning, socioeconomic differences, and constraints in the teacher training and support systems (Singh & Allicock, 2014; Ibrahim et al., 2023).

Geometry as an important component of the mathematics curriculum of secondary education needs both conceptual and spatial reasoning. Nevertheless, its successful delivery is often hampered by the gaps in the intrinsic self-efficacy of a teacher, the usefulness of instructional resources and the lack of pedagogical training. Therefore, there is need to understand the wider context of education when analysing the factors influencing teacher confidence and effectiveness in teaching geometry.

- *Historical Development and Educational Reforms*

The evolution of the development of mathematics education in Guyana has been affected by several key reform programmes, such as the Secondary School Reform Project (SSRP), the Primary Education Improvement Project (PEIP), and the Guyana Mathematics Project. These reforms aimed to modernise curricula, improve teacher training, and address student performance. However, their long-term effects have been mixed due to inconsistencies in implementation, inadequate monitoring, and low levels of sustainability measures (Bowe, 2015; Singh & Allicock, 2014).

A substantial flaw in these reforms is the discrepancy between the policy design and its practical effectiveness within the classroom environment. Educational institutions, particularly those in rural and remote areas, continue to experience shortages of instructional resources and lack access to continuous professional development opportunities. These issues have impacted pedagogical approaches in geometry, especially considering that effective instruction necessitates both specialized content knowledge and pedagogical skills (Sweeney & George, 2024).

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Moreover, ignoring the importance of psychological factors such as teacher confidence and mathematics anxiety has constrained the effectiveness of reform initiatives. Evidence suggests that approximately 50-60% of preservice teachers in Caribbean settings experience moderate to high levels of mathematics anxiety, which adversely affects their instructional confidence (Atwell-Chin Hong, 2021). Absent targeted interventions to address these emotional components, sustainable enhancements in teaching quality are unlikely to be realized.

International support, exemplified by programmes such as the Education For All Fast Track Initiative (EFA-FTI), has contributed to enhancements in infrastructure and training. Nevertheless, dependence on external funding sources has prompted concerns regarding sustainability and local applicability, as imported pedagogical models frequently fail to correspond with the specific conditions of local classrooms (Bowe, 2015; Ibrahim et al., 2023). These deficiencies underscore the imperative to concurrently develop reforms that are context-aware and centered on the needs of teachers.

- *Socioeconomic Influences*

Socioeconomic disparities significantly influence the quality of mathematics education in Guyana. Educational institutions located in rural and hinterland regions frequently lack essential teaching materials, infrastructure, and opportunities for professional development for educators. These inequalities directly affect both teacher confidence and student achievement (Ibrahim et al., 2023). Educators working in under-resourced environments often face challenges in delivering geometry instruction effectively, as students in such settings are typically taught in large classrooms, lack access to teaching aids, and receive limited institutional support, which hampers the creation of a positive learning environment. This observation aligns with findings reported by Perera and John (2020), who contend that environmental constraints can substantially diminish teachers' perceived instructional competence.

Furthermore, students from economically disadvantaged households encounter supplementary obstacles, such as restricted access to supplementary educational resources and diminished academic support within the home environment. These factors contribute to disparities in mathematics achievement and perpetuate cycles of educational inequity (Wang, 2023). The cumulative impact of institutional and familial limitations creates a challenging environment for both instruction and learning of geometry.

Furthermore, technological inequalities exacerbate these disparities. Although the integration of digital tools in geometry education has the potential to enhance accessibility through visualization techniques that improve geometric teaching and learning, as well as demonstrate the vitality of such technology and facilitate learning, access to reliable internet, devices, and electricity remains unequal across different regions (Ibrahim et al., 2023). Addressing these systemic inequalities is crucial for advancing the objectives of enhancing teacher effectiveness and student outcomes.

- *Performance at the Caribbean Examination Level*

Student performance in mathematics at the Caribbean Secondary Education Certificate (CSEC) level continues to highlight systemic challenges within the education system. Reports consistently show that a significant proportion of students do not attain satisfactory passes in mathematics, with geometry identified as a particularly troublesome area requiring conceptual understanding and spatial reasoning.

One critical factor affecting performance is mathematics anxiety among both teachers and students. Studies suggest that over half of preservice teachers in Caribbean contexts experience moderate to severe mathematics anxiety, which can negatively impact classroom instruction and student learning (Atwell-Chin Hong, 2021). This anxiety often results in reduced instructional effectiveness and lower student engagement.

Teacher self-efficacy plays a key role in enhancing student outcomes. Teachers with higher confidence levels are more likely to adopt student-centred and innovative teaching methods, which boost engagement and understanding (Chang, 2015; Olawale & Hendricks, 2024). Conversely, low self-efficacy is linked to dependence on traditional, lecture-based approaches that restrict student participation.

External factors, including environmental disruptions like hurricanes, also affect academic performance. Research shows that such events can reduce mathematics test scores by 0.01 to 0.06 standard deviations across Caribbean countries (Spencer et al., 2016). These findings emphasise the need to build resilience within the education system through flexible teaching methods and contingency planning. Innovative instructional approaches, such as inquiry-based and discovery learning, have demonstrated significant potential in improving geometry results. Research indicates that students exposed to these methods develop stronger reasoning, communication, and problem-solving skills compared to those taught using traditional methods (Siregar et al., 2020; Alghadari et al., 2020). However, successful implementation mainly depends on teachers' confidence and competence, further emphasising the importance of self-efficacy.

- *Teaching and Learning Challenges in Geometry*

The teaching of geometry in Guyana faces several challenges that persist in teacher training and pedagogical skills. Research shows that many mathematics teachers feel ill-equipped to deliver effective geometry instruction due to gaps in content knowledge and pedagogical techniques (Sunzuma & Maharaj, 2019). A significant problem is teachers' difficulty with the specialised language and abstract concepts of geometry. This often hampers their ability to communicate ideas clearly and to help students develop a deep understanding of the subject. Additionally, many teachers find it hard to relate geometry to real-world situations, which further diminishes student engagement and the practical value of geometry.

The ongoing dependence on traditional teaching methods contributes to ineffective learning. Teachers with low self-efficacy are less inclined to adopt interactive or

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student-centred approaches, leading to fewer opportunities for critical thinking and problem-solving (Olawale & Hendricks, 2024). This results in persistent cycles of disengagement and underachievement in geometry.

Cultural relevance remains a critical concern. The research indicates that approximately 47% of educators report insufficient opportunities to acquire comprehensive knowledge regarding culturally responsive teaching methodologies. Furthermore, about 30% encounter difficulties in generating contextually pertinent examples for their instructional practices (Sunzuma & Maharaj, 2019). This deficiency in contextualisation may render geometric concepts appear abstract and detached from students' lived experiences.

Furthermore, deficiencies in advanced content knowledge adversely affect teachers' ability to facilitate higher-order learning. Educators often focus on procedural skills rather than fostering conceptual understanding, which constrains students' capacity to solve complex problems in geometry (Boonstra et al., 2023). Addressing these issues necessitates a sustained commitment to targeted professional development and support systems.

➢ *Summary*

Overall, the background analysis indicates that mathematics education in Guyana is influenced by a complex interplay of historical, socioeconomic, and pedagogical factors. Persistent inequalities, insufficient teacher training, and systemic obstacles continue to affect both teacher confidence and student performance in geometry. Addressing these issues necessitates a comprehensive strategy that integrates policy reform, professional development, and resource allocation to promote a more equitable and effective mathematics education system.

➢ *Research Questions*

- What are the levels of self-efficacy among Grade 11 mathematics teachers in teaching geometry?
- What individual and environmental factors influence teacher self-efficacy?
- How does teacher self-efficacy impact instructional practices and student engagement?
- What strategies can enhance teacher self-efficacy in geometry instruction?

II. REVIEW OF LITERATURE

➢ *Conceptual Framework of Teacher Self-Efficacy*

The conceptual framework illustrates the relationships among teacher self-efficacious mastery experiences, vicarious experiences, verbal persuasion, and the emotional states, and their influence on instructional practices. This ultimately impacts students' engagement and achievement in geometry.

Table 1 Conceptual Framework of Teacher Self-Efficacy

Self-Efficacy Components	Instructional Practices	Student Outcomes
Mastery, Vicarious, Verbal, Emotional	Teaching Methods, Technology, Differentiation	Engagement, Achievement, Confidence

➢ *Social Cognitive Theory*

Teacher self-efficacy is primarily rooted in social cognitive theory, which suggests that human behaviour is influenced by the ongoing interaction of personal, behavioural, and environmental factors. In educational settings, this framework illustrates how teachers' beliefs about their abilities influence their instructional choices, persistence, and classroom effectiveness (Bandura, 1997; Tschannen-Moran & Hoy, 2001).

In the context of teaching geometry, social cognitive theory provides a useful framework for understanding how teachers in Guyana develop confidence in teaching complex, abstract subjects. Geometry requires not only the knowledge of the content to be learned, but also the ability to support visual-spatial reasoning and problem-solving. As a result, teachers' belief in their instructional skills has a direct impact on their readiness to use new methods and involve students in effective learning.

Recent research underscores the strong connection between teacher self-efficacy and the quality of instruction, flexibility, and student engagement, particularly in mathematics education (Lazarides & Warner, 2020; Jung et al., 2023). This directly supports the aim of the current study, which seeks to examine the impact that self-efficacy has on teaching practices and student outcomes in Grade 11 geometry classrooms in Guyana.

➢ *Components of Self-Efficacy*

Teacher self-efficacy is influenced by four key components: mastery experiences, vicarious experiences, verbal persuasion, and physiological and affective states. These elements work together and are essential for explaining differences in teachers' confidence and instructional methods.

➢ *Mastery Experiences*

Mastery experiences are widely considered the most significant source of self-efficacy, as they offer direct evidence of success in teaching tasks (Lazarides & Warner, 2020). Teachers who effectively implement geometry lessons and notice improvements in student comprehension are more likely to build lasting confidence in their instructional skills.

However, in contexts such as Guyana, opportunities for mastery are often limited by systemic challenges, including scarce resources and inadequate professional development. This leads to inequalities, where only some teachers can gain positive teaching experiences. Consequently, disparities in self-efficacy may arise, directly addressing Research

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Question 1 (RQ1) regarding differences in teacher self-efficacy levels.

Moreover, mastery experiences are strongly connected to instructional innovation. Teachers who succeed with inquiry-based or activity-driven geometry methods are more likely to continue using such strategies, thereby affecting RQ3 (instructional practices and student engagement) (Siregar et al., 2020).

- *Vicarious Experiences*

Vicarious experiences are those that teachers have when they observe colleagues successfully teach similar content. This is especially important in resource-poor systems like Guyana, where formal training opportunities may be limited.

Peer observation, mentoring, and collaborative planning enable teachers to demonstrate effective geometry teaching strategies. Research shows that such collaborative environments considerably improve both individual and collective teacher efficacy (Olivier et al., 2019; Olawale & Hendricks, 2024).

Nevertheless, the efficacy of vicarious learning is contingent upon access to high-caliber models. In educational institutions where collaborative efforts are restricted, educators may lack exposure to effective practices, thereby impeding their professional growth. This issue is directly pertinent to RQ2 (factors influencing self-efficacy), underscoring the significance of institutional backing and professional learning communities.

- *Verbal Persuasion*

Verbal persuasion includes feedback, encouragement, and professional dialogue that strengthen teachers' beliefs in their abilities. In the Guyanese setting, where formal evaluation systems may lack consistency, feedback from school leaders and colleagues becomes a vital way to boost confidence.

Research demonstrates that specific, actionable feedback is considerably more effective than general praise in boosting teacher self-efficacy (Lazarides & Warner, 2020). Additionally, structured feedback systems within professional development programmes have been shown to encourage experimentation with innovative teaching strategies, including technology integration in geometry.

This component is especially relevant to RQ4 (strategies to improve self-efficacy), as it highlights the significance of mentoring, coaching, and reflective practice in the development of teachers.

- *Physiological and Affective States*

Emotional and psychological states, such as stress, anxiety, and motivation, greatly affect teachers' self-efficacy. Mathematics anxiety, in particular, continues to be a significant obstacle in Caribbean education systems.

Research shows that over 50% of teachers in similar settings experience moderate to high levels of mathematics anxiety, which harms their instructional confidence and classroom effectiveness (Atwell-Chin Hong, 2021). Teachers under high stress are less likely to adopt innovative or student-centred methods, often sticking to traditional approaches.

This has direct implications for RQ3, as emotional states influence classroom practices and student engagement. Additionally, gender-based differences in self-efficacy and anxiety have been documented, indicating the need for targeted interventions (Olawale & Hendricks, 2024).

- *Synthesis of Components*

The four components of self-efficacy do not work separately; instead, they interact to influence teaching behaviour. For instance, a teacher who successfully delivers a geometry lesson (mastery), observes colleagues employing innovative strategies (vicarious experience), receives constructive feedback (verbal persuasion), and feels low anxiety (affective state) is more likely to develop strong and lasting self-efficacy.This comprehensive perspective bolsters the study's conceptual framework and highlights the importance of holistic professional development models that encompass all aspects of teacher growth.

- *Sources of Self-Efficacy*

Building on these components, the sources of self-efficacy offer a deeper understanding of how teachers' beliefs are cultivated and sustained over time. Mastery experiences continue to be the most significant predictor of teacher behaviour, as they directly influence instructional perseverance and adaptability (Tschannen-Moran & Hoy, 2001). Educators who consistently succeed in teaching geometry are more inclined to explore innovative pedagogical methods, consequently enhancing student academic performance.

Vicarious experiences contribute to the development of collective teacher efficacy, which serves as a significant predictor of instructional improvement across schools (Olivier et al., 2019). In Guyana, enhancing collaborative networks among educators can be a cost-effective way to improve teaching quality. Verbal persuasion facilitates these experiences by providing validation and guidance. Nevertheless, its effectiveness depends on credibility and consistency, highlighting the importance of implementing structured mentoring systems.

Physiological and emotional states influence how teachers interpret their experiences. Teachers who see challenges as manageable are more likely to persist and innovate, whereas those under chronic stress may disengage.

Together, these sources directly address RQ2, showing that teacher self-efficacy is shaped by personal, institutional, and systemic factors.

- *Impact of Teacher Self-Efficacy on Teaching Practice*

Teacher self-efficacy significantly influences instructional practices, particularly in mathematics and geometry education. Teachers with high self-efficacy tend to:

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Use student-centred and inquiry-based approaches

- Differentiate instruction to meet diverse learning needs
- Integrate technology and visual tools
- Foster active student engagement

(Olawale & Hendricks, 2024; Adams & Enu, 2023)

These practices are vital for geometry, where conceptual understanding and visualisation are crucial.

In contrast, teachers with low self-efficacy tend to depend on traditional, lecture-based methods, reducing opportunities for student interaction and higher-order thinking (Sunzuma & Maharaj, 2019). This reinforces patterns of disengagement and underachievement, especially in under-resourced schools.

Importantly, while large-scale studies such as TIMSS indicate that the direct effect of teacher self-efficacy on student achievement is relatively small (effect size < 0.05), its indirect effects on classroom climate, motivation, and engagement are significant (Jerrim et al., 2023). This distinction is crucial in reinforcing the argument of this study.

Teacher self-efficacy also contributes to:

- Student motivation and confidence
- Positive classroom relationships
- Resilience in challenging teaching environments

(Jung et al., 2023; Prewett & Whitney, 2021)

This strongly supports RQ3, confirming that self-efficacy affects not only how teachers teach but also how students learn.

➢ *Implications for the Study*

The literature clearly demonstrates that teacher self-efficacy is:

- A key determinant of instructional quality
- Strongly influenced by systemic and contextual factors
- Critical for student engagement and long-term achievement

However, a significant gap still exists in Caribbean-specific research, especially concerning geometry instruction at the secondary level. This study addresses this gap by offering a localised analysis of teacher self-efficacy in Guyana.

Furthermore, the literature supports the need for:

- Targeted professional development
- Collaborative teacher networks
- Emotional and psychological support systems

These insights directly inform RQ4, guiding the development of strategies to improve teacher self-efficacy in geometry instruction.

➢ *Professional Development and Teacher Self-Efficacy*

Professional development (PD) is recognised as a key method for strengthening teacher capacity, instructional quality, and self-efficacy, especially in complex subjects like geometry. Darling-Hammond and colleagues explain that effective PD goes beyond traditional, fragmented workshops by focusing *on content-oriented, sustained, collaborative, and practice-based learning opportunities* that fundamentally transform teachers' practices and beliefs about instruction (Darling-Hammond, Hyler, & Gardner, 2017).

Research indicates that when PD involves active engagement, curriculum-specific strategies, and reflection, teachers are more likely to internalise and adapt new methods, thus boosting their confidence in teaching challenging content (Darling-Hammond et al., 2017). In mathematics education, these PD characteristics are especially important; targeted PD that highlights pedagogical content knowledge and student-centred approaches improves teachers' ability to facilitate spatial reasoning and conceptual understanding in geometry — areas where many teachers feel least prepared. Sustained PD also promotes professional learning communities, allowing teachers to share effective practices, model innovative instruction, and bolster one another's self-efficacy, a factor proven crucial in contexts facing systemic barriers like those in Guyana (Darling-Hammond et al., 2017; Garet, Porter, Desimone, Birman, & Yoon, 2001).

Localized evidence further emphasises the transformative potential of PD in strengthening teacher self-efficacy in mathematics within Caribbean and Guyanese contexts. Budhoo's qualitative work on geometry teacher efficacy stresses that PD is not only desirable but *necessary* for teachers to develop confidence and effective instructional strategies in geometry classrooms (Budhoo, 2021). His findings revealed that in the absence of sustained, context-specific PD, teachers often lack opportunities to build mastery experiences, engage in reflective practice, or collaborate on elements critical to developing instructional self-assurance. This aligns with international research showing that effective PD increases teachers' instructional competence, which in turn enhances student engagement and achievement (Darling-Hammond et al., 2017; Garet et al., 2001). For Guyana, where inequities in school resources, uneven access to training, and geographic isolation of rural teachers persist, PD programmes that are extended, coherent, and embedded within teachers' work environments offer a powerful strategy for increasing teachers' confidence, innovativeness, and resilience. Adopting these high-quality PD practices could help bridge gaps in geometry instruction, support curriculum reform goals, and elevate instructional quality across diverse school contexts nationwide.

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III. METHODOLOGY

➢ *Research Design*

This research utilized a qualitative case study methodology to examine the determinants influencing mathematics educators' self-efficacy in geometry instruction within Guyana. The case study approach was appropriate, as it facilitated a comprehensive exploration of teachers' lived experiences, perceptions, and pedagogical practices in their authentic classroom settings. This methodology allowed the researcher to capture the intricate interactions between individual and environmental factors that influence teacher self-efficacy (Creswell & Poth, 2018).

➢ *Research Questions*

The study was guided by the following research questions:

- What individual factors influence mathematics teachers' self-efficacy in teaching geometry?
- What environmental factors affect teachers' confidence and instructional practices in geometry?
- How do professional development, technology integration, and collaboration enhance teachers' self-efficacy?

➢ *Participants and Sampling*

Participants included secondary school mathematics teachers from selected schools across Guyana. A purposive sampling strategy was used to ensure representation across:

- Years of teaching experience
- Academic qualifications
- School contexts (urban vs. rural)

Approximately 10–15 teachers were selected to provide rich, detailed insights.

➢ *Data Collection Methods*

Data were collected using:

- Semi-structured interviews (primary method)
- Document review (lesson plans, curriculum guides)
- Reflective teacher narratives (where available)

Interviews focused on:

- Teachers' confidence in teaching geometry
- Experiences with professional development
- Use of instructional resources and technology
- Perceived challenges and supports

➢ *Data Analysis*

Data were examined through thematic analysis following Braun and Clarke's (2006) six-step framework.

- Familiarisation with data
- Coding
- Generating themes
- Reviewing themes
- Defining and naming themes
- Reporting

Themes were aligned with the study's conceptual framework:

- Individual Factors (experience, content knowledge)
- Environmental Factors (resources, professional support)
- Enhancement Strategies (PD, technology, collaboration)

➢ *Trustworthiness*

To ensure rigor:

- Credibility: Member checking of interview responses
- Dependability: Audit trail of coding decisions
- Confirmability: Use of verbatim quotes
- Transferability: Thick descriptions of context

IV. FINDINGS

The analysis revealed three major themes aligned with the research questions:

Table 1 Summary of Findings

Theme	Key Findings	Implications
Teacher Confidence	Varied levels; lower in under-resourced schools	Need for targeted support
Professional Development	Limited geometry-specific training	Expand continuous training
Technology Use	Low integration due to lack of resources	Improve access and training
Instructional Practices	Traditional methods dominate	Promote student-centered approaches
Student Engagement	Higher with innovative teaching	Encourage interactive strategies

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➢ *Theme 1: Individual Factors Influencing Self-Efficacy*

- *Teacher Experience*

Findings revealed that experience alone did not guarantee high self-efficacy.

✓ Novice teachers often expressed higher confidence in modern teaching strategies:

"I feel comfortable using new methods because that's how we were trained recently."

✓ Experienced teachers demonstrated strength in classroom management, but some reported difficulty adapting:

"I've been teaching for years, but geometry has changed, and I'm not always sure about the new approaches."

These findings support earlier research showing that newer teachers may benefit from updated pedagogical training, while experienced teachers may require ongoing support (Caddle et al., 2016; Olawale & Hendricks, 2024).

- *Content Knowledge*

Teachers with strong mathematical backgrounds reported significantly higher confidence:

"Once I understand the concept deeply, I can explain it in different ways."

Conversely, teachers lacking geometry specialization expressed uncertainty:

"Sometimes I avoid going too deep into geometry because I'm not fully confident."

This aligns with evidence that content knowledge strongly predicts instructional confidence and student outcomes (Mohr-Schroeder et al., 2017).

➢ *Theme 2: Environmental Factors Affecting Self-Efficacy*

- *School Resources*

A major finding was the impact of limited resources, especially in rural schools.

✓ Teachers reported lack of:

- Geometry tools
- Technology
- Visual teaching aids

"We don't have the tools to demonstrate concepts properly, so we rely on the textbook."

This resulted in:

✓ Reduced innovation
✓ Increased reliance on traditional teaching methods

Consistent with research, inadequate resources negatively affect teacher confidence and instructional quality (Olawale & Hendricks, 2024).

- *Professional Support*

Teachers highlighted limited access to structured professional development:

"Workshops are rare, and when they happen, they're not focused on geometry."

However, those who participated in training reported improved confidence:

"After the training, I felt more confident trying new teaching strategies."

Collaborative support was also limited:

"We don't really get time to plan together as a department."

These findings align with studies emphasizing the importance of mentorship, coaching, and collaborative learning (Jung et al., 2023; Buffington et al., 2021).

➢ *Theme 3: Strategies for Enhancing Self-Efficacy*

- *Professional Development*

Teachers strongly emphasized the need for continuous, geometry-specific training:

"We need workshops that focus specifically on geometry—not general math."

Participants who experienced structured PD reported:

✓ Improved confidence
✓ Better lesson planning
✓ Increased student engagement

This supports evidence linking sustained professional development to improved teacher efficacy and student outcomes (Jacobs et al., 2017; Zakariya, 2022).

- *Technology Integration*

Technology use was limited but highly valued where available.

Teachers who used tools like GeoGebra reported:

"Students understand better when they can see the shapes moving."

However, barriers included:

✓ Lack of devices
✓ Limited training
✓ Fear of over-reliance

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These findings align with research on TPACK and technology integration challenges (Joo et al., 2018; Thurm & Barzel, 2020).

➢ *Collaborative Learning*

Collaboration emerged as a powerful but underutilized strategy.

Teachers who engaged in peer discussions reported:

"When we share ideas, it makes teaching easier and more effective."

Benefits included:

- Shared problem-solving
- Increased confidence
- Exposure to new strategies

However, lack of structured systems limited its impact, consistent with findings by Jacobs et al. (2017).

V. DISCUSSION

The findings highlight that teacher self-efficacy in geometry is shaped by a complex interaction of personal and contextual factors, rather than a single variable.

➢ *Interplay Between Experience and Content Knowledge*

The study challenges the assumption that experience alone leads to higher self-efficacy. Instead, content knowledge emerged as a stronger determinant, supporting prior research (Mohr-Schroeder et al., 2017). In the Guyanese context, this suggests that professional upgrading of experienced teachers is essential.

➢ *Impact of Resource Inequality*

The findings highlight systemic inequalities in school resources, especially between urban and rural areas. Limited access to instructional materials and technology restricts teachers' capacity to implement innovative practices, reinforcing traditional methods (Olawale & Hendricks, 2024).

This highlights the need for equitable resource distribution policies in Guyana.

➢ *Critical Role of Professional Support*

Professional development was identified as a key driver of self-efficacy, particularly when:

- Content-specific
- Sustained over time
- Practice-oriented

This aligns with literature emphasizing mastery experiences and reflective practice as central to building teacher confidence (Zakariya, 2022; Jacobs et al., 2017).

➢ *Technology as a Transformative but Uneven Tool*

While technology has the potential to enhance geometry instruction through visualization and interaction, its impact in Guyana remains uneven due to:

- Infrastructure gaps
- Limited training

Teachers' concerns about over-reliance on technology also highlight the need for balanced integration strategies (Thurm & Barzel, 2020).

➢ *Collaboration as a Sustainable Strategy*

Collaborative learning presents a cost-effective and scalable solution for improving teacher self-efficacy. The findings suggest that structured professional learning communities could:

- Bridge knowledge gaps
- Promote innovation
- Sustain instructional improvement

This is particularly relevant in resource-constrained settings like Guyana.

➢ *Implications for Policy and Practice*

The study suggests several key actions:

- Strengthen geometry-focused professional development
- Invest in equitable distribution of teaching resources
- Expand access to technology and TPACK training
- Institutionalise collaborative professional learning communities
- Support continuous content knowledge development for teachers

➢ *Conclusion of Discussion*

Teacher self-efficacy in geometry within Guyana is not fixed but constantly shaped by experience, knowledge, and systemic support structures. Closing gaps in professional development, resources, and collaboration can foster a more supportive environment where teachers feel confident and capable, ultimately enhancing student outcomes in mathematics (Chang, 2015).

VI. CONCLUSION

The findings of this study highlight that mathematics teachers' self-efficacy in teaching geometry in Guyana is influenced by a dynamic interaction of individual and environmental factors. Teacher experience alone does not guarantee confidence; instead, it is the combination of content knowledge, access to professional support, and adaptability to evolving instructional practices that fosters true efficacy (Caddle et al., 2016; Olawale & Hendricks, 2024). Teachers with strong geometry content knowledge and participation in structured professional development showed higher confidence, more innovative teaching methods, and a greater ability to promote student engagement, emphasising the

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importance of targeted training and reflective practice (Mohr-Schroeder et al., 2017; Jacobs et al., 2017).

Environmental factors, especially the adequacy of school resources and professional support systems, play a crucial role in shaping teacher self-efficacy. Limited access to technology, culturally relevant materials, and collaborative opportunities in resource-limited settings hinder teachers' ability to adopt modern, student-centred pedagogies (Sunzuma & Maharaj, 2019; Koh et al., 2016). Conversely, teachers who engage in collaborative learning, peer mentoring, and technology-supported instruction report increased confidence and a greater willingness to implement innovative strategies, underscoring the vital role of systemic support in sustaining progress (Buffington et al., 2021; Thurm & Barzel, 2020).

These findings confirm that enhancing teacher self-efficacy is not solely an individual effort but requires comprehensive, context-aware interventions that combine content mastery, continuous professional development, collaborative structures, and access to instructional resources. In the Guyanese context, strategically addressing these factors can enable teachers to deliver effective, inclusive geometry instruction, ultimately leading to increased student achievement and engagement in mathematics (Chang, 2015; Olawale & Hendricks, 2024).

In conclusion, strengthening teacher self-efficacy requires a multifaceted approach: investing in content-specific training, facilitating technology integration, promoting collaborative professional learning, and ensuring fair resource distribution. By adopting these strategies, educational policymakers and school leaders in Guyana can develop resilient, confident, and adaptable mathematics educators capable of transforming classroom practice and improving student outcomes in geometry and beyond.

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