African Research Journal of Education and Social Sciences | ISSN: 2312-0134 | W: www.arjess.org

Comparison of the Academic Achievement between Cooperative Learning and Non-Cooperative Learning Strategies in Chemistry among Students in Murang'a County, Kenya

Authors: Kabanga Grace Wairimu[1], Nicholas W. Twoli[2] & Michael Muchoki Waititu[3]

[12&3]Department of Educational Communication and Technology Kenyatta University,
P.O Box, 43844, 00100, Nairobi, Kenya
Email: wairimugk2016@gmail
Tel: +254720628635

Abstract: *The employment of cooperative learning as an instructional method across different countries has exhibited positive outcomes in learners' academic achievement. The study intended to establish the comparison of the academic achievement between cooperative learning and non-cooperative learning strategies in chemistry among students in murang'a county, Kenya. The study was carried out in Kangema Sub-County, Murang'a County, applied a quasi-experimental design. The target population was Form 3 students. Purposive sampling was employed to select four schools to arrive at two control and two experimental groups. The study employed a sample size of 198 students. Data collection instruments included students' pre and post-achievement tests. Data was analysed using SPSS package and presented using tables, pie charts and bar graphs. The study established that there was a significant difference between learners taught using cooperative learning and those taught using non-cooperative learning with the former showing improved academic achievement. There was significant increase in the post-intervention mean score posted by students in the experimental groups. This is not the case in the control groups. For instance, the percentage increase in the mean score in School A between pre and post-data is 38.50%. A similar increase is noted in School B at 49.70%. On the contrary, both the two control groups posted a fall in their students' mean scores with School C posting a 0.47% and School D posting a 2.05% decline in their mean score performance respectively. The significant improvement demonstrated can be attributed to the discussions held among learners in learning Chemistry. The study concludes that cooperative learning strategy is more effective than non-cooperative strategy in teaching Chemistry. The study thus recommends that the ministry of education should enact and implement a policy that facilitates the integration of cooperative learning as one of the primary teaching methods. The government should train teachers on use of cooperative learning in teaching Chemistry.*

Key words: *Cooperative learning, Academic Achievement, Non-Cooperative Learning Strategies, Non-cooperative learning, Cooperative learning strategies, Learning Strategies, Chemistry Learning Strategies*

African Research Journal of Education and Social Sciences | ISSN: 2312-0134 | W: www.arjess.org

INTRODUCTION

A cooperative instructional strategy is a teaching strategy in which small teams, each with students of different levels of ability use a variety of learning activities to improve their understanding of a subject. Each member of a team is expected not only to learn what is taught but also to help teammates learn, thus creating an atmosphere of achievement (Olatoye, Aderogba, &Aanu, 2011). The cooperative instructional strategy enables students to have active control over their learning and enhance their academic achievement (Ajaja&Eravwoke, 2010). Studies that examined cooperative instructional strategies show that these strategies, used in both theoretical and laboratory settings, could help students improve their academic and social skills by ensuring their active participation in learning processes (Carpenter, 2013).

Over the years, cooperative learning has emerged as one of the most widespread and fruitful areas of theory, research, and education practice. Cooperative learning can be delineated as a teaching method that engages students in groups during the learning process to understand and learn the content of the subject (Slavin, 2011). Typically, the traditional class activities create a single-winner situation, where one can only succeed if others lose. However, the cooperative learning approach is the direct opposite of the traditional method. It underscores the importance of collective winning and success. Cooperative learning has an edge over other teaching methods in terms of its effectiveness for improved cognition, social skills, and motivation. Two major attributes that have distinguished cooperative learning from traditional learning include interdependence (positive), as well as accountability as each member of the group, is important for the success of all members (Slavin, 1990). Many research studies have proved its competence in terms of augmenting academic achievement (McMaster & Fuchs, 2012; Winston, 2012).

Cooperative learning also improves positive attitudes towards students' learning and improved social relations in addition to high self-esteem and cohesiveness (Johnson & Johnson, 2008; Sahin, 2010; Johnson & Johnson, 2015). Mahamod and Somasundram (2017) also describe cooperative learning as the instructional strategy in which students work together to achieve their learning target. Polloway, Patton, and Serna (2011) also present cooperative learning as a method when that improves motivation, class participation, and academic achievement of students during the teaching process. The diverse and positive outcomes that simultaneously result from cooperative efforts have sparked numerous research studies on cooperative learning focused on preventing and treating a wide variety of social problems. Such social challenges include diversity (racism, sexism, inclusion of handicapped), antisocial behavior (delinquency, drug abuse, bullying, violence, incivility), lack of pro-social values and egocentrism, alienation and loneliness, psychological pathology, low self-esteem, and many more (Slavin, 2009).

The experiences in integrating cooperative learning as an instructional method have been on the rise and attributed to several factors such as the variety of cooperative learning methods available for teacher use, ranging from very concrete and prescribed to very conceptual and flexible (Ezeano, 2013). Many researchers have explored cooperative learning as an instructional strategy with their study outcomes indicating positive and improved results in the learners.

African Research Journal of Education and Social Sciences | ISSN: 2312-0134 | W: www.arjess.org

At the global level, many studies demonstrate the role of cooperative learning in student achievement. Yamarik (2017) explored the effect of cooperative learning on student learning outcomes in economic instruction in California USA; and found that students taught by cooperative learning achieved greater academic performance in the form of higher exam scores. Hsiung (2012) in his empirical evidence study in China suggests that students studying cooperatively exhibit significantly better academic achievement. Karali and Aydemir (2018) explored the effect of the cooperative learning method on students' academic achievement and attitudes towards mathematics in Turkey and found cooperative learning was more effective in increasing the academic achievement of the students in mathematics courses compared to teacher-centered teaching. Altun (2015) study in Turkey on the efficiency of learning plan implementation prepared with the cooperative learning method established that cooperation based learning-teaching environment supported permanent learning, provided opportunities to be successful, contributed to the development of social and personal skills, and also inspired students to be successful at all stages.

In Africa, studies in countries like Nigeria, Ghana, and South Africa have essentially demonstrated that cooperative learning is an essential strategy for classroom initiatives (Mensah, 2013). Kolowale (2012) investigated the effects of cooperative and competitive learning on the academic performance of students in mathematics in Nigeria; to find out which one of them is the more effective learning strategy. The findings revealed that cooperative learning strategy is more effective than competitive learning strategy and that boys performed significantly better than girls did in both the two learning strategies. However, since most prior studies do not carefully monitor the time on task, it is unclear whether the observed learning benefits are due to the intrinsic superiority of cooperative learning or merely a reflection of the increased amount of time students spend on studying. Moreover, these studies have tended to be general and focusing on Mathematics.

Abimbola (2013) explains that the educational system in Nigeria provides little opportunities for students to engage in self-instruction because they are always being taught by teachers either in schools or coaching classes, or parents and siblings at home, without knowing how to study by themselves, except, perhaps, students in boarding schools. The strategy utilized in this study is an adapted version of the popular cooperative learning strategy (Adigwe, 2011). These researchers have reported the potency of this strategy in enhancing students' performance in science and related subjects. This adapted version is called "Cooperative Instructional Strategy" (CIS) which was specifically aimed at improving problem-solving abilities among learners (Aluko, 2008).

Chemistry is a science subject, which requires hands-on activities in its teaching and learning. In recent times, there has been a decline in the performance of Chemistry in Kenya certificate of secondary education, which has been blamed on some less effective teaching, and learning strategies that have been blamed on some less effective teaching and learning strategies that have been used during instruction and in the preparation of candidates for the KCSE examination. Performance records for the past years reveal Chemistry is not well performed as shown by results from KNEC.

African Research Journal of Education and Social Sciences | ISSN: 2312-0134 | W: www.arjess.org

Cooperative learning aims to organize classroom activities into academic and social learning experiences and has been described as "structuring positive interdependence" among learners and teachers (Maluri, 2016). Olarewaju (2012) asserts that students learning cooperatively can capitalize on one another resources and skills unlike in individual learning, which can be competitive. In cooperative learning, the teachers' role changes from giving information to facilitating students learning. Yet, the perception and the extent to which teachers use cooperative learning in Chemistry has not been overly explored in research in the local context. The underperformance of students in Chemistry, from statistics given over the years at the regional level, necessitates the search for alternative instructional strategies that could ensure better students achievement. It is against this background that this study seeks to investigate the effects of cooperative learning on the achievement of students in Chemistry in secondary schools in Murang'a County.

There has been underperformance in the Mole concept, which has affected the overall performance in Chemistry in Kenya. The Mole concept has been identified as one of the underperformed topics, which has led to poor performance, has led to low mean grades for most students in many secondary schools. This underperformance might have been caused by several factors including methods of performing practicals, teaching strategies, availability of resources, poor teaching methodologies, inadequate teaching, and learning resources, and teachers' perception towards students' abilities to do well in Chemistry (Chebii, 2011). This underperformance has been affecting students' chances of proceeding to higher levels in their academics.

Several interventions have been put into place to address this underperformance in Chemistry at the KCSE level. Through Kenya Education Sector Support Program (KESSP), the issue of inadequate resources has been addressed. The Strengthening of Mathematics and Science in Secondary Education (SMASSE) program has addressed the teachers' pedagogical issues. However, the student underperformance of Chemistry in KCSE persists and therefore this study seeks to investigate the effect of integrating cooperative learning in teaching and learning of Chemistry.The current study therefore intended to investigate the effect of integrating co-operative learning in teaching Chemistry among public secondary schools in Murang'a County, Kenya.

African Research Journal of Education and Social Sciences | ISSN: 2312-0134 | W: www.arjess.org

METHODOLOGY

Research Design

This study employed a quasi-experimental design. It used pre-test and post-test to investigate the outcomes of the experimental and control groups. In a quasi-experimental design, the main purpose was to determine possible cause and effect.The experimental group was taught using cooperative learning while the control groups were taught using conventional methods for six weeks. Both the experimental and control groups were taught on the same topic, which was Mole Concept in Chemistry.

Target Population

The target population for this study were form three students and Chemistry teachers in Murang'a County, Kenya. Kangema Sub-County has 27 public secondary schools. However, for the Quasi-experimental design, the target population included four public secondary schools (two boy schools and two girls' schools) students and Chemistry teachers respectively.

Sampling Procedures

This study made use of stratified random sampling, simple random sampling, and purposive sampling to determine the settings of the participants. The 27 Schools in Kangema Sub-County were grouped into four zones (Zone A, B, C, and D). The strata enabled the researcher to organize the population into homogenous subsets and then select the appropriate number of elements from each. On the other hand, random sampling was used to select the sample schools from the four zones. Simple random sampling was preferred because it ensures that any of the possible subsets of the sample is equally likely to be selected. The researcher randomly selected two girls' schools from zones A and B and two boys' schools from zones C and D. Consequently, a purposive sample is one in which the researcher creates a representative sample based on the purposes.Four form three Chemistry teachers were purposively selected because they teach the selected form three learners.

The sample size of the study comprised of four schools drawn from 27 schools A sample size of 198 (109 students in the control group, 89 students in the experimental group, and 4 Chemistry teachers) was considered, drawing a response from Form Three students taking Chemistry subject and Chemistry teachers. Schools were sampled based on the same mean grade. Given that experimental studies take a lot of time and involve various activities in class, the study was restricted to a smaller population. Therefore, two boys' schools and two girls' schools were considered and the sample size determination is presented in Table 1.

Table 1: Sample Size for the Study

School Type	Categories Regions	Control Group	Experimental Group	Chemistry Teachers
Boys	School 1		46	1

African Research Journal of Education and Social Sciences | ISSN: 2312-0134 | W: www.arjess.org

Schools	School 2	58		1
Girls	School 1		43	1
Schools	School 2	51		1
TOTAL		**109**	**89**	**4**

The 40 students in each class in the control and experimental groups are approximate values because some classes may have less than or more than 40 students.

Research Instruments

Data collection used the following instruments: pre-test, post-test, observation schedule, and interview schedule. This triangulation enabled the researcher to obtain a variety of information on the effects of cooperative learning on the achievement of students in Chemistry in secondary schools in KangemaMurang'aCounty,Kenya.

The Student Achievement Tests included a pre-test and post-test to determine student ability in both experimental and control groups. The pre-test ensured that students had almost the same ability on fundamentals of Chemistry before any treatment was carried out. The test involved 15 multiple-choice questions validated by experts in Chemistry (the researcher's supervisors and the head of the subject in the researcher's school) and the Department of Educational Communication and Technology.The test was scored according to the marking scheme developed by the teachers and the researcher. The post-test was given after teaching and was to determine if the intervention has made a significant difference.

The researcher developed a checklist that guided observation of activities that took place during the integration of cooperative learning in the classroom during teaching and learning Chemistry lessons. The observations enabled theresearcher judge whether cooperative learning was achieved to the required expectations.

Semi-structured interviews were used to obtain information from the Chemistry teachers. A face-to-face interview schedule was also used. The intent was to help the researcher obtain in-depth information on the experiences of teachers in the integration of cooperative learning in teaching and learning Chemistry. Since the quasi-experimental design sample would not be fully informative, the use of interviews was adopted as a triangulation strategy to gather more information on teachers' experiences and enable a proper analysis of the investigation.

Data analysis

Data analysis started by checking the gathered raw data for completeness, usefulness, and accuracy. Quantitative data was analyzed discretely based on descriptive and inferential statistics. Analysis was based on certain measures of central tendency (Means and Standard Deviations).Data obtained from pre-tests and post-tests were analyzed using inferential statistics

African Research Journal of Education and Social Sciences | ISSN: 2312-0134 | W: www.arjess.org

on the Statistical Package for Social Sciences (SPSS) software, which covered the objective of the study. Data analysis focusing on students' academic achievement in cooperative and non-cooperative learning was carried out using the paired t-test. A summary of the data analysis is given in Table 2 below.

RESULTS

The objective of the study sought to determine the difference in academic performance between students taught using cooperative learning approach and those taught using non-cooperative learning strategy. Table 1 shows the distribution of the respondents by Students' pre and post-treatment scores

Table 3:

Students' pre and post-treatment scores

Entry	Variable	N	Mean	StdDev	Range	Minimum	Maximum
School A (Experimental)	PRE	46	34.78		23.00	25.00	48.00
	POST	42	48.17	+13.39	41.00	28.00	69.00
School B (Experimental)	PRE	43	33.40	------	17.00	26.00	43.00
	POST	40	49.40	+16.0	40.00	29.00	69.00
School C (Control)	PRE	56	34.11	-------	22.00	26.00	48.00
	POST	57	33.95	-0.16	29.00	24.00	53.00
School D (Control)	PRE	51	33.61	-------	22.00	24.00	46.00
	POST	51	32.92	-0.69	33.00	19.00	52.00

The results from table 3 indicate that cooperative learning has the potential of improving the learners' scores and the overall class means scores.

African Research Journal of Education and Social Sciences | ISSN: 2312-0134 | W: www.arjess.org

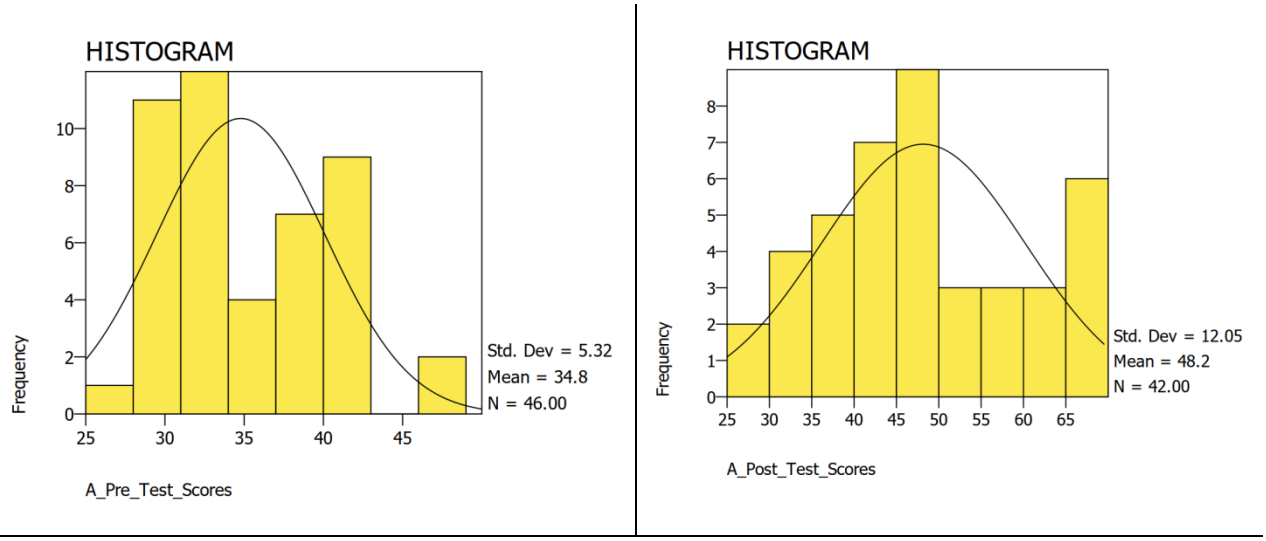

Figure 1: *Frequency Distribution for Pre and Posttest Scores in School A (Experimental)*

The frequency distribution graphs for pre and post-test scores in School A (Figure 1) show that cooperative learning indeed can lead to improved collective performance for the learners. This is unlike in the individualistic method where the scores are indicative of extensive dispersion. An interesting observation from the School A graphs shows that the greatest concentration/distribution of the student's scores in the pre-test values lies between 31 and 34. However, an increase in the post-test scores was observed as the most concentration of scores lies between 45 and 50. The pre-test scores distribution display a positive skew/ right-skewed graph with the mass of the distribution concentrated on the left indicating low/poor performance. On the other hand, the posttest graph shows an almost symmetrical distribution in the students' scores.

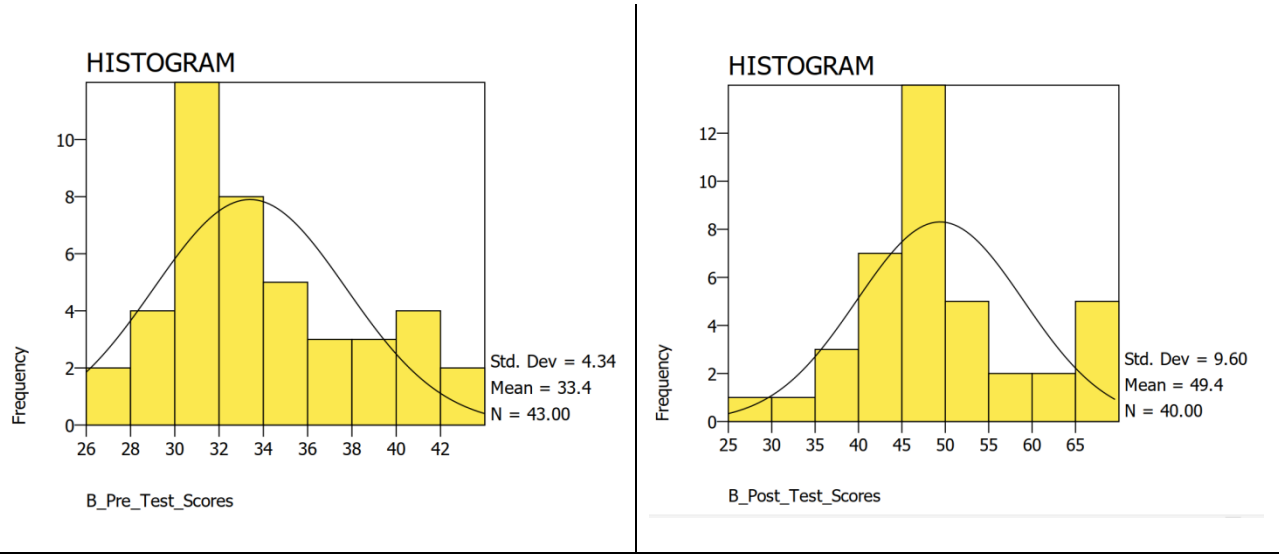

Figure 2: Frequency Distribution for Pre and Posttest Scores in School C (Control)

African Research Journal of Education and Social Sciences | ISSN: 2312-0134 | W: www.arjess.org

Similar observations were evident for the pre and post-test scores in School B as shown in the frequency tables above. The greatest concentration of the pre-test values lies between 30 and 32, which in the posttest shows a shifted increase of the mass distribution of the scores to between 45 and 50. School B also shows a positive skew distribution while that of the posttest scores is almost symmetrical

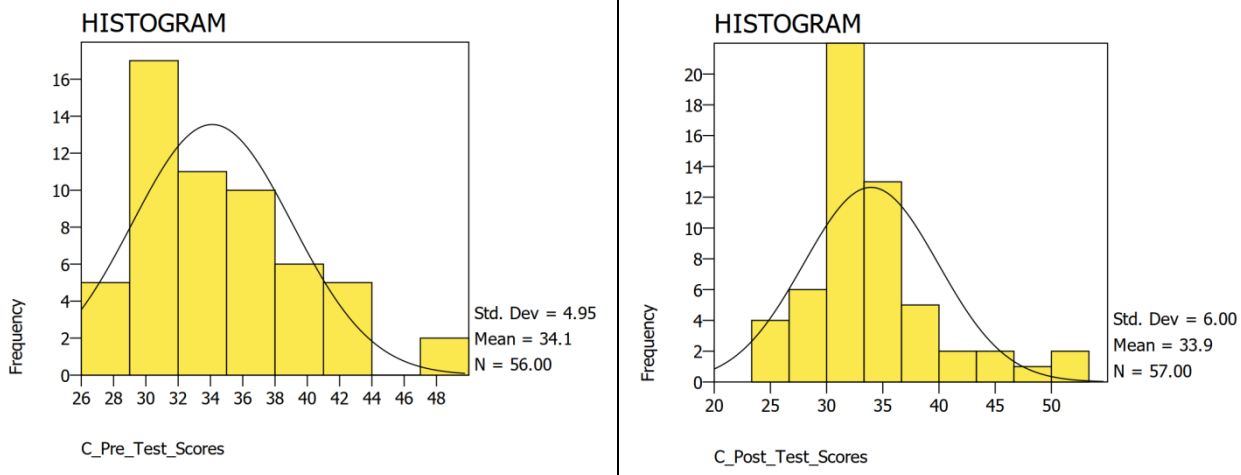

Figure 3: Frequency Distribution for Pre and Posttest Scores in School D (Control)

Both the pre and post-test scores in Schools C and D, exhibit positive skew in their distributions as shown in figures above.

Table 4
Pre and Posttest Analysis for School A (An Experimental School)

Paired Sample Statistics

		Mean	N	Std. Deviation	S.E. Mean
Pair 1	A_POST	48.17	42	13.39	1.86
	A_PRE	35.45	42		.78

Paired Samples Test

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error	Lower	Upper			

African Research Journal of Education and Social Sciences | ISSN: 2312-0134 | W: www.arjess.org

				Mean					
Pair 1	A_POST - A_PRE	12.71	8.15	1.26	10.18	15.25	10.12	41	.000

The test results for School B are similar to those for School A indicating the existence of significant difference in the learners' academic achievements before and after the intervention; (*p*-value, .000 < .05).

Table 5 : Pre and Posttest Analysis for School B (An Experimental School)

Paired Sample Statistics

		Mean	N	Std. Deviation	S.E. Mean
Pair 1	B_POST	49.40	40	16.0	1.52
	B_PRE	33.77	40		.67

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	B_POST - B_PRE	15.63	7.01	1.11	13.38	17.87	14.10	39	.000

Table 6: Pre and Posttest Analysis for School C (A Control School)

Paired Sample Statistics

		Mean	N	Std. Deviation	S.E. Mean
Pair 1	C_POST	33.88	56	0.16	.81
	C_PRE	34.11	56		.66

Paired Samples Test

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error	Lower	Upper			

African Research Journal of Education and Social Sciences | ISSN: 2312-0134 | W: www.arjess.org

				Mean					
Pair 1	C_POST - C_PRE	-.23	3.56	.48	-1.18	.72	-.49	55	.627

On the contrary, the test results for School C, being a control sample shows that there is no significant difference in the learners' outcome in the Pre and Post data. This is because the significance (sig.)/ *p*-value is greater than the alpha value (.627 > .05)

Table 7: Pre and Posttest Analysis for School D (A Control School)

Paired Sample Statistics

		Mean	N	Std. Deviation	S.E. Mean
Pair 1	D_POST	32.92	51	0.69	.87
	D_PRE	33.61	51		.64

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	D_POST - D_PRE	-.69	3.61	.51	-1.70	.33	-1.36	50	.181

The test outcomes for School D also a control group show similar results as in those in School C as indicated in the table above. This is because the *p*-value, .181 > .05.

The information in the four tables above being representative of the test results from the two experimental and the two control schools are indicative of one major finding. That indeed, cooperative learning has a significant impact on the learners' achievement. The results show that learners while learners in the experimental groups exhibited dismal performance before the experiment this is not the case after the cooperative learning intervention is carried out on the same group.

DISCUSSION

The results from table 3 indicate that cooperative learning has the potential of improving the learners' scores and the overall class means scores. These findings are in line with the outcomes of similar past studies that sought to compare the statistical relationship between the cooperative and individualistic teaching strategies on students' academic outcomes (Yamarik, 2007;

African Research Journal of Education and Social Sciences | ISSN: 2312-0134 | W: www.arjess.org

Gubbad& Mohammed, 2010; Saleh, 2011; Buchs, Wiederkehr, Filippou, Sommet, &Darnon, 2015; Molla&Muche, 2018; Bores-García, Hortigüela-Alcalá, Fernandez-Rio, González-Calvo, &Barba-Martín, 2021).

The frequency distribution graphs for pre and post-test scores in School A (Figure 1) show that cooperative learning indeed can lead to improved collective performance for the learners. This is unlike in the individualistic method where the scores are indicative of extensive dispersion. An interesting observation from the School A graphs shows that the greatest concentration/distribution of the student's scores in the pre-test values lies between 31 and 34. However, an increase in the post-test scores was observed as the most concentration of scores lies between 45 and 50. The pre-test scores distribution display a positive skew/ right-skewed graph with the mass of the distribution concentrated on the left indicating low/poor performance. On the other hand, the posttest graph shows an almost symmetrical distribution in the students' scores.

Further,research shows that students who learn in cooperative groups exhibit an increase as well as symmetrical distribution in their collective test scores (Kuhlman, 2016; Gerald, & Allan, 2018; Zambrano, Kirschner, Sweller, &Kirschner, 2019). This is evident in the pre and post-test graphs shown in figure 2. Studies have attributed these findings to the fact that cooperative learning facilitates increased peer-to-peer interactions, exchange of information, and co-construction of knowledge amongst the learners thus enhancing increased collective knowledge gain (Saunders, 2008; Eskay, Onu, Obiyo, &Obidoa, 2012; Buchs&Butera, 2015; Al-Kaabi, 2016; Salomone& Kling, 2017; Van Ryzin&Roseth, 2018).

Similar observations were evident for the pre and post-test scores in School B as shown in the frequency tables in figure 2 below. While the greatest concentration of the pre-test values lies between 30 and 32, which in the posttest shows a shifted increase of the mass distribution of the scores to between 45 and 50. School B also shows a positive skew distribution while that of the posttest scores is almost symmetrical.

Notably, apart from descriptive treatment, the students' pre and post-intervention scores were also subjected to inferential treatment. While descriptive statistics describe and summarize data that can be visualized in the form of a chart or a graph, inferential statistics helps to make predictions and conclusions on the associations between variables under a quantitative study (Chin & Lee, 2008; Amrhein, Trafimow, & Greenland, 2019). A case in point is that inferential statistics procedures are useful in comparing the differences that may exist between a set of treatment groups/ samples by observing the characteristic of a set test-statistic value. Elements such as the degree of freedom, which is a measure tied to the size of a sample, and set criteria for rejection are adopted together with the test-statistic value to ascertain whether a difference between groups exists (Dahiru 2008; Greenland et al., 2017). The rejection criteria as an element of inferential statistics guide whether to reject or accept the null hypothesis - H_0 (Marshall &Jonker, 2011; Marino, 2018; Amrhein*et al.*, 2019).

While there are various types of inferential statistics, it is important to note that each one of them is usually appropriate for a given research approach. In the case of this study, the paired t-test

African Research Journal of Education and Social Sciences | ISSN: 2312-0134 | W: www.arjess.org

was deemed the most appropriate for analyzing the level of statistical significance between students' academic achievement in cooperative and non-cooperative learning. The paired t-test also known as the paired-difference t-test, the dependent samples t-test, or the repeated-samples t-test is a parametric statistical procedure employed in determining whether the mean difference between two sets of data is zero (Kim, 2015; Xu*et al*., 2017; Liang, Fu, & Wang, 2019). In other words, it is used to analyze data from paired measurements. The before-and-after measurements as is the case in this study is a notable research design in which the paired t-test is commonly used as an inferential statics tool (Kim, 2015; Xu*et al*., 2017).

The test-statistic value typically referenced when testing for statistical significance using the paired t-test is the *p*-value/ alpha value. The *p*-value reveals the probability associated with the test outcomes concerning the null hypothesis (Nahm, 2017). This study explores null hypotheses; HO_1 inferring to the relationship between teaching using cooperative learning and students' academic achievement.

The observation of the *p*-value usually goes hand in hand with the chosen confidence interval and level. A confidence interval is the expected range of values within which a test result may fall if the test is to be carried out repeatedly (Hazra, 2017). It thus has a lower and an upper bound value. On the other hand, the confidence level usually represented as a percentage is the number of times a test estimate is reproducible within the confidence interval's upper and lower bounds based on the chosen alpha value (Hazra, 2017). The alpha value or the significance level is the discretionally chosen cut-off probability value by the researcher that he or she sets to accept or reject the null hypothesis (Kim, 2015; Xu*et al.*, 2017). In most cases, the most typical alpha values adopted in research are 0.01 and 0.05 at 99% and 95% confidence levels respectively. The 0.05 is the most common alpha value employed by most researchers and the one adopted in this study.

Of importance, while the researcher sets the alpha value, the *p*-value is what the test reveals. In analyses where the *p*-value exceeds/ is greater than the alpha value, the outcome is to accept the null hypothesis since the value proves that there is no significance between the test variables (Kim, 2015; Xu*et al.*, 2017). On the contrary, where the *p*-value is less than the set alpha value, the guidance is to reject the null hypothesis. The rejection of the null hypothesis is so because a level of significance is proved to exist between the test variables.

With the adoption of the .05 alpha value and using the paired t-test analysis in this study, to compare the academic achievement of students taught using cooperative learning and those taught using non-cooperative learning strategies, the outcomes are presented in tables 4, 5, 6 and 7.The comparison of the Pre and Post data from school A indicates that the *p*-value (Sig.) is less than the alpha value (*p*-value, .000 < .05). In this case, the null hypothesis is rejected about School A and the alternative hypothesis accepted. As such, the results are indicative that in respect to School A, there is a significant difference in academic achievement between students taught using cooperative learning and those taught using non-cooperative learning strategies in Chemistry.

African Research Journal of Education and Social Sciences | ISSN: 2312-0134 | W: www.arjess.org

As evident in the post-intervention data, the learners' achievements reflect improved performance. The findings from this study agree with similar establishment from other studies carried out on the effectiveness of cooperative learning as an instructional strategy capable of enhancing students' academic achievement. Bilesami and Oludipe (2012) for instance attest to this fact and reported that learners taught using the cooperative method improved their academic achievement in science education. Further, Samuel and John (2014) in their study on the impact of cooperative learning on students' outcomes in their chosen context also established that learners exhibit better performance in chemistry than when taught using the conventional classroom approach. It is certain as revealed in this study that in instances where the status quo remains and the teachers instruct their students using the conventional learning method, the students' achievements are likely to remain the same or even deteriorate. This is because education is constantly evolving and the learning environment is never constant but always dynamic (Garcia-Huidobro, Nannemann. Adeyemi 2018) declares that students who go through conventional teaching methods more often than not post poor performance than those who experience cooperative learning.Similarly,Christian and Pepple (2012) support this position in their study where they established that the students in their study's sample exemplified enhanced academic performance in Chemistry after going through a cooperative learning intervention.

CONCLUSION

From the findings exhibited in this study,the researcher concludes that students taught using the cooperative learning method demonstrated improved academic achievementinChemistry when compared to those taught using a non-cooperative learning strategy.Further,the study concludes that cooperative learning strategy is more effective than non-cooperative strategy in teaching Chemistry.Based on the research findings this study makes the following recommendations:The cooperative learning method should be a more preferred instructional method in teaching Chemistry in secondary schools than the conventional approach as it has the potential of improving students' academic outcomes; Cooperative learning to be taught to teachers during induction; and the government should develop and implement a policy that incorporates cooperative learning in teacher education.

References

Abimbola, I. O. (2013).*The misunderstood word in science: Towards a technology of perfect understanding for all*. Library and Publications Committee, University of Ilorin.

Adeyemi, B. A. (2018). Effects of cooperative learning and problem solving strategies on junior secondary school students' achievement in social studies.*Journal of Educational Psychology, 16*(3), 691-708.

Ajaja, O. P., &Eravwoke, O. U. (2010).Effects of cooperative learning strategy on junior secondary school students' achievement in integrated science.*The Electronic Journal for Research in Science & Mathematics Education, 14*(1), 1- 18.

Al-Kaabi, A. F. (2016). *Effects of collaborative learning on the achievement of students with different learning styles at Qatar University* (Doctoral dissertation, Brunel University London).

African Research Journal of Education and Social Sciences | ISSN: 2312-0134 | W: www.arjess.org

Altun, S. (2015).The Effect of Cooperative Learning on Students' Achievement and Views on the Science and Technology Course. *International Electronic Journal of Elementary Education* *7*(3), 451-468

Amrhein, V., Trafimow, D., & Greenland, S. (2019). Inferential statistics as descriptive statistics: There is no replication crisis if we don't expect replication. *The American Statistician*, *73*(sup1), 262-270.

Belesanmi, A., &Oludipe, D. (2012).Effectiveness of cooperative learning strategies on Nigerian secondary school students' academic achievement in basic science. British *Journal of Education, Society &Behavioral Science*, *1*(1), 307-325.

Bilesanmi-Awoderu, J.B. (2012). Effect of Computer-assisted Instruction and Simulation/Games on the Academic Achievement of Secondary School Students' in Biology.*Sokoto Educational Review*, *8* (1), 49-60.

Bores-García, D., Hortigüela-Alcalá, D., Fernandez-Rio, F. J., González-Calvo, G., &Barba-Martín, R. (2021). Research on cooperative learning in physical education: Systematic review of the last five years. *Research quarterly for exercise and sport*, *92*(1), 146-155.

Buchs, C, &Butera., F (2015). Cooperative learning and social skills development. In: Gillies, R. (Ed.), *Collaborative Learning: Developments in research and practice*. New York: Nova Science.

Buchs, C., Wiederkehr, V., Filippou, D., Sommet, N., &Darnon, C. (2015). Structured cooperative learning as a means for improving average achievers' mathematical learning in fractions.*Teaching Innovations*, *28*(3), 15-35.

Carpenter, S., & McMillan, T. (2003). Incorporation of a cooperative learning technique in organic chemistry.*Journal of Chemical Education*, *80*(3), 330.

Chebii, J. (2011). Effects of science process skills mastery learning approach on secondary school students' achievement and acquisition of selected Chemistry practical skills in Koibatek District Schools. *Kenya Educational Review Journal, 3* (8), 1291-1296.

Chin, R., & Lee, B. Y. (2008). *Principles and practice of clinical trial medicine*.Elsevier.

Christian, M., &Pepple, T. (2012).Cooperative and individualized learning strategies as predictors of students' achievement in secondary school Chemistry in River state.*Vocational Education and Technology*, *9* (2), 1-12.

Dahiru T. (2008). P - Value, a true test of statistical significance? A cautionary note.*Annals of Ibadan postgraduate medicine*, *6*(1), 21–26.

Eskay, M., Onu, V. C., Obiyo, N., &Obidoa, M. (2012). Use of Peer Tutoring, Cooperative Learning, and Collaborative Learning: Implications for Reducing Anti-Social Behavior of Schooling Adolescents. *Online Submission*.

Ezeano, (2013).Science Teaching for Effective Development in Nigerian Secondary Schools.

Garcia-Huidobro, J., Nannemann, A., Chang-Bacon, C., & Thompson, K. (2017). Evolution in educational change: A literature review of the historical core of the Journal of Educational Change. *Journal of Educational Change*, *18*, 263-293.

Gerald, B., & Allan, M. (2018).Effect of cooperative learning on students' attitude and performance towards probability distributions in statistics.*Journal of Education and Practice*, *9*(14), 43-50.

African Research Journal of Education and Social Sciences | ISSN: 2312-0134 | W: www.arjess.org

Gubbad, A. A. M. A., & Mohammed, A. (2010). The effect of co-operative learning on the Academic Achievement and Retention of the Mathematics Concepts at the Primary School in Holy Makkah. *Journal of King Saud University*,*22*, 13-23.

Hazra, A. (2017). Using the confidence interval confidently.*Journal of thoracic disease*, *9*(10), 4125.

Hsiung, C. M. (2012).The effectiveness of cooperative learning.*Journal of engineering Education*, *101*(1), 119-137.

Karali, Y., &Aydemir, H. (2018).The Effect of Cooperative Learning on the Academic Achievement and Attitude of Students in Mathematics Class.*Educational Research and Reviews*, *13*(21), 712-722.

Kim, T. K. (2015). T test as a parametric statistic. *Korean journal of anesthesiology*, *68*(6), 540.

KNEC.(2014). *Press statement on the release of the 2010 KCSE examination results by the cabinet secretary*. Nairobi: KNEC:

Kolawole, E. B. (2008). Effects of competitive and cooperative learning strategies on academic performance of Nigerian students in mathematics.*Educational Research and Reviews*, *3*(1), 033-037.

Kuhlman, J. L. (2016). Using Cooperative Learning to Increase Achievement of Urban Learners in Math and Reading through Strong Interpersonal Relationships. Retrieved from http://repository.stcloudstate.edu/cgi/viewcontent.cgi?article=1019&context=ed_etds

Liang, G., Fu, W., & Wang, K. (2019).Analysis of t-test misuses and SPSS operations in medical research papers.*Burns & trauma*, *7*.

Marino, M. J. (2018). Statistical analysis in preclinical biomedical research.In *Research in the biomedical sciences* (pp. 107-144).Academic Press.

Marshall, G., &Jonker, L. (2011). An introduction to inferential statistics: A review and practical guide. *Radiography*, *17*(1), e1-e6.

Nahm, F. S. (2017). What the *P* values really tell us. *The Korean journal of pain*, *30*(4), 241–242.https://doi.org/10.3344/kjp.2017.30.4.241

Olatoye, R.A., Aderogba, A.A. &Aanu, E.M. (2011). Effect of co-operative and individualized 'eaching methods on senior secondary school students' achievement in organic Chemistry. *Pacific Journal of Science and Technology*,*12* (2), 310-319.

Oludipe, D. (2012). Gender difference in Nigerian secondary students' academic achievement in Chemistry.*Journal of Educational and Social Research*, *2*(1), 76-81.

Saleh, T. A. (2011). Statistical Analysis of Cooperative Strategy Compared with Individualistic Strategy: An Application Study. *Journal of Effective Teaching*, *11*(1), 19-27.

Salomone, M., & Kling, T. (2017). Required peer-cooperative learning improves retention of STEM majors. *International journal of STEM education*, *4*(1), 1-12.

Saunders, A. (2008). Does Cooperative Learning Increase Participation in the Classroom? Retrieved from https://fisherpub.sjfc.edu/cgi/viewcontent.cgi?article=1116&context=education_ETD_masters

Slavin, R. E. (2013).*Cooperative learning: Theory, research, and practice*. Englewood Cliffs, NJ: Prentice-Hall.

African Research Journal of Education and Social Sciences | ISSN: 2312-0134 | W: www.arjess.org

Van Ryzin, M. J., &Roseth, C. J. (2018). Cooperative learning in middle school: A means to improve peer relations and reduce victimization, bullying, and related outcomes. *Journal of educational psychology*, *110*(8), 1192.

Vygotsky, L. (1978). *Mind in society: The development of higher psychological processes*.Cambrid MA: Harvard University Press.

Wang, Y., Rodríguez de Gil, P., Chen, Y. H., Kromrey, J. D., Kim, E. S., Pham, T.,

Yamarik, S. (2007). Does cooperative learning improve student learning outcomes?.*The journal of economic education*, *38*(3), 259-277.

Zambrano, J., Kirschner, F., Sweller, J., &Kirschner, P. A. (2019).Effects of group experience and information distribution on collaborative learning.*Instructional Science*, *47*(5), 531-550.

CONFLICT OF INTEREST

The author declared none.

ACKNOWLEDGEMENT

The author extends gratitude towards the students, teachers and administrators of the schools where the study was carried out.