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Evaluating the effectiveness of private supplementary tutoring on grade 12 learners' mathematics achievement

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Abstract

This study evaluated the effectiveness of private supplementary tutoring on grade 12 learners' mathematics performance in selected schools within the OR Tambo Inland District, in the Eastern Cape Province of South Africa. The research involved 347 participants from four schools and was grounded in Lev Vygotsky's socio-cultural learning theory. Utilizing quantitative methodology and a causal-comparative research design, data were collected through a questionnaire and the standardized mathematics test. Both descriptive and inferential statistical techniques were employed in the analysis of data. Findings indicate that learners who attended private supplementary tutoring significantly outperformed those who did not. Additionally, 72.5% of the privately tutored learners sought tutoring to enhance their overall mathematics performance, while 86.1% of the non-tutored cited affordability as the primary barrier. Recommendations include strategies for stakeholders to maximize the benefits of private supplementary tutoring sessions and to develop alternative measures to support learners who are financially constrained from accessing such tutorials.

Keywords: private supplementary tutoring, mathematics performance, geometry test, grade 12 learners

INTRODUCTION

Private supplementary tutoring is increasingly recognized as a significant strategy for enhancing learners' academic performance, particularly in challenging subjects such as mathematics (Gan & Shahrill, 2019). Defined as supplementary lessons that occur outside regular school hours and focus on academic subjects–including mathematics, science, and language. Private supplementary tutoring sessions are usually provided in exchange for a fee (Bray, 2014). This type of instruction, often delivered in small groups or one-on-one settings, is arranged, and paid for by individuals rather than by the state (Johnson & Johnson, 2018). The prevalence of private supplementary tutoring is especially notable in subjects perceived as demanding and prone to underperformance, such as mathematics. In South Africa, mathematics is a crucial component of the school curriculum, yet underperformance in this subject remains a significant concern (Mukuka & Alex, 2024; Sriraman, 2017).

It is also important to recognize that poor performance in mathematics is not unique to South Africa; it has been documented in various international contexts. Results from globally based student assessments consistently reveal low levels of achievement in mathematics (Mullis et al., 2012, 2020; Organization for Economic Cooperation and Development [OECD], 2019).

In sub-Saharan Africa, particularly South Africa, the situation appears more challenging (Bethell, 2016; Luneta, 2022; Mukuka & Alex, 2024; Osta et al., 2023; Reddy et al., 2022). One consequence of this underperformance is the increasing number of secondary school learners opting for mathematical literacy instead of mathematics (DBE, 2022). The persistent underperformance of students in mathematics across various contexts highlights the urgent need for effective interventions. Many researchers (e.g., Alex &

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Contribution to the literature

- This study contributes evidence that private supplementary tutorials have a significant positive effect on learners' mathematics performance.
- It highlights the role of accessibility and affordability in learners' decisions to attend private supplementary tutoring, suggesting that improvements in these areas could lead to higher attendance rates and potential benefits for more learners.
- The study affirms the need for schools and educational authorities to integrate structured support programs and address classroom resource limitations, which could reduce reliance on private supplementary tutoring and improve learners' learning outcomes.

Mukuka, 2024; Bethell, 2016; Luneta, 2022; Mukuka et al., 2021) have emphasized this issue, advocating for specific strategies to tackle the challenges in mathematics education.

In the specific context of OR Tambo Inland District of the Eastern Cape Province, a recent study by Maqoqa (2024) identified pedagogical and methodological challenges, as well as learners' lack of interest and comprehension in various geometrical concepts. These factors significantly impact the teaching and learning of Euclidean geometry, ultimately affecting overall mathematics performance. This persistent problem underscores the necessity of exploring effective interventions, such as private supplementary tutoring, to enhance mathematics achievement among learners in this region. Private supplementary tutoring is a widespread phenomenon in many countries and is deeply embedded in their educational cultures. It has been particularly prominent in East Asian countries like Japan, South Korea, China, and Singapore, where there is a traditional emphasis on intellectual advancement (Bray, 2023). However, private supplementary tutoring has also gained recognition in America, Asia, and Europe (Kim & Jung, 2019; Park et al., 2016; Wang & Guo, 2018). Precisely, Bray (2009) reported that about 50% to 80% of students, particularly those in advanced grades in many countries across Eastern Europe, Africa and East Asia participate in private supplementary tutoring.

While private supplementary tutoring has also gained recognition in contexts like South Africa (Mogari et al. 2009), not much is known about its effectiveness, especially in peri-urban areas like the OR Tambo Inland District of the Eastern Cape Province. Therefore, this study aimed to investigate the effectiveness of private supplementary tutoring on mathematics achievement among grade 12 learners in OR Tambo Inland District of the Eastern Cape Province. Specifically, the following research questions were investigated:

1. Is there any significant difference in performance in mathematics between grade 12 learners who attend private supplementary tutoring and their counterparts who do not in selected schools?
2. What are respondents' perspectives on attendance and non-attendance of private supplementary tutoring in mathematics?

In this research, we examined the impact of private supplementary tutoring on mathematics achievement. Our goal was to gain insights into the effectiveness of private supplementary tutoring as an educational strategy. Specifically, we investigated the relationship between private supplementary tutoring attendance and learners' performance in mathematics, with a particular focus on Euclidean geometry. To guide our investigation, we adopted a positivist paradigm, emphasizing empirical evidence, objectivity, and causal relationships (Creswell & Creswell, 2018). Anticipating that our findings would inform the use of private supplementary tutoring to enhance learning outcomes in mathematics, we aimed to address a critical educational challenge in the OR Tambo Inland District and beyond.

Literature Review

Researchers generally agree that private supplementary tutoring serves to enhance and reinforce the material taught in regular classes. In this study, private supplementary tutoring is defined as additional lessons provided by a private tutor outside of school hours, excluding free remedial classes organized by teachers, schools, or departments. These sessions are often conducted in small groups or one-on-one (Gan & Shahrill, 2019).

Private tutors, much like regular teachers, aim to improve students' understanding and performance but charge fees for their services. In some cases, even public schools offer what is termed 'shadow education' (Šťastný, 2022). According to Kinyaduka (2014), schools sometimes mandate private supplementary tutoring for students struggling academically. Moreover, Bray et al. (2016) suggest that low teacher salaries may drive teachers to recommend private supplementary tutoring to supplement their income. This has been observed in Egypt, where state-facilitated private supplementary tutoring led to significant issues with teacher corruption and the undermining of public education (Sobhy, 2012).

Students also seek private supplementary tutoring to build confidence and improve their skills in specialized areas (Ghatpande & Tilak, 2020). Several factors contribute to the need for private supplementary tutoring, particularly in mathematics, where poor performance is a notable issue. These factors may be categorized as follows:

School-related factors

Overcrowded classrooms and high teacher-learner ratios are significant problems. Kim and Park (2010) argue that students from schools with larger class sizes have higher chances of seeking private supplementary tutoring. Smaller class sizes allow teachers to give more attention to each student, potentially reducing the need for external help. Furthermore, a lack of resources and facilities in many schools (especially in low-resource settings) negatively impacts mathematics performance, prompting students to seek private tutors to fill these gaps. Mathematics textbooks and teaching aids are crucial for effective learning, and their absence can lead to poor performance (Suleiman & Hammed, 2019). Chetty et al. (2014) highlight that access to good teachers can have long-term benefits, including higher earnings in adulthood.

Learner-related factors

Examination preparation drives students to seek private supplementary tutoring. Genç and Yayli (2019) note that students frequently experience anxiety and unease during exam periods, and private supplementary tutoring provides a less pressured environment for study. Improving results is another motivation, with parents and teachers recommending private supplementary tutoring to boost academic performance (Gan & Shahrill, 2019). Other factors include students' lack of prior knowledge and negative attitudes towards topics like geometry. Mulala (2015) argues that a student's attitude directly influences their performance in mathematics.

Parent-related factors

Parental educational background and involvement significantly affect students' academic performance. Zamisa (2019) argues that insufficient parental engagement in a child's education can result in low achievement in mathematics, especially in areas such as geometry. Moreover, family income influences the likelihood of affording and investing in private supplementary tutoring, with wealthier families being more able to do so (Zhang & Xie, 2016).

Teacher-related factors

Teachers who exhibit low confidence and competence in delivering mathematics lessons may cause their students to seek private supplementary tutoring elsewhere. This means that the knowledge and professional development of teachers are crucial. Alex (2019) emphasizes that teachers' content knowledge affects what and how they teach, as well as what students learn. Hill and Ball (2004) found that teachers who participate in professional development programs improve their teaching effectiveness.

Given the above, it is important to note that while private supplementary tutoring can enhance learners' academic performance, it also has potential drawbacks. Chui (2016) points out that private supplementary tutoring can impose a financial burden on parents and exacerbate economic imbalances and social inequality. Moreover, Zhang and Bray (2016) highlight that private supplementary tutoring can lead learners to develop a negative perception of mainstream education, resulting in disruption and demotivation among teachers. When students learn specific topics in advance through private supplementary tutoring, they may lose interest when these topics are later introduced by their teachers. Recognizing these negative effects, some countries are considering banning shadow education (Byun et al., 2018; Chui, 2016).

In light of these drawbacks, this study not only assessed the impact of private supplementary tutoring on students' achievement in mathematics but also aimed to uncover learners' views on the role of private supplementary tutoring in addressing poor performance in mathematics. By examining factors related to schools, students, parents, and teachers, this research sought to provide a comprehensive understanding of the dynamics influencing students' mathematics achievement.

Theoretical Framework

This study is underpinned by Lev Vygotsky's socio-cultural theory, which is complemented by the family investment model (FIM).

Lev Vygotsky's socio-cultural theory

Lev Vygotsky's socio-cultural theory, developed in 1934, posits that learning is influenced by social and cultural contexts (Rathakrishnan et al., 2021). According to Vygotsky, cognitive development is a collaborative process, where reasoning is shaped through dialogue with more knowledgeable individuals (Daneshfar & Moharami, 2018). This theory emphasizes the role of social interaction in knowledge construction, particularly through concepts such as scaffolding, the zone of proximal development (ZPD), internalization, and language.

Scaffolding is the process by which knowledgeable individuals, such as tutors, assist learners in connecting new concepts and improving understanding (Gonulal & Loewen, 2018). In mathematics, especially geometry, learners often face difficulties that necessitate additional support (Naidoo & Kapofu, 2020). Private tutors provide scaffolding by employing clear teaching strategies that enhance mathematics learning (Bowles et al., 2018).

Effective scaffolding improves students' problem-solving abilities in areas like Euclidean geometry, which requires critical thinking and deeper comprehension (Rokhmat & Putrie, 2019).

ZPD refers to the range of tasks a learner can perform with guidance but not yet independently (Guseva & Solomonovich, 2017). The effectiveness of private supplementary tutoring can be measured by the extent to which learners progress within their ZPD and eventually solve problems independently (Baker et al., 2010).

Internalization is the process by which learners absorb and integrate knowledge into their existing cognitive structures (Suthers, 2006). In the context of study, it has been assumed that effective internalization helps learners understand and apply mathematical concepts in various contexts. As such, it is believed that private supplementary tutoring has potential to help learners understand concepts meaningfully especially those that might have proved challenging to them during regular classes.

Language plays a crucial role in learning mathematics. Mathematical language, consisting of specialized symbols and terminology, requires dedicated time and effort to master (Srinivas et al. 2019). Private tutors help learners navigate this language, facilitating a deeper understanding of mathematical concepts (Ferreira & Freitas, 2020). This is attributed to the fact that most private supplementary tutoring sessions are organized in small groups, which gives a tutor enough room to assist learners based on their diverse needs.

Family investment model

The FIM is based on the idea that well-resourced families are more likely to invest in their children's education and development (Duleep, 1989). Private supplementary tutoring, which incurs additional costs, is more accessible to affluent families, providing their children with an educational advantage. In contrast, families with limited financial resources may rely solely on public schooling, which can be insufficient, especially in challenging subjects like mathematics.

This model is relevant to this study because it highlights the disparity in access to private supplementary tutoring based on family income. Well-resourced families can afford more frequent and sustained private supplementary tutoring sessions, which can significantly enhance their children's mathematics performance. Conversely, families with lower incomes may struggle to afford such services, limiting their children's opportunities for academic improvement through private supplementary tutoring.

Integration of the two theories in the study

Combining Vygotsky's socio-cultural theory with the FIM provides a comprehensive framework for understanding the dynamics of private supplementary tutoring in mathematics. Vygotsky's theory explains the educational processes and interactions that make private supplementary tutoring effective, emphasizing the importance of scaffolding, ZPD, internalization, and language in learning. Meanwhile, the FIM addresses the socioeconomic factors that influence access to these educational opportunities. By examining both the pedagogical and socioeconomic dimensions, this study aims to provide a holistic understanding of how private supplementary tutoring impacts mathematics achievement among grade 12 learners. This dual-theoretical approach highlights the importance of both effective teaching strategies and equitable access to educational resources in improving academic outcomes.

METHODS

Research Design

As indicated earlier, this study examined the relationship between private supplementary tutoring attendance and learners' performance in Euclidean geometry among grade 12 students. The study employed a causal comparative research design. The causal comparative research design, also known as ex post facto research, is well-suited for our study in the sense that we aimed to investigate the effect of an independent variable (private supplementary tutoring attendance) on a dependent variable (learners' performance in Euclidean geometry). This is a widely acknowledged design in academic research (Creswell & Creswell, 2018). By comparing two groups (tutored vs. non-tutored), we were able to determine whether private supplementary tutoring causally influences learners' outcomes in the domain of Euclidean geometry, thus contributing to a comprehensive understanding of the educational dynamics at play.

Selection of Respondents

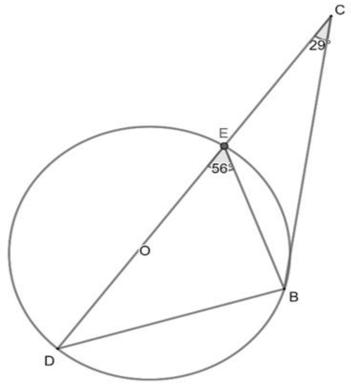
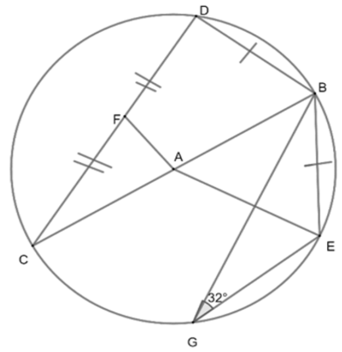
In this study, the original plan was to have a sample size of 375, aiming for a representative subset. To determine this sample size, the following formula was utilized:

$$n = \frac{N}{1+Ne^2}. \quad (1)$$

Here, n is the sample size, N is the population size (N = 6,000), and e is the margin of error at 5% level.

Following the determination of the appropriate sample size, a random sampling method was employed to select four secondary schools from a pool of 102 secondary schools situated in the OR Tambo Inland

Table 3. Samples of the administered geometry test questions

Figure	Question description and suggested solution/answer	Mark allocation
	Q1. Complete the following statement about the alternate segment theorem: The angle between the tangent to a circle and a chord is … Suggested answer: … *equal to the angle in the alternate segment*	1 mark (cognitive demand: **K**)
	Q2. In diagram, O is a centre of circle B, D and E. BOE is a straight line produced to C such that $\boldsymbol{B\hat{C}E = 29^0}$. BE is drawn such that $\boldsymbol{B\hat{E}O = 56^0}$.	
	(a) Show that BC is NOT the tangent to the circle with DBE. Suggested solution: $\boldsymbol{E\hat{B}D = 90}^0$ … Angle on the semicircle ∴ $\boldsymbol{\hat{D} = 34^0}$… Sum of the angles in a triangle. $\boldsymbol{E\hat{B}C + 29^0 = 56^0}$… Ext angle of a triangle = sum of 2 opp interior angles $\boldsymbol{E\hat{B}C = 27^0}$. $\boldsymbol{\hat{D} \neq E\hat{B}C}$ implying that the theorem stated in Q1 does not hold. Hence, BC is NOT the tangent to the circle with DBE.	4 marks (cognitive demand: **P**)
	(b) If the radius of the circle is 5 units, determine the value of BE, correct to ONE decimal digit. Suggested solution: $\boldsymbol{DE = 10\ units}$. $\boldsymbol{\cos 56^0 = \frac{BE}{10}}$. $\boldsymbol{BE = 10 \times \cos 56^0 = 5.6}$.	2 marks (cognitive demand: **R**)
	Q3. In the diagram, A is a **center** of the circle and CAB is a diameter of the circle. AF bisects CD at F. G and E are points on the other side of CB with respect to D. Chords DB, BE and EG are drawn such that DB = BE and $\boldsymbol{E\hat{G}B = 32^0}$.	
	(a) Determine with reasons the size of angle BAE. Suggested answer: $\boldsymbol{B\hat{A}E = 64^0}$… angle at centre is twice angle at the circumference.	4 marks (cognitive demand: **R**)
	(b) If FA= x units, write down with reason, length of BE in terms of x. Suggested answer: By mid-point theorem, $\boldsymbol{DB = 2FA = 2x, hence\ BE = 2x}$	3 marks (cognitive demand: **R**)
	(c) Prove that triangle CAF is congruent to triangle CBD. Suggested solution: In ΔCAF and $\boldsymbol{\Delta CBD}$. $\boldsymbol{\hat{F} = \hat{D} = 90^0}$ (line from the **center** perpendicular to the chord bisects the chord). $\boldsymbol{\hat{C}}$ is common to both triangles $\boldsymbol{\hat{A} = \hat{B}}$ since AF and BD are parallel (by mid-point theorem). Therefore, ΔCAF /// $\boldsymbol{\Delta CBD}$…A, A, A.	3 marks (cognitive demand: **C**)

District. The selection was designed to randomly select two schools from rural areas and two from urban areas. This approach ensured that each school within the target district had an equal opportunity to be part of the research. Each chosen school provided data from a minimum of 30 and a maximum of 91 grade 12 mathematics learners. However, the final participant count amounted to 347, falling short of the initially planned 375 participants. This discrepancy was partly due to absenteeism among learners during the data collection process.

Data Collection Instruments

In this research, data collection involved two main instruments: a structured questionnaire and a standardized Euclidean geometry test. The questionnaire was distributed to learners across the four different schools (both rural and urban settings) and primarily consisted of "yes" or "no" responses, along with demographic information. The information collected through the questionnaire included respondent's gender, place of residence (rural or urban), school location (rural or urban), whether they attended or did not attend private supplementary tutoring sessions, and the reasons for attending or not attending.

In contrast, the geometry test adhered to the guidelines outlined in the curriculum and assessment policy statement (CAPS) by the DBE (2011). **Table 1** provides samples of the geometry test questions administered to the respondents. Following the recommendations of the CAPS document (p. 58), the geometry test included questions with varying levels of cognitive demand: knowledge (K), routine procedure (R), complex procedure (C), and problem-solving (P).

At the knowledge level, students demonstrate factual recall and basic understanding. This involves remembering definitions, facts, and simple concepts such as identifying geometric shapes or recalling the properties of angles. Routine procedures involve applying well-established algorithms or methods, where students follow step-by-step processes to solve problems. Examples include calculating the perimeter of a polygon, finding the area of a triangle, or using the Pythagorean theorem.

Complex procedures require deeper understanding and reasoning, where students apply multiple steps or strategies to solve non-standard problems. For instance, this could involve proving congruence between triangles. Problem-solving tasks demand creativity, critical thinking, and the ability to apply mathematical

Table 2. Descriptive statistics for students' performance in geometry test

Group	N	Mean	Standard deviation	Skewness	Kurtosis
Tutored	80	53.95	28.054	-0.307	-1.196
Non-tutored	267	33.59	25.807	0.682	-0.416

concepts in novel situations. Students analyze complex problems, devise strategies, and justify their solutions. An example might be constructing a geometric proof.

Validation of Data Collection Instruments

To ensure instrument reliability, a rigorous validation process was conducted, involving evaluation by field experts. Following a procedure like the one employed by Mukuka et al. (2020) in their validation of a "mathematical reasoning assessment tool", key indicators such as sufficiency, clarity, coherence, and relevance were assessed for all items in both the questionnaire and geometry test. Following expert feedback, refinements were made, and the validated instruments were then used for data collection.

The test, which was designed to be completed within a 30-minute timeframe, carried a total of 25 marks. Following the test, a questionnaire was distributed to the same respondents. We made sure that the identification number on the test script corresponded to the identification number on each respondent's questionnaire. This strategy played a crucial role in correlating each respondent's solutions (answers) to the geometry test with their responses to the questionnaire. This was achieved while maintaining the anonymity of the respondents, as they were not required to disclose their identities.

Data Analysis

This study employed a quantitative approach, analyzing data from respondents using both Microsoft Excel and the statistical package for social science version 27. Descriptive statistics were computed, including measures such as frequencies, means (M), standard deviations (SD), minimum and maximum values, skewness, and kurtosis. These descriptive statistics were presented before establishing whether there was a statistically significant difference between the privately tutored and non-privately tutored students. Frequency distributions helped quantify responses within specified categories. Frequency distributions were also used for identifying coding errors and wrong entries, which were corrected before further analysis. Mean values provided insights into average scores, while standard deviations gauged data dispersion around the mean. Skewness and kurtosis values assessed data fluctuations and deviations from a normal distribution.

For inferential statistics, an independent samples t-test assessed geometry performance differences between learners who attended private supplementary tutoring and those who did not. To strengthen the overall quality of the research findings assumption checking for an independent samples t-test were conducted to guarantee the reliability and validity of these statistical analyses. As per the recommended procedure (Field, 2013), we checked for normality, homogeneity of variances between the two groups, and the presence or absence of outliers in the data.

Ethical Considerations

This study adhered to ethical guidelines at all stages of the project. Researchers obtained informed consent from all respondents and emphasized their right to withdraw without adverse consequences. The process aligned with the university's guidelines. Respondents were assured that personal information would not be solicited or exposed. Additionally, the principle of safety and protection was upheld to ensure no harm to respondents physically or otherwise. After obtaining the ethical clearance certificate (ref no. FEDSRECC02-11-21) from the university, permission to conduct the research was sought from Eastern Cape Department of Education.

RESULTS

Research Question 1

Table 2 illustrates the mean scores for two distinct groups based on their participation in private supplementary tutorials. Based on results displayed in **Table 2**, the number of students who did not attend private supplementary tutoring was significantly higher than those who attended. The reasons for this high prevalence of non-attendance are displayed in **Table 2**.

Based on the results displayed in **Table 2**, respondents who attended private supplementary tutoring sessions scored higher (M = 53.95, SD = 28.054) than those who did not attend private supplementary tutoring sessions (M = 33.59, SD = 25.807). However, it essential to note that this analysis requires an assessment of whether the observed mean difference between these groups is statistically significant. Therefore, an independent samples t-test was conducted.

Before running an independent samples t-test, an examination of assumptions was carried out to ensure the appropriateness of the data for conducting an independent samples t-test. Upon conducting the Kolmogorov-Smirnov (K-S) and Shapiro-Wilk (S-W) tests, it was discovered that the data did not meet the assumption of normality. However, an examination of the skewness and kurtosis coefficients, as presented in

Table 3. Independent samples t-test results

	Levene's test		t-test results			95% confidence interval	
	F	Sig.	t	df	Sig.	Lower	Upper
Equal variances	3.82	.051	6.07	345	.000	13.76	26.97
Unequal variances			5.8	121.8	.000	13.41	27.31

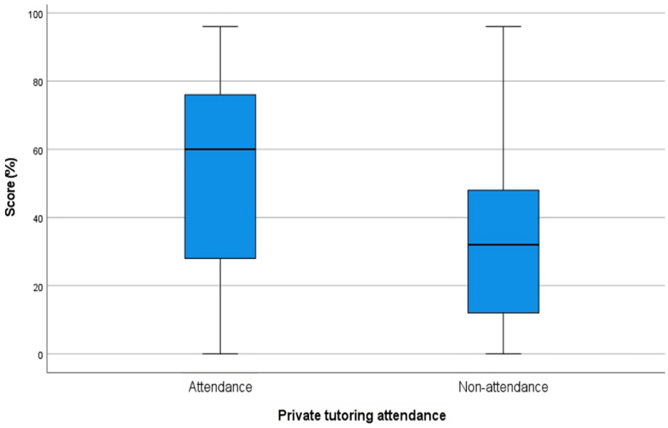


Figure 1. Box plot for attendance and non-attendance of private supplementary tutoring sessions (Source: Authors' own elaboration, using SPSS)

Table 2, revealed that both the tutored and non-tutored groups fell within the acceptable range for random fluctuations, as suggested by Kline (2008). This indicates that, despite a minor departure from a normal distribution, the data were still amenable to statistical analysis. This justifies the execution of the independent samples t-test, the outcomes of which are presented in **Table 3**.

Furthermore, it is noteworthy that no outliers were identified in the data, as depicted in the box plots provided in **Figure 1** for both the tutored (attendance) and non-tutored (non-attendance).

Based on **Figure 1**, it is evident that the minimum and maximum scores for both groups were identical. Nevertheless, a key distinction arises when considering the medians: the non-attendance group displayed a lower median score compared to their counterparts who attended private supplementary tutoring sessions. Furthermore, **Figure 1** offers a compelling visual representation of the skewness within the two groups, highlighting that the non-tutored group exhibited a greater degree of skewness compared to the tutored group. This is consistent with the skewness coefficients displayed in **Table 2**.

Based on Levene's test results displayed in **Table 3**, variances of the two groups (tutored and non-tutored) were insignificantly different at the 5% level of significance since, p =.051 is greater than .05. This means that the assumption of homogeneity of variances was also achieved, further justifying the appropriateness of conducting an independent samples t-test.

The findings presented in **Table 2** reveal a substantial 20.36 mean difference in performance between respondents who attended private tutorials and their counterparts who did not attend. Furthermore, the independent samples t-test results (as displayed in **Table 3**) yielded a p-value of less than .001, signifying that this difference in mean performance is statistically significant. Consequently, it can be concluded that learners who participated in private supplementary tutoring sessions significantly outperformed those who did not attend. This conclusion is further amplified by the substantial effect size (d = 0.773), indicating a noteworthy impact of supplementary private supplementary tutoring on students' performance in mathematics.

Table 4. Reasons for respondents' private supplementary tutorial attendance

Reasons for attendance	Frequency	Percent
To boost mathematics performance	58	72.5
To prepare for examination	18	22.5
For individual attention	4	5.00
Total	80	100

Research Question 2

The second research question sought to profile students' perspectives on their attendance and non-attendance of private supplementary tutoring.

It has been shown in **Table 2** that only 80 respondents indicated having attended private supplementary tutoring sessions. **Table 4** illustrates the reasons as to why these respondents chose to attend private supplementary tutorial sessions.

Results displayed in **Table 4** show that 72.5% of participants reported that they attended private supplementary tutoring classes with a view to improve their performance in mathematics. Furthermore, 22.5% of respondents claimed that they only wanted private supplementary tutoring classes for exam preparations, and only 5% wanted individual attention.

On the other hand, results displayed in **Table 2** show that a higher proportion of respondents (n = 267) belonged to the non-tutored group. Reasons for non-attendance are displayed in **Table 5**.

Results displayed in **Table 5** demonstrate that 86.1% of respondents did not attend private supplementary tutoring classes because of cost and financial limitations. Only 8.6% stated that private supplementary tutoring sessions were unavailable in their area. It is reasonable to assume that many of these respondents would likely attend private supplementary tutoring if such centers were available nearby.

Table 5. Reasons for not attending private supplementary tutoring sessions

Reasons for non-attendance	Frequency	Percent
Affordability	230	86.1
No tutors around	23	8.6
No need for tutorials	3	1.1
Unaware of private tutoring classes	9	3.4
Other reasons	2	0.7
Total	267	100

DISCUSSION

The first research question examined the impact of private supplementary tutoring classes on students' mathematics performance. Findings reveal that those who attended tutorials (n = 80) scored significantly higher (M = 53.95, SD = 28.054) than those who did not (n = 267, M = 33.59, SD = 25.807). A further analysis of an independent samples t-test results revealed a significant mean difference between the two groups, $t(345) = 6.07$, $p < .0001$. The analysis further concluded that private supplementary tutoring substantially enhances mathematics performance, as evident by a large effect size, d = 0.773.

These results suggest a statistically significant association between private supplementary tutorial attendance and improved mathematics performance, with potential implications for overall mathematics achievement. In essence, the more learners attend private supplementary tutoring, the higher their proficiency in mathematics, which positively influence their overall mathematics performance. These findings align with those of Ghatpande and Tilak (2020), who also observed that learners who opt for private supplementary tutoring tend to exhibit greater confidence in their respective subjects and frequently attain higher academic results when compared to their non-tutored counterparts.

Furthermore, similar findings were obtained by Guill and Bos (2014) in Germany, who reported that private supplementary tutoring had a demonstrable positive impact on learners' mathematics achievement. According to a recent study by Shokirova and Rasulov (2024), tutoring in high school showed diverse effects on overall academic performance, with a notably beneficial impact observed specifically in mathematics.

While it is recognized that private supplementary tutoring can have a significant impact on learning outcomes, it is important to note that this impact is not universally consistent. A study conducted by Zhang et al. (2022) on the mathematics learning of middle school students in China found only a marginal effect of private supplementary tutoring on learners' achievement levels in mathematics. This finding suggests that the benefits of private tutoring can vary widely, influenced by individual circumstances and a range of other variables.

In addition, the effectiveness of private supplementary tutoring is not constant; it can fluctuate based on several factors. These factors encompass the standard of tutoring offered, the student's degree of involvement, and the particular setting in which learning occurs. Given these considerations, Zhang et al. (2022) advise parents to exercise caution when selecting private supplementary tutoring for their children. They also call for the government to establish comprehensive and professional guidelines to regulate the private supplementary tutoring industry. This dual approach ensures that the potential benefits of private supplementary tutoring are maximized, while any negative impacts are mitigated.

The second research question sought to understand students' perspectives on attending and not attending private supplementary tutoring. Among the 80 respondents who attended tutoring, the majority (72.5%) did so to improve their mathematics performance, while 22.5% attended to prepare for exams, and 5% sought individual attention. Conversely, of the larger group of non-attendees (n = 267), the primary deterrent was affordability (86.1%), with a smaller proportion (8.6%) citing the lack of available tutors in their area. This suggests that if tutoring services were more accessible and affordable, there could potentially be a higher attendance rate.

The students' perspectives on attendance and non-attendance of private supplementary tutoring provide empirical support for many of the factors identified in the literature.

First, the high attendance of private supplementary tutoring due to the desire to boost mathematics performance and exam preparation resonates with the literature that overcrowded classrooms and high student-teacher ratios often drive students to seek additional help (Chetty et al., 2014; Kim & Park, 2010). The lack of resources and facilities in many schools, as mentioned in the literature, could be a contributing factor to the high attendance of private supplementary tutoring (Suleiman & Hammed, 2019).

Second, the motivation to improve results and alleviate exam-related anxiety, as found in this study, aligns with the literature's findings on learner-related factors (Genç & Yayli, 2019). The literature also mentions students' lack of prior knowledge and negative attitudes towards certain topics as reasons for seeking private supplementary tutoring (Gan & Shahrill, 2019; Mulala, 2015).

Third, literature emphasizes importance of teachers' content knowledge and professional development (Alex, 2019; Mukuka & Alex, 2024), which could be linked to the quality of private supplementary tutoring provided by the teachers. Indirectly, this could imply that teachers who lack confidence and competence may lead students to seek private supplementary tutoring.

CONCLUSION

This study aimed at investigating the impact of private supplementary tutorials on students' mathematics performance and to understand the factors influencing students' decisions to attend or not attend these tutorials. The findings reveal a significant positive effect of private supplementary tutoring on mathematics performance, with tutored students scoring notably higher than their non-tutored peers. This result affirms the potential benefits of private supplementary tutoring in enhancing mathematical proficiency, which has significant implications for teaching and learning practices in mathematics.

The implications for teaching and learning are substantial. Schools and educators should recognize the value of supplementary tutoring and consider integrating structured support programs within the school system to provide additional help to students who need it. Additionally, addressing the high student-teacher ratios and resource limitations in classrooms could reduce the reliance on private supplementary tutoring. Efforts should also be made to improve the accessibility and affordability of tutoring services to ensure that more students can benefit from additional academic support, particularly those from lower-income backgrounds.

Despite the significant contribution this research will make to the field, we acknowledge that the study required data collection from diverse contexts and educational levels. However, financial constraints limited our ability to visit many schools, particularly those in remote areas within the district. As such, it is essential to conduct further research to understand the varying impacts of private supplementary tutoring across different contexts and populations. Future studies could explore the quality and effectiveness of tutoring services, the long-term impact on academic achievement, and the potential psychological effects on students.

Additionally, policymakers should consider developing comprehensive guidelines to regulate the private supplementary tutoring industry, ensuring that it operates to high standards and provides equitable access to quality education support. This dual approach will help maximize the benefits of private supplementary tutoring while minimizing any negative impacts, thereby ensuring that all learners could succeed in mathematics and other subjects. Furthermore, addressing the potential equity implications is crucial, particularly in terms of accessibility and affordability for learners from lower-income backgrounds. By making private supplementary tutoring more accessible and affordable, we can help bridge the gap in educational opportunities and support all learners in achieving their full potential.

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