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Peer Tutoring Strategy: A Quantitative Analysis of Pre-Service Teachers' Academic Achievement in Mathematics

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Abstract

This research focused on investigating the impact of employing peer tutoring as an instructional approach on the academic attainment of pre-service teachers in mathematics within selected Colleges of Education in Ghana. The investigation was guided by two research inquiries and corresponding hypotheses. The research design employed was quasi-experimental, involving a sample of 370 third-year pre-service teachers drawn from three Colleges of Education situated in two regions of Ghana. To gather data for analysis, a Mathematics Students Achievement Test (MSAT) was crafted and validated by three experts, demonstrating a reliability index of 0.81 as determined by Pearson Product Moment Correlation. The collected data underwent analysis utilizing adjusted means and standard deviations to address the research queries. Meanwhile, the null hypothesis was assessed using Analysis of Covariance (ANCOVA) at a significance level of 0.05. The outcomes of the study unveiled that participant exposed to the peer tutoring instructional approach achieved higher scores and exhibited notably superior performance compared to those who experienced the traditional talk and chalk teaching method. Moreover, the assessment of interaction effects indicated that gender did not significantly interact with the teaching strategy in relation to students' average performance. In conclusion, this study underscores the efficacy of employing peer tutoring as an instructional strategy for teaching mathematics. Consequently, it is recommended that mathematics educators embrace this approach as a valuable tool within their instructional repertoire. Given that peer tutoring demonstrated greater effectiveness and contributed to heightened mathematics achievement compared to conventional teaching methods, it should be integrated as one of the preferred strategies for mathematics instruction in classrooms.

Keywords: Peer Tutoring Strategy, Quantitative Analysis, Pre-Service Teachers, Academic Achievement, Mathematics

1. Introduction

Mathematics, a realm of study concerned with the organization, arrangement, and interconnections that originated from basic actions such as counting, measuring, and describing shapes, delves into the realms of logical reasoning and numerical computations. As it has

evolved, its focus has shifted towards increasingly refined and abstract concepts (Whitehead, 2017). The significance of mathematics resonates deeply in our daily existence, functioning as the bedrock and language of virtually all scientific domains. Its capacity to unveil patterns and facilitate comprehension of our surroundings is invaluable. Nevertheless, for numerous individuals, whether at the elementary, secondary, or even university level, mathematics remains daunting due to its inherent abstraction (Powell, Lembke, Ketterlin-Geller, Petscher, Hwang, Bos, Hopkins, 2021). Hence, the responsibility lies with mathematics educators to cultivate an environment that nurtures students' engagement with this subject. A viable approach to achieve this goal is by fostering collaborative learning through the implementation of peer tutoring strategies.

Peer tutoring, as defined by Gu and Gu (2019), encompasses a sustained intervention where the exchange of knowledge among peers extends beyond purely academic domains. Peer tutoring or support is a widely accepted practice in higher education worldwide, encompassing various activities. These activities encompass scenarios like peers facilitating group study sessions, such as Peer Assisted Study Sessions, or engaging in one-on-one peer support within academic peer-learning contexts or programs (Giles & Ody, 2015; Andreanoff, 2016). Additionally, some of these initiatives incorporate structured learning tasks (Chilvers, 2016; Leidenfrost et al., 2014), while others emphasize offering moral encouragement (Fayram et al., 2018). The advantages of peer tutoring or support for students are typically evidenced through heightened confidence and motivation, increased participation both socially and academically, and an enhanced sense of belonging. Mentors engaging in these practices benefit by cultivating deeper subject expertise and honing valuable employability skills. From an organizational standpoint, several research studies have indicated an augmentation in student retention (Giles & Ody, 2015; Andreanoff, 2016; Olivier & Burton, 2020).

Shi (2019), highlighted that within the realm of mathematics, there exists significant diversity in students' skill levels, with researchers attributing this variance to factors like class size and foundational mathematical knowledge. Undoubtedly, the student demographic attending Colleges of Education in Ghana is highly heterogeneous, encompassing a range of characteristics such as interests, readiness, capabilities, abilities, age, and socioeconomic backgrounds. These factors collectively impose limitations on the teaching and learning process. Furthermore, class sizes surpass acceptable standards, undermining the effectiveness of mathematics instruction, which is a subject of broad importance. The academic performance of students in mathematics, both within internal and external examinations, has shown a notable lack of proficiency. Employing traditional methods like the talk and chalk approach has yielded limited outcomes due to the expansive class sizes (Zhang & Bayley, 2019; Fisher et al., 2020).

Consequently, a fundamental question arises: In light of these constraining factors, what alternative instructional strategy can mathematics educators adopt beyond the conventional talk and chalk method? The current educational landscape underscores the necessity for a more outcomes-focused teaching strategy that centers on students and adapts to the contemporary era of education. This shift allows for flexibility in both learning methodologies and pedagogical approaches, aiming to enhance students' academic achievements.

2. Review of Previous Literature

Peer Tutoring

As Wang (2018) expounds, peer tutoring stands as an instructional approach wherein educational institutions (teachers, departments, schools) formulate opportunities that enable students to engage in reciprocal teaching and learning. This methodology facilitates the adept utilization of both teacher and peer-tutor capabilities, fostering personalized instruction and effective classroom management. In essence, peer tutoring involves students taking on the role of educators for fellow students, either of similar or disparate ages, engaging in one-on-one interactions, or with one mentor guiding the learning of two or three students (Cornelius & Sandmel, 2018).

Cross et al. (2020) put forth the viewpoint that peer teaching (tutoring) functions as an instructional framework where learners collaborate in tandem. Additionally, Bukari and Kuyini (2015) characterized peer tutoring as a collaborative learning process wherein students impart desired skills and knowledge to their peers, with active coordination with teachers to address queries or concerns. Nonetheless, the constant presence of a teacher is crucial to promptly address any issues that might arise among students. Cropp (2017) contended that peer tutoring or support significantly enriches the overall learner experience, assuming a pivotal role in cultivating learning communities that impact student confidence, motivation, and ultimately, retention. Similarly, motivation and enhanced confidence exert influence on participation and the growth of a cohesive learning community (Deshler, Fuller, & Darrah, 2019).

Fuadiah and Suryadi (2019) emphasized the need to adapt teaching and learning practices to facilitate cognitive and social development for both high-performing and low-performing students, using an individualized and positive approach. Vygotsky, as cited in Abdelkarim and Abuiyada (2016), proposed that effective learning involves dialogue and interaction among individuals. As a pedagogical strategy, peer tutoring has been identified as a means to promote interaction among students, which has led to its increasing recognition and acceptance within educational institutions. The impact of peer interaction extends to academic achievement and motivation (Abdelkarim & Abuiyada, 2016; Debbağ & Yıldız, 2021).

Furthermore, the varying performance levels of students within a class, grade level, or school environment make peer tutoring a viable approach for students with diverse abilities, across different age groups, and from various socioeconomic backgrounds. Lam (2019) further defined peer tutoring as a form of communication between a proficient student, who has excelled or recently succeeded in the course, and another student facing challenges in the same subject.

In this scenario, the students with advanced understanding of the lesson take on the role of tutors, assisting their peers referred to as tutees. To enhance the teaching and learning of mathematics, it is important to foster a natural and interactive environment, enabling students to acquire valuable skills from their fellow students. The concept of drawing from Vygotsky's theory of social constructivism illustrates how students learn from each other, developing and exchanging simple techniques or approaches for solving mathematical problems. Peer tutoring is a valuable practice, aligning with Albert Bandura's social learning theory, where students (mentees) directly imitate the behavior of their fellow student (mentor), subsequently

replicating their actions. The practical significance of mathematics as a daily skill can be effectively cultivated when peers collaborate in activities such as practicing giving and receiving change during buying and selling transactions. As such, peer tutoring empowers students to engage in mutual learning, fostering cooperative interactions that extend into their daily lives (Abdellkarim & Abuiyadu, 2016).

Furthermore, as highlighted by Jalal (2021), peer tutoring stands out as a highly potent strategy within the realm of teaching and learning. This approach adeptly addresses both the social and academic facets of education, forging an environment that fosters comfortable and effective interactions for both teaching and learning endeavors. Additionally, Asempapa et al. (2021) observed that students who engage in collaborative group work exhibit enhanced performance in examinations, particularly in tasks that necessitate reasoning and critical thinking capabilities. In essence, peer tutoring embodies a form of collaborative learning that often arises organically among groups of students.

Peer Tutoring on Students' Achievement in Mathematics

Utilizing peer tutoring has been demonstrated as an effective method for boosting mathematical achievement (Chong et al., 2020). Orland-Barak and Wang (2021) underscored that peer tutoring benefits both proficient and struggling learners. It empowers adept learners to attain mastery over course concepts, enabling them to articulate their ideas with confidence. Concurrently, learners facing challenges witness improvement and advancement in their performance, enhancing their grasp of lesson content. This strategy fosters crucial values such as sharing, self-esteem, and self-discipline for both proficient and struggling learners alike (Abdelkarim & Abuiyada, 2016).

In a separate investigation, Jibrin and Zayum (2012) discovered that individuals exposed to the peer tutoring method exhibited significantly superior achievements compared to those who experienced traditional teaching methods. The peer tutoring approach promotes collaborative learning, allowing students to glean insights from peers who may be at the same or varying academic levels and ages. Consequently, this approach surmounts certain obstacles often associated with sole reliance on teacher-led instruction. The peer tutoring instructional strategy, also known as peer tutoring, peer leadership, cooperative learning pairs, peer-assisted learning, peer education, child-teach-child, mutual instruction, partner learning, and peer teaching (Zhang & Bayley, 2019; Fisher et al., 2020), encompasses diverse terminologies.

Moreover, the efficacy of teaching and learning hinges significantly on the teacher's influence, in addition to other factors such as student interest, preparedness, content relevance, and access to educational resources. Educators are acknowledged as the custodians of the education system, as the quality of education can only match the caliber of its teachers (Rosemary et al., 2015). Particularly in mathematics, teachers play a pivotal role in employing suitable teaching strategies to enhance student performance. The adoption of the peer tutoring instructional strategy holds the potential to support students both academically and socially. Proficient peer tutoring not only fosters learning motivation and subject-oriented performance but also serves as a social platform for mentors and mentees to recognize and validate effective practices.

Gender and Mathematics Achievement

A prominent issue within mathematics education is the establishment of a teaching and learning environment that ensures equal opportunities for male and female students in mastering mathematics (Mensah & Nabie, 2021). Addressing gender-related disparities in mathematics achievement is a crucial concern for mathematics educators and policymakers. Substantial empirical evidence from sources like Awofala & Lawani (2020), Mensah & Nabie (2021), and Mensah et al. (2022) supports the assertion that employing student-centered teaching approaches in mathematics classrooms results in comparable performance levels for both male and female students. Nonetheless, the prevalence of male dominance in mathematics and other STEM disciplines remains noteworthy. For instance, Johnson and Kasmer (2018) identified statistically significant differences favoring male participants in terms of mathematics achievement. This underscores the necessity to explore the impact of more student-centered teaching methods in mathematics education in relation to gender dynamics.

Nonetheless, the majority of research on peer tutoring or support within higher education primarily centers around in-person learning scenarios (Lee, McGee, Pfund, & Branchaw, 2015; Haran & Jeyaraj, 2019; Bradley-Levine, 2016). Minimal investigation has been conducted on the application of the peer tutoring instructional strategy to enhance pre-service teachers' performance in mathematics. This study endeavors to implement the peer tutoring instructional strategy within a mathematics classroom setting, with the objective of ascertaining its potential to complement the conventional methods commonly employed in numerous Colleges of Education across Ghana.

Inquiries of the Study

The study was steered by the subsequent inquiries:

1. What impact does the implementation of the peer tutoring instructional strategy have on the mathematical accomplishments of pre-service teachers?
2. Does gender exert any influence on the mathematical achievements of pre-service teachers when the peer tutoring instructional strategy is employed?

Research Assumptions

The study formulated the following hypotheses as guiding principles:

H1: The utilization of peer tutoring instructional strategy does not lead to a significant impact on the achievement of pre-service teachers in mathematics.

H2: The implementation of the peer tutoring instructional strategy does not yield a significant influence of gender on the achievement of pre-service teachers in mathematics.

3. Methodology

Research Design

In this study, the researchers adopted a quasi-experimental design, which is a recognized quantitative research approach. This methodology aims to ascertain whether specific activities or materials yield discernible distinctions when applied to particular participant categories (Sileyew, 2019; Handley et al., 2018; Turner et al., 2017). The primary objective of employing this design is to establish potential cause-and-effect relationships between independent and

dependent variables. In an experimental design, the experimental group receives the designated treatment, whereas the control group does not (Creswell, 2014).

Given these principles, the research study was structured using a randomized control-group pretest post-test design. This approach was chosen due to its capacity to align groups through random assignment, the application of a pre-test, the utilization of peer tutoring as a teaching strategy (treatment), and the implementation of a post-test to assess variations in students' academic achievement. Consequently, the study adopted an experimental group design, specifically focusing on the non-equivalent control group design. The rationale for employing a quasi-experimental design lies in its suitability for assessing causal relationships when randomized controlled trials (RCTs) may not be feasible due to practical or ethical constraints. The chosen design allows for the examination of the impact of the peer tutoring teaching strategy on academic achievement while considering the limitations inherent in controlling all variables completely. The randomized control-group pretest post-test design offers a way to mitigate the influence of pre-existing differences among groups and permits a more valid assessment of the effectiveness of the peer tutoring approach

Population and Sampling

The study encompasses a population of 1,750 third-year pre-service teachers from Colleges of Education (CoEs). These institutions are located in the Eastern and Volta regions of the Republic of Ghana. The sample includes 370 pre-service teachers selected from these three CoEs, with 153 males (41.4%) and 217 females (58.4%) comprising the respondents. The selection of the three CoEs was carried out through purposive sampling, while a random sampling technique was utilized to identify a total of six classes (two classes from each college) for inclusion in the study. The selection of the CoEs was accomplished through non-probability sampling (Creswell, 2014), taking into account their proximity to the researchers.

Within each of the three colleges, one class was designated as the experimental group, while the other class was assigned as the control group. In total, the experimental group consisted of 193 respondents, with 110 (57.0%) females and 83 (43.0%) males. Similarly, the control group comprised 177 respondents, consisting of 96 females (54.2%) and 81 males (45.8%). This sampling approach ensured the immediate validation of data, as it encompassed all participants without exclusion. The demographic breakdown of the respondents can be found in Table 1 below.

Table 1: Demographic Information of Respondents

Category		**Male (n=153)**	**Female (n=217)**
College	A	41 (26.8%)	62 (28.6%)
	B	60 (39.2%)	75 (34.6%)
	C	52 (34.0%)	80 (36.8%)
Age	15-20	10 (6.5%)	25 (11.5%)
	21-25	61 (39.9%)	84 (38.7%)
	26-30	67 (43.8%)	78 (35.9%)
	30+	15 (9.8%)	30 (13.8%)

Validity and Reliability of Test Instrument

The collection of data involved a mathematics performance test comprising 25 multiple-choice objective questions with answer options (A-D), meticulously formulated by the researchers. To ascertain its validity, the instrument underwent validation by an expert from the mathematics departments of the three colleges included in the study. Additionally, content validity was upheld by aligning the test items with the mathematics curriculum for the first semester of the third year. To ensure reliability, a test-retest approach was adopted, and a Pearson Product Moment Correlation coefficient of 0.81 was attained. For this reliability test, a complete level 300 class consisting of 65 student teachers from one of the colleges was chosen. The test was administered, and after a three-week interval, the same test was re-administered to the same group, with their scores subsequently correlated using the Pearson Product Moment Correlation. A correlation coefficient of 0.81 signifies a robust level of reliability for the test instrument (Creswell, 2014)

Treatment

Prior to implementing the treatment, a pre-test was meticulously administered to gauge the initial proficiency levels of both the experimental and control groups. This pre-test served as a baseline measure to understand the starting point of each group before any intervention took place. The subsequent treatment phase spanned a duration of twelve weeks. Over this period, the experimental group engaged in lessons that employed the peer tutoring teaching strategy, designed to foster collaborative and interactive learning. In parallel, the control group underwent the same lessons but with the conventional teaching approach, which typically involves teacher-centered instruction. The sole distinction between the two groups resided in the teaching strategy employed.

Following the completion of the treatment phase, a post-test was conducted under identical conditions to those of the pre-test. This post-test was designed to assess the participants' achievements and learning outcomes subsequent to the treatment period. By comparing the pre-test and post-test results, the study aimed to determine the impact of the peer tutoring instructional strategy on the experimental group's performance relative to the control group's performance with the traditional approach

4. Results

The gathered data underwent analysis through the utilization of the Statistical Package for the Social Sciences (SPSS). The outcomes of the analysis are organized in alignment with the research questions that served as the study's guiding principles. To address the Research Questions (RQ), metrics such as mean and standard deviation were computed, alongside the application of an independent samples t-test. On the other hand, the null hypotheses were subjected to examination using analysis of covariance (ANCOVA) at a significance level of 5%. The ensuing section presents a comprehensive presentation of the obtained results

1. What impact does the implementation of the peer tutoring instructional strategy have on the mathematical accomplishments of pre-service teachers?

This research query primarily delved into assessing the impact of the peer tutoring teaching strategy on the academic accomplishments of pre-service teachers in mathematics, in contrast to the conventional chalk and talk method. In order to address this inquiry, the pre-test and post-test scores of the participants were subjected to analysis through descriptive statistics. The outcome of this analysis is presented in Table 2 below:

Table 2. Descriptive statistics of Pre-test and Post-test Scores of the two groups

Group	N	Pre-test		Post-test		
		Mean	SD	Mean	SD	MD
Experimental Group	193	23.45	8.42	67.54	13.67	44.09
Control Group	177	22.12	4.32	38.34	6.23	16.22

The data presented in Table 2 provides a detailed overview of the outcomes observed between the experimental group, where mathematics was taught using the peer tutoring instructional strategy, and the control group, where the traditional talk and chalk method was employed. For the experimental group, their pre-test mean score in mathematics was 23.45, with a corresponding standard deviation of 8.42. In comparison, the control group, taught using the talk and chalk approach, displayed a pre-test mean score of 22.12, accompanied by a standard deviation of 4.32.

Further examination of Table 2 reveals the post-test outcomes. The experimental group showcased a post-test mean score of 67.54, with a standard deviation of 13.67. Conversely, the control group displayed a post-test mean score of 38.34, accompanied by a standard deviation of 6.23. Notably, the difference in mean scores between the pre-test and post-test for the experimental group was 44.09, while the corresponding difference for the control group was 16.22. This indicates that both groups demonstrated improvements from their pre-test scores to their post-test scores. However, the substantial mean difference of 44.09 recorded by the experimental group, instructed using the peer tutoring instructional strategy, suggests a more substantial improvement compared to the control group taught using the talk and chalk method. These findings collectively suggest that the peer tutoring instructional strategy exerted a more pronounced effect on the achievement of students in mathematics, in contrast to the talk and chalk method. The substantial improvement in mean scores for the experimental group underscores the efficacy of the peer tutoring strategy in enhancing students' mathematical achievements.

The examination of the first hypothesis involved investigating whether a statistically significant difference exists between the mean scores of the experimental group and the control group.

(H1): The utilization of peer tutoring instructional strategy does not lead to a significant impact on the achievement of pre-service teachers in mathematics.

In order to assess this hypothesis, an analysis of covariance (ANCOVA) was conducted at a significance level of 0.05. The goal was to determine whether notable distinctions between the two teaching methods exist. The outcome of this analysis is presented in Table 3.

Table 3. Illustrates the ANCOVA results depicting the mean performance scores of the experimental and control groups.

Source	Type III sum of square	df	Mean Square	F	P
Corrected Model	473.744	2	236.872	10.484	.000
Intercept	2122.141	1	2122.141	77.323	.000
Pretest	1172.101	1	1172.101	4.711	.019
Group	301.699	1	301.699	19. 122	.000
Error	3121.119	188	20.589		
Total	72259.490	193			
Corrected Total	4002.212	192			

The findings presented in Table 3 demonstrate a noteworthy contrast in the mean performance scores between students who were instructed in mathematics using the peer tutoring instructional strategy and those who were taught using the talk and chalk method. Specifically, an F-ratio of 19.122 was calculated, accompanied by an associated probability value of 0.000.

The observed probability value of 0.000 is significantly smaller than the predetermined level of significance, which was set at 0.05. As a consequence, the null hypothesis (Ho_1) was invalidated in favor of the alternate hypothesis. This outcome underscores that a substantial difference indeed existed in the performance of students who were taught utilizing the peer tutoring instructional strategy in comparison to their counterparts taught through the talk and chalk method. In simpler terms, the experimental group, employing the peer tutoring strategy, displayed significantly superior performance compared to the control group

RQ 2 Does gender exert any influence on the mathematical achievements of pre-service teachers when the peer tutoring instructional strategy is employed?

The aim of this research question was to explore whether a significant difference exists between male and female participants who were exposed to the peer tutoring instructional strategy. Initially, a comparison was made between the pre-test scores of males and females in the two distinct groups, employing independent samples t-tests at a significance level of 0.05. This step was taken to determine if any notable differences existed before the administration of the post-test. The outcomes of these analyses are presented in Tables 4 and 5 below:

Table 4: Comparison of Groups (Pre-test Scores for Male Pre-Service Teachers)

Group	N	Mean	SD	t-value	Df	p-value
Experimental	193	15.63	5.47	-0.18	78	0.91
Control	177	15.66	5.26			

Table 4 presents a detailed overview of the pre-test scores for the male participants in both the experimental and control groups. In the experimental group, the mean score and standard deviation were recorded as (M = 15.63, SD = 5.47), while the corresponding figures for the control group were (M = 15.66, SD = 5.26). The statistical analysis, conducted at a significance level of 0.05, resulted in an observed condition of [t (78) = -0.18, P = 0.91], with [$\alpha < p \rightarrow 0.91 > 0.005$]. Upon closer examination of the results, the calculated p-value of 0.91 surpassed the

significance threshold of 0.05. Consequently, the observed difference between the two groups was not statistically significant. This implies that there was no substantial distinction detected in the mean performance scores of the male participants during the pre-test phase, prior to the implementation of any treatment.

Table 5: Comparison of Groups (Pre-test Scores for Female Pre-Service Teachers)

Group	N	Mean	SD	t-value	Df	p-value
Experimental	193	17.14	6.04	0.51	98	0.79
Control	177	16.88	6.67			

Table 5 provides an in-depth examination of the pre-test scores for the female participants across both the experimental and control groups. In the experimental group, the mean score and standard deviation were calculated as (M = 17.14, SD = 6.04), whereas for the control group, these values were recorded as (M = 16.88, SD = 6.67). The statistical analysis, performed at a significance level of 0.05, revealed an observed condition of [t (98) = 0.51, P = 0.79], with [$\alpha < p \rightarrow 0.79 > 0.005$].

Upon closer scrutiny of the results, the computed p-value of 0.79 exceeded the predefined significance threshold of 0.05. Consequently, the observed difference between the two groups was not found to be statistically significant. This signifies that there was no substantial disparity detected in the mean performance scores of the female participants during the pre-test phase, before the initiation of any treatment.

Furthermore, Table 6 offers a comprehensive presentation of the descriptive statistics encompassing the mean, standard deviation, and mean differences for the pre-test and post-test scores of both male and female respondents who were instructed using the peer tutoring instructional strategy (experimental group).

Table 6: Overview of Descriptive Statistics for Pre-test and Post-test Scores of Male and Female Students Instructed with Peer Tutoring Instructional Strategy.

Group	N	Pre-test		Post-test		
		Mean	SD	Mean	SD	MD
Male	83	18.32	8.17	67.74	15.97	49.42
Female	110	19.10	9.42	68.56	15.23	49.46

The findings, as presented in Table 6, offer valuable insights into the academic performance of male and female students who were instructed in mathematics using the peer tutoring instructional strategy. Among male students, the pre-test mean was recorded as 18.32, accompanied by a standard deviation of 8.17. Following the treatment, the post-test mean rose to 67.74, with a standard deviation of 15.97. This change indicates a significant increase in mean scores, with a difference of 49.42 between the pre-test and post-test means for the male group.

Similarly, for female students, the pre-test mean was calculated as 19.10, with a standard deviation of 9.42. Subsequent to the intervention, the post-test mean reached 68.56, and the

standard deviation was 15.23. This, too, reflected a considerable rise in mean scores, with a difference of 49.46 between the pre-test and post-test means for the female group. These results suggest that both male and female students, when taught mathematics using the peer tutoring instructional strategy, achieved at a similar level. To address this research question comprehensively, the second hypothesis was subjected to testing

(H2): The implementation of the peer tutoring instructional strategy does not yield a significant influence of gender on the achievement of pre-service teachers in mathematics.

An analysis of covariance (ANCOVA) was executed at a significance level of 0.05 to determine whether any noteworthy difference existed in the mean performance scores of male and female students who were taught mathematics using the peer tutoring instructional strategy. The outcome of this analysis is presented in Table 7 below:

Table 7: Examination of Covariance Analysis (ANCOVA) for Mean Performance Scores of Male and Female Experimental Groups

Source	Type III sum of square	df	Mean Square	F	P
Corrected Model	2219.414	2	1157.523	20.109	.522
Intercept	3348.231	1	3348.231	39.196	.623
Pretest	1675.119	1	1675.119	14.228	.311
Gender	1118.242	1	1118.242	19. 441	.291
Error	5521.487	188	85.952		
Total	575314	193			
Corrected Total	17514.222	192			

The findings presented in Table 7 provide an insightful view into the mean performance scores of male and female students who received instruction in mathematics through the peer tutoring instructional strategy. An F-ratio of 19.441 was calculated, accompanied by an associated probability value of 0.291.

Upon closer examination, it is evident that the calculated probability value of 0.291 surpasses the predetermined significance level of 0.05. Consequently, the null hypothesis (H_2) was upheld. This outcome suggests that gender does not exert a significant influence on students' performance when they are taught mathematics using the peer tutoring instructional strategy.

5. Discussion

The paragraph outlines the key findings of the study and provides context to these results. In Table 2, the data indicates that students taught mathematics through peer tutoring instructional strategies achieved higher mean scores in comparison to their peers who were taught using the traditional talk and chalk method. This suggests that the peer tutoring approach led to improved performance.

Furthermore, Table 3 reinforces this observation by revealing a significant difference in the mean performance scores of students taught mathematics using peer tutoring instructional strategies and those taught using talk and chalk. This outcome is consistent with prior research conducted by Chong et al. (2020) and Wang (2018), whose studies also found that students

exposed to peer tutoring teaching strategies achieved significantly better results than those exposed to conventional teaching methods. The paragraph draws a connection to Abdellcarim and Abuiyada's (2016) work, emphasizing that their findings support the idea that peer tutoring effectively enhances mathematical achievement. The paragraph also aligns with Asempapa et al.'s (2021) conclusions that peer tutoring is beneficial for both fast and slow learners. This alignment underscores the versatility of the peer tutoring strategy, as it appears to accommodate various learning paces and abilities. Overall, the paragraph highlights the consistency of the study's findings with existing research, thereby reinforcing the idea that the peer tutoring instructional strategy indeed contributes positively to students' mathematical achievement, aligning with both prior research and contemporary educational insights

The findings presented in Table 6 bring to light an intriguing observation: the achievement mean scores of male and female students, who were instructed in mathematics using peer tutoring instructional strategies, were equivalent. This indicates that the peer tutoring approach yielded similar outcomes for both genders.

Additionally, the outcome from Table 7 aligns with the hypothesis that there is no noteworthy difference in the performance of pre-service teachers who were exposed to the peer tutoring instructional strategy in mathematics in Ghana, based on gender. In essence, the application of peer tutoring demonstrated no gender bias in enhancing students' academic performance in mathematics. This means that peer tutoring did not favor male students over female students, nor did it favor females over males. The improvements in academic performance achieved through peer tutoring were not influenced by gender; both male and female students exhibited enhanced grades.

This finding corresponds with the results of comparable studies conducted by Jibrin and Zayum (2012), Fayram et al. (2018), and Lam (2019). These studies, conducted independently, similarly concluded that there was no notable disparity in the academic achievement of both male and female students exposed to peer tutoring instructional strategies in the fields of mathematics and science.

6. Conclusion

Based on the outcomes derived from the investigation, the researchers draw a decisive conclusion: the peer tutoring instructional strategy surpasses the traditional talk and chalk teaching method, showing its capacity to enhance students' academic performance in the subject of mathematics. The study's results further point out that both male and female students derive equivalent benefits from the implementation of the peer tutoring instructional strategy.

These findings collectively imply that the peer tutoring strategy of teaching holds substantial promise. Specifically, the study underscores that adopting this strategy within Colleges of Education (CoEs) could notably impact the teaching and learning of mathematics. This insight becomes especially important in preparing future educators for the foundational levels of education. The researchers assert that incorporating the peer tutoring strategy into CoE classrooms for mathematics could serve as a positive example for aspiring teachers, enabling them to apply similar practices when they eventually transition into their roles as active

educators. This, in turn, holds the potential to contribute to improved achievement in mathematics at the foundational education level.

Recommendations

Based on the study's findings, the researchers strongly advocate for mathematics educators to adopt peer tutoring instructional strategies as a means to enhance students' academic performance. This recommendation is rooted in the study's own outcomes, which clearly establish the superior effectiveness of peer tutoring instructional strategy within the context of mathematics education in Colleges of Education (CoEs) in Ghana.

Furthermore, the researchers suggest that both the Ghanaian government and education stakeholders should take decisive steps to create a conducive environment that promotes and supports the integration of peer tutoring instructional strategies. To achieve this, initiatives such as organizing conferences, seminars, and workshops could be undertaken with the active involvement and sponsorship of CoE administrations and Professional Development (PD) coordinators. These events would serve to educate educators on the effective implementation of peer tutoring strategies in their teaching methods.

Additionally, it is recommended that further research endeavors be undertaken in other CoEs across various regions within Ghana, as well as in different educational jurisdictions. These endeavors are essential to provide a comprehensive understanding of the broader impact and implications of peer tutoring instructional strategies in the realm of mathematics education.

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