

# A Comparison of Mathematics Achievement of Learners Who Learned Using Peer Tutoring Strategy and Those Who Learned Without Using Peer Tutoring.

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## ABSTRACT

Peer tutoring is an instructional strategy where learners take responsibility for teaching other learners, either of the same age or different. The process can be face-to-face interaction or with teachers guiding the learning. The study's objective was to establish the difference in Mathematics achievement between learners who learned using a peer tutoring strategy and those who learned without peer tutoring. The study was guided by the Social Constructivism theory developed by Vygotsky (1978). A quasi-experimental research design was adopted. The target population was Form II learners and Mathematics Teachers from public secondary schools in Kiambu County, Kenya. A stratified random sampling was used to form a sample of four (4) public secondary schools two (2) single schools and two (2) mixed schools. The sampled schools were grouped into two (2) groups, a control group and an experimental group. Data was collected using Mathematics achievement tests, a pretest and a post-test. To ensure the validity of the instruments, two (2) senior examiners and four (4) Mathematics educators in the County reviewed a pretest and a post-test. Quantitative data from Mathematics achievement tests was analyzed using the independent samples t-test and interpreted using the statistical package of social sciences (SPSS version. 27). The findings of the study revealed that there is a statistically significant difference in Mathematics achievement tests between Form II learners who learned Mathematics through peer tutoring strategy and those who learned Mathematics without the peer tutoring strategy. The hypothesis was examined at a significance level set at  $\alpha = .05$ . The mean score for the control group was 37.31 and a standard deviation of 4.482 which differed significantly from those in the experimental group, which had a mean score of 43.09, and the standard deviation of 5.229. The results indicated a significant statistical difference [  $t(158) = 7.500$ ,  $p\text{-value} = .000 < .05$  ]. From the results, it is concluded that learners using peer tutoring find that, it is easier to understand the Mathematical concepts and able to complete the task given by the teachers than those colleagues who learned without using peer tutoring. It suggested that Mathematics teachers should use peer tutoring strategy in secondary schools as a way of enhancing learners' achievement in Mathematics.

**Keywords:** Peer tutoring strategy, Kenya, Mathematics Achievement, Social Constructivism Theory

## INTRODUCTION

Mathematics encompasses the study of number, quantity, and space (Isack, 2015). It is a fundamental field that empowers learners and prepares them for a successful future, as highlighted by Belbase et al. (2022). A strong foundation in Mathematics is crucial for learners' academic achievement. It enhances problem-solving skills, critical thinking abilities, and logical reasoning capabilities, as emphasized by (Celik & Ozdemir, 2020). Mathematical skills are further honed through the school Mathematics curriculum (Adamu, 2020). Research evidence shows that courses of study such as engineering, computer science, finance and data analysis, rely heavily on Mathematical concepts and principles. A deep understanding of Mathematics increases their professional success and provides learners with the computational proficiency needed to perform well in these fields (Onoshapokaiye, 2023).

Abdul-Raheen et al. (2017) have indicated that the teaching and learning process entails the exchange of knowledge between learners and teachers. In 2015, the United Nations Educational Scientific and Cultural

Organization (UNESCO) highlighted the importance of teachers coordinating the teaching and learning process to ensure quality education in the classroom. This indicates that teachers should have content suitable for learners' abilities and possess the necessary skills to address diverse needs in an inclusive environment to effectively manage the learning process Ali et al. (2015). In 2001, the National Research Council revealed that utilizing learner-centered methods plays a fundamental role in shaping learners' academic achievement in Mathematics. One such learner-centered method for enhancing Mathematics achievement is the peer tutoring strategy, a systematic, peer-mediated teaching strategy (Asaf & Zahoor, 2017).

In peer tutoring sessions, tutors have the opportunity to support the success of their peers, derive meaning and fulfillment from learning to maintain credibility and effectiveness in sharing knowledge while the tutees have the chance to comprehend, clarify, and deepen their understanding (Tan & Gevera, 2020). Teachers expected to teach large classes employed peer tutoring which places the responsibility of teaching in the hands of well-prepared and knowledgeable students whom the teachers had trained. Peer tutoring supports teachers in the formation of groups of students to perform various activities. Teachers provide guidance to ensure that slower learners are adequately guided and benefit from the peer tutoring process, Arthur et al. (2022).

Bellen and Jomoc, (2017) have revealed that peer tutoring strategy is more effective for learners in grades one, two and three, school-wide programmes, urban settings, low socioeconomic areas, and in learner-controlled tutoring sessions. Utilizing peer tutoring has been demonstrated as an effective method for boosting Mathematical achievement Chong et al. (2020). In a research study conducted in Spain, Moliner and Alegre, (2020b) used a sample of 420 learners in grades seven (7) and nine (9) from 12 to 15 years. The objective of the study was to examine the influence use of peer tutoring strategy on learners' academic achievement in Mathematics. The researchers applied self-concept theory and quantitative research methodology. The finding indicated that most learners had a positive effect on the implementation of peer tutoring and were able to reduce anxiety over Mathematics topics.

In a research study conducted in South Africa. Robert and Spangenberg, (2020) used a sample for grade 12 learners in private schools. The purpose of the study was to investigate the influence use of peer tutoring on learners' academic in Mathematics. Qualitative research methodology was used. The finding indicated that there was an increased level of learner motivation through tutorials conducted during tutoring and tutors' understanding of the role of encouraging tutees to be responsible for assignments. The tutees' self-confidence in Mathematics also increased. In a research study conducted by Etsu and Manko (2019) in Niger State, the findings indicated that peer tutoring is more effective in improving the academic interest, zeal, and success of less competent students in high school Geometry than the chalk-and-talk methods of teaching.

In Kenya, a research study by (Kibuthu, 2016) was conducted to investigate the effect of peer tutoring on the academic achievement of learners with disabilities in standard four in Nyeri County, Kenya. A descriptive research design was adopted for the study. Standard four learners and all Mathematics teachers were used as the target population of the study. Two sets of questionnaires, interview schedules, and observation checklists were used as research instruments. The findings revealed that tasks that peers mostly committed to included peer tutors demonstrating to the tutee as an activity while the process of learning was highly achieved. The learners seek guidance from the teachers and ask each question, concentrating on the activity. Mathematics teachers were trained appropriately and well-equipped to include peer tutoring in their classes.

The findings from the aforementioned studies collectively underscore the significant positive effect of peer tutoring strategy on learners' Mathematics achievement. The information provide in this paper seeks to address a knowledge gap in Mathematics achievement in Kiambu County secondary schools in Kenya, with aim of providing research evidence on the difference in achievement in Mathematics between learners who learned using peer tutoring and those who learned without using peer tutoring strategy.

## Statement of the Problem

Achievement in Mathematics in Kenya continues to be below expectations despite various research efforts to remedy the situation. Efforts have been made to counter the problem of poor achievement in Mathematics at secondary school level, but no significant improvement has been recorded (KNEC, 2022). Numerous research

efforts have been focused on identifying factors that constrain the learning of Mathematics. The use of teacher-centred rather than learner-centred methods of teaching as well as low motivation of learners have been highlighted as some of the problems affecting learners' achievement in Mathematics.

The teaching strategies applied by a majority of Mathematics teachers do not accord the learners opportunities to develop their creative ability, critical thinking, imagination, and intuition. As a result, Mathematics teachers are continually searching for varied approaches to use so as to attain the stated Mathematics educational objectives. Research has shown that teaching Mathematics using peer tutoring could result in better achievement. This is because peer tutoring enhances the personal abilities of various learners compared to teacher-centered methods of teaching. The study was carried out to establish the difference in Mathematics achievement between learners who learned using peer tutoring strategy and those who learned without using peer tutoring in secondary schools, in Kiambu County, Kenya.

### **Objective of the study**

The objective of the study was to establish the difference in Mathematics achievement between learners who learned using peer tutoring strategy and those who learned without using peer tutoring.

### **Hypothesis of the study**

The hypothesis of the study was that there is no statistically significant difference in Mathematics achievement between learners who learned using peer tutoring and those who are learned without using peer tutoring.

### **Theoretical Framework**

The research study was guided by Social Constructivism Theory developed by (Vygotsky, 1978). Vygotsky asserted that the process of learning that comes from social interaction within a language and a cultural context is the most important tool in learning. Learners' success is gained through tutors who facilitate the teaching activity. The learning activities are organized in ways that are realistic and practical such that learners are involved in one guided activity instead of following didactic explanations of abstract concepts. The argument is that learners can approach unfamiliar problems with confidence and provide appropriate solutions based on previous experience. The peer tutoring concept is in line with the aspects of Social Constructivism theory in the development of social negotiations between tutors and their peers in which knowledge construction is achieved through communication, collaboration and dialogue.

Another building block of Social Constructivism is the Zone of Proximal Development (ZPD), Defined as ‘ the distance between the actual development level as determined through independent problem-solving and the level of potential development as determined problem solving under adult guidance or in collaboration with other capable peer’ (Vygotsky,1978, p.57). ZPD is integral to peer tutoring, with tutoring interactions occurring as tutor-tutee collaborations. For scaffolding to improve learning, tutors must deliberately link new information to already known information (Valkenburg & Dzuback,2009). According to Wood et.al (1976), there are six (6) key scaffolding elements: (a) recruitment - gathering learner interest in the task's requirements; (b) reduction in the degree of freedom - simplifying the task; (c) direction maintenance - keeping the learner on a particular objective; (d) marking critical features - confirming/ checking; (e) frustration control - managing the learners' emotional state; and (f) demonstration -task-based solution.

A study by (Vygotsky, 1987) further classified the learners into three (3) categories based on individual differences. According to him, one group of learners represents those who may easily comprehend the teachers and do not need any further assistance. Such learners are grouped in the Zone of Proximal Development. The second group, (Vygosky, 1987) recommended peer tutoring, home tuition, and group discussion because it is beneficial for both tutor and tutee. The cognition of the tutor is developed by the preparation of the lessons and responding to the tutees' questions while the learning of the tutees is developed in the shape of providing opportunities for free discussions and asking questions. The third group of students are those who are incapable of understanding something even with the provision of external help. These learners are classified in the Zone of No Development (Mehra & Mondal, 2005). This is the reason that (Vygotsky, 1978) supported peer tutoring

as useful approach for tutees as well as tutors.

## REVIEW OF RELATED LITERATURE

In a research conducted in the United Kingdom, Thurston et. al. (2020) used a sample of 487 students aged 10 to 12 from 20 elementary schools in three (3) different districts. The purpose of the study was to establish the influence use of peer tutoring on students' academic achievement in Mathematics and some aspects of social and cognitive skills. Quantitative research methodology was adopted. The findings indicated that learners' Mathematics achievement increased and there was no significant effect on social and cognitive skills stated.

A study by Deshler et al. (2019) was conducted in the United States of America (USA) to investigate the influence of same-age peer tutoring strategy on learners' academic achievement in Mathematics. The researchers employed a mixed-methods research design. The findings indicated that learners showed higher achievement levels, learners' persistence increased slightly, and learners became committed to completing their studies.

In Australia, (Johnston, 2021) conducted a study involving second-year undergraduate learners in numerical methods, in applied Mathematics. The objective of the study was to establish the effect use of same-age tutoring on learners' academic achievement in Mathematics. A quantitative research method was used. The findings indicated that same-age tutoring increased learners' understanding of the content, improved students' language skills and increased learners' self-confidence.

A research study was conducted in Turkey (Yaman, 2019). The study aimed to determine the effect use of a same-age peer tutoring strategy on learners' academic achievement in Mathematics. The researcher used a sample of eight (8) out of 50 first-year engineering students and applied Sociocultural and Constructivism theory and quantitative research methodology. The findings indicated that there was no significant effect on academic achievement.

In another study, (Parkinson, 2009) carried out a carefully controlled study of the effects of peer-assisted learning of first year students and second year students. After one semester of tutoring, there were substantial and significant differences observed between the tutored and non-tutored students. The tutored students had progressively increased their performance in Calculus compared to the non-tutored students, with their examination marks in Chemistry and Calculus substantially improved and failure rates cut dramatically.

In a research study conducted in the Philippines, Berso and Lorente (2020) used a sample of five (5) classes of grade nine (9) students of Bantayan National Secondary School, Tabaco City. The purpose of the study was to determine the influence use of same-age tutoring on learners' academic achievement in quadratic equation topics. They used descriptive and comparative research design. The findings indicated that the level of achievement in quadratic equation topics increased for both tutor and tutee, with tutors being comfortable asking questions and understanding the learning better.

A research study conducted in South Africa by (Campbell, 2019) investigated the influence of peer tutoring strategy on learners' academic achievement in Mathematics. The study was guided by Social Constructivist theory. The findings indicated that there was no significant effect noted on academic achievement. The social aspect gives high motivation to the tutee where the tutee shows interest in discussions with tutor face to face. The learners' cognitive can be built through assignments completed with the tutor.

A study by (Hannah, 2008) examined peer tutoring of a high school Mathematics course as a potential enhancement to the learning process. The investigation focused on the attitudes of tutees following their interaction with peer tutors during after school tutorial sessions. The results of the study showed participation in peer tutorials appeared to have a predictive effect on increased achievement, but not on student attitudes toward learning Mathematics. Despite the existing literature providing insights into the effectiveness of peer tutoring strategy, there is a need for further investigation into the specific conditions and subjects under which this strategy is more effective. The existing studies have not comprehensively addressed the peer tutoring strategy and its effect on learners' achievement in Mathematics. This study aims to address this gap in knowledge and methodology investigating the difference in academic achievement between the use of peer tutoring strategy and

teacher-centered methods.

## METHODOLOGY

The research employed a quantitative method approach. This study's quantitative design was quasi-experimental. The study employed the pretest, post-test quasi-experimental design. Due to the inability to assign randomly to treatment groups, a nonequivalent control group design was implemented. Therefore, a quasi-experimental design was used to test the hypotheses of the study. The study comprised an experimental group that received peer tutoring and a control group assigned to a traditional teaching approach. The design was diagrammatically represented in Table 1 below;

**Table 1 Nonequivalent pretest post-test (control group) Design**

Grouping	Pre-treatment test	Research Condition	Post-test
EG	O <sub>1</sub>	X <sub>1</sub>	O <sub>2</sub>
CG	O <sub>1</sub>	–	O <sub>2</sub>

Where:

**EG** – Experimental group

**CG** – Control group

**O<sub>1</sub>** – Pre-treatment test

**O<sub>2</sub>** – Post-test (for all the groups)

**X<sub>1</sub>** – Research treatment

– No treatment

The study took place in the Ruiru sub-county of Kiambu County, Kenya. The target population was 160 Form II learners and 20 Mathematics teachers from public secondary schools in Kiambu County, Kenya. A stratified random sampling was used to form a sample of four (4) public secondary schools two (2) single schools and two (2) mixed schools. The sampled schools were grouped into two groups (control group and experimental group). Data was collected using Mathematics achievement tests, a pretest and a post-test. To ensure the validity of the instruments, senior examiners and Mathematics educators in the county reviewed a pretest and a post-test. Quantitative data from Mathematics achievement tests was analyzed using the independent samples t-test and interpreted using the statistical package of social sciences (SPSS version. 27). The researcher employed the t-test to examine the mean difference in academic achievement of learners in the experimental group and learners in the control group.

## FINDINGS

### Experimental and control group before intervention

Data was collected using a pretest and post-test Mathematics achievement tests. . The data statistics for this study have been indicated in Table 2 below



**Table 2: Results of independent samples t-test on the pretest for both groups**

	Pretest	N	Mean	Std. Deviation	Std. Error Mean
Scores	EG	80	41.88	3.551	.397
	CG	80	40.17	3.306	.370

Table 2 shows that experimental group obtained a mean score of 41.88 while the control group obtained a mean score of 40.17 before the intervention. The mean difference between the two groups was 1.71.

**Table 3 Results of independent samples t-test on the pretest for both groups**

		Levene's Test for Equality of Variances		t-test for Equality of Means						
Scores		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
									Equal variances assumed	.001
Equal variances not assumed			3.145	157.201	.002	1.706	.542	.635	2.778	

According to the above results in Table 3, Levene's test was not statistically significant, the test value of ( $F=0.01$ ) and ( $P=0.971$ ). We accept the null hypothesis and assume the variances are equal. However, because the probability value (p-value) was 0.971 in equal variance assumed ( $P>0.05$ ) revealing that there was no remarkable disparity in the mean score of the two groups (experimental group and control group) before the intervention. The results of the study indicated that Form II students in both experimental group and Control group were similar in abilities before the treatment was administered. Mean score for the experimental group was 41.88 and the standard deviation was 3.551 and mean score of the control group was 40.17 and the standard deviation was 3.306.

**Experimental group and control group after intervention**

**Table 4: Output of the independent samples t-test on the post-test for both groups**

	Post- test	N	Mean	Std. Deviation	Std. Error Mean
Scores	EG	80	43.09	5.229	.585
	CG	80	37.31	4.482	.501

Table 4 indicates that the experimental group obtained an average mean score of 43.09 while the control group

obtained an average mean score of 37.31. The mean difference between the two groups was 5.78 in favor of the experimental group. The second Table 4 below indicates the finding of the statistical comparison between two groups.

**Table 5: The output of the independent samples t-test on the post test for both groups**

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Scores	Equal variances assumed	1.168	.281	7.500	158	.000	5.775	.770	4.254	7.296
	Equal variances not assumed			7.500	154.388	.000	5.775	.770	4.254	7.296

Table 5 indicates that the probability value was small ( $P < 0.05$ ) in equal variances not assumed revealing that there is a statistical difference in the average means scores of both groups. The findings of this study established that the Form II students using the peer tutoring strategy performed better in Mathematics than their colleagues who learned Mathematics without using peer tutoring strategy. This teaching strategy assisted Form II students in the Ruiru sub-County in the experimental group to understand Mathematics better than their counterparts in the control group. The finding of the research study has established that there is a statistical difference in Mathematics achievement test between Form II students who were taught Mathematics with peer tutoring strategy ( $M=43.09$ ,  $SD= 5.229$ ) and those who were taught Mathematics without the peer tutoring strategy ( $M = 37.31$ ,  $SD= 4.482$ ).

## DISCUSSION

The results of this investigation are in line with the research study conducted by Deshler et al. (2019) in the USA. The purpose of the study was to investigate the influence use of same-age peer tutoring strategy on learners' academic achievement in Mathematics and for some aspects of social skills. The findings indicated that learners show higher achievement levels, learners' persistence increased, slightly learners are more committed to completing their studies. Similarly, the present study's findings corroborate with the research study conducted by (Johnston, 2021) in Australia for second-year undergraduate learners in numerical methods in Applied Mathematics. The findings indicated that same-age tutoring increases learners' understanding of the content of lessons learned, improving students' language skills and self-confidence is increasing.

## CONCLUSION

On the based of the findings of the study, three (3) conclusions are made as follows;

1. Learners using peer tutoring find it easier to understand the Mathematics concepts and are able to complete the tasks given by the teachers. As a result, Learners showed positive effects on the implementation of peer tutoring and were able to reduce anxiety over Mathematics.
2. Learners who engaged in peer tutoring experienced notable enhancements in the Mathematics scores and

learners in peer tutoring groups demonstrated greater perseverance and resilience in tackling challenging Mathematical problems.

3. The results indicated that there was a statistical difference in Mathematics achievement tests between learners in experimental group and their colleagues placed in control group. Thus, learners in the organized peer group expressed higher confidence, a positive attitude toward Mathematics, and enhanced problem-solving skills.

## RECOMMENDATION

The following recommendations are made, based on the findings of the study:

1. It is advisable to include a peer tutoring strategy in the teaching of Mathematics in regular classes and other science subjects.
2. Conducting seminars and workshops to train Mathematics teachers on implementing peer tutoring would be beneficial.
3. Incorporating peer tutoring into the Mathematics curriculum is recommended

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