

Effect of Cooperative Mastery Learning Approach on Secondary School Students Achievement based on Gender in Kirinyaga County, Kenya

Kairo Nkirote Catherine

P.O. Box 3-60400 Chuka

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ABSTRACT

Through the study of Physics, technological advancement promoting standard of living, creation of wealth, health and industrialization has been realized. The Kenyan government has put much effort to reduce gender disparity in achievement in physics in secondary schools. However, and despite these efforts, the desired outputs have not been realized. Though a number of factors may be responsible for this prevailing situation in secondary schools in Kenya, it is envisaged that inappropriate teaching approaches used in teaching physics contribute to gender disparity in achievement in physics. While cooperative mastery learning approach has been shown to reduce gender disparity in other science subjects' studies addressing the effect of cooperative mastery learning approach towards student's achievement in Physics based on gender are inadequate. Hence this study investigated the effects of Cooperative Mastery Learning Approach on secondary school students' achievement in Physics based on gender in Kirinyaga County. Solomon's four quasi experimental group design was used. The target population was 5850 form two Physics students in the secondary schools in Kirinyaga County, Kenya. A sample of 180 respondents was obtained from the population. Simple random sampling was used to draw the participating four schools from the purposively selected Sub-county schools. The assignment of selected schools to either experimental or control group was done by simple random sampling. The research instrument that was used was physics Achievement Test (PAT). The Reliability was tested by subjecting the instrument to a pilot study in a school in Embu County. Reliability coefficient for Physics Achievement Test was 0.798. Statistical Package for Social Sciences (SPSS) version 25.0 was used for data analysis. The raw data obtained was analyzed descriptively using Mean, Standard deviation, percentages and inferentially using parametric tests (one-way ANOVA, t-test and Posthoc Analysis). The level of significance for acceptance or rejection of null hypotheses was at $\alpha = 0.05$. The study established that cooperative mastery learning approach enhances students' academic achievement in Physics for both genders. Further the study findings show that there was no statistical significance difference in student achievement in physics based on gender. From the findings of the study cooperative mastery learning approach is effective in improving student achievement in Physics for both boys and girls. Therefore, Physics teachers should incorporate cooperative mastery learning approach in teaching in order to reduce gender disparity in students' achievement in Physics.

Keywords: Achievement, Cooperative Mastery Learning Approach, Gender Disparity

INTRODUCTION

Science education, both globally and locally, should build conceptual knowledge among students arising from their intellectual practices and commitments. Such scientific understanding is vital for the development of learners' skills and capabilities in readiness for their outside world exposure (Gonzales & Reyes, 2016). Since scientific and technological revolutions support economic advancements, advancements in healthcare systems, and infrastructures, scientific education is an essential development driver (Chioma, 2015). Scientifically manufactured items are changing corporate processes throughout various economies, and the lifestyles of all those who may benefit from them. Kola (2013) holds that innovations driven by science in

industries like medical wellness enhances people's livelihoods by providing timely and high-quality medical care. Creating situations that enhance students' own interpretation and integration of ideas scientifically, is crucial to establish clarity of the major challenge in teaching science across the world. Education institutions mainly secondary schools in Kenya, try to attain academic objectives and goals through teaching within school disciplines. As a result, physics education is primarily concerned with attaining academic objectives and goals within the framework of physics (Meheux, 2017). Physics being one of the STEM subjects, is generally studied in secondary schools as it functions as a basis for preparing learners to become productive citizens in society as well as specific future training. In schools, physics is taught using a range of activities designed to enhance student learning (Prima, Utari, Chandra, Hasanah, & Rusdiana, 2018). Learning physics is founded on the notion of prioritizing scientific procedures in order to develop products that are based on the scientific attitudes.

Physics education therefore enables the learner to acquire problem-solving and decision-making skills that provides ways of thinking and inquiry which help them to respond to widespread and radical changes in industry, health, climatic changes, information technology and economic development. These changes demand knowledge of scientific principles in order to tackle them (Otieno, 2015). The teaching of Physics provides the learners with understanding, skills and scientific knowledge needed for scientific research, fostering technological and economic growth in the society, where they live thus improving the standards of living (Wambugu, 2006). Though physics is essential for industrialization, there has been a decline in academic achievement in secondary school students (Wachanga, Johnson & Francis 2013). The poor performance in physics is no gender exception, it cut across both male and female but it is very important to find out the level of failure between male and female so as to proffer adequate solution to it. According to studies, girls underachieve and they are underrepresented in the sciences, particularly physics (Malachy & Ononugbo, 2006; Simeon & Musa, 2010). There is consequently a need to remedy this gender difference in a manner that enhances girls' performance, giving them a better chance of enrolling in occupations that demand a solid Physics foundation (Republic of Kenya, 2005). Onah and Ugwu (2010) hold that gender has been regarded as having a major influence on high school learners' achievement in physics. Another study, conducted by Akinbobola and Afolabi (2010), found that gender does not act as a major predictor of learners' educational success in sciences specifically physics, instead, the teaching methodologies used need not discriminate against any gender. Therefore, use of appropriate teaching method is critical to the successful teaching and learning of Physics.

There are models for learning, techniques, and procedures that can help in the physics education process. To meet the goals of physics learning at this education level, the subject must be adequately presented to learners using appropriate teaching methods (Puspitasari, Lesmono & Prihandono, 2015). The instructors' selection and application of an appropriate teaching approach for acquiring knowledge is critical. Teachers must use suitable teaching approach that best fit specific goals that constitute successful learning and teaching to assist the process of information transmission (Thomas & Israel, 2013, Ezenwafor & Molokwu, 2015). Gengle, Abel, and Mohammed (2017) argues that teaching approaches are classified as learner-centered or teacher-centered. The teacher-centered methodology is a teaching approach in which the instructor controls the learning and teaching activities (Gengle, Abel & Mohammed, 2017). The students tend to be passive recipients of knowledge, with minimal interaction between them and the instructor. As a result, the instructor becomes a knowledge distributor, while the student becomes a memorizer of knowledge (Abimbola & Abidoeye, 2013; Hossain & Tarmizi 2013). When the approach is centered on the teacher, students are demotivated to actively participate in the educational process. To remedy such problems, Zakaria, Chin, and Daud (2010) argue education is supposed to concentrate on actively engaging learners as core participants rather than just providing rules, concepts, and processes for learners to memorize.

In an effort to address gender disparity in students' performance in physics, research on the influence of

teaching methodologies have been conducted in Kenya. Keter (2013) holds that cooperative mastery learning is an approach wherein students are educated together in smaller groups of a maximum of five people and provides students with chances to actively participate in learning. The content to be learned is divided into small, easily manageable segments, where each has its own set of goals, and formative assessments are provided to learners at the conclusion of every unit to assess their comprehension levels. Learners who do not acquire the required level of proficiency are subjected to remediation, which aims to remediate learning difficulties, lowering variation in performance levels, and ultimately eradicating achievement gaps. Keter and Ronoh (2016) evaluated how academic success on chemistry students is influenced by cooperative learning approach per gender across Bomet County. The study's findings revealed that learners educated using the cooperative mastery learning approach (CMLA) outperformed those instructed utilizing traditional teaching approach. The findings also revealed that when girls and boys were taught using a CMLA, there showed no gender disparity in achievement.

A study by Keter (2013) on effects of cooperative mastery learning approach on secondary school students' motivation and achievement in chemistry in Bomet County, Kenya, stressed on both motivation and achievement through stepwise mastery of content, corrective feedback, remediation as well as cooperative skills. The findings indicated that the motivation level was significantly higher for students taught using CMLA compared to those taught using conventional teaching approach. Students taught using CMLA achieved significantly higher in CAT than those taught using conventional teaching methods. However, there was no significant gender difference in motivation and achievement when boys and girls were taught using CMLA. The results showed that CMLA is superior to conventional teaching approach in terms of motivating the learners towards chemistry and achieving higher scores in the subject. Keter (2013) further adds that the cooperative activities supplement, but do not replace, direct instruction. However, they involve individual accountability because group success depends on members' contribution to a team task. Positive interdependence is critical to successful application of the CMLA teaching approach. It benefits both the weak and bright students because group memberships and interpersonal interaction are not, in themselves, sufficient to produce higher achievement and productivity. In a cooperative group, bright students are also seen as resources and are valued by group members. The CMLA exhibited these qualities hence higher achievement was reported in the study.

A study by Keter (2018) on effects of computer based cooperative mastery learning on secondary school students' skills acquisition, motivation and achievement in chemistry practicals in Bomet County, Kenya utilized the experimental and control groups to determine the relative effects of computer based cooperative mastery learning on students' achievement in Chemistry practical, an analysis of students' CAT post-test scores was carried out. The results indicated that the performance of the Experimental Groups was higher compared to that of the control groups. The findings of the study showed that computer based cooperative mastery learning approach has a positive significant effect on students' Skills Acquisition, Motivation, and Achievement in Chemistry when it is used in teaching Chemistry. The study also revealed that, gender has no significant effect on students' skills acquisition, motivation and achievement in chemistry when computer based cooperative mastery learning approach is used to teach.

Obafeni and Deborah (2015), investigated the influence of students' gender on their understanding, application and analysis of Light waves concept in physics in Ikwerre Local Government Area of Rivers State, Nigeria. A quasi-experimental pretest posttest design comprising of three experimental and one control group was used, each group was taught with a different Instructional method. A purposively selected sample of fifty-five (55) physics students of Senior Secondary 2 class was involved in the study. Two instruments- Mathematics Ability Test and Physics Performance Test on Light Waves with reliability coefficients of 0.97 and 0.89 respectively were used. The performances of the students were considered at the levels of understanding, application and analysis of Light waves. Data collected was analysed using Mean scores and Percentages for the research questions, while 4×2 Multivariate Analysis of Covariance was

used to test the hypotheses. Analysis of results showed that Demonstration method stands out as an effective method in bridging gender gap in the learning of difficult physics concepts like Light waves. Furthermore, a significant difference was found between the performance of male and female students in the application of Light waves while there was no significant difference between the performance of male and female students in the understanding and analysis of Light waves. The Post hoc analysis indicated that male students taught using Guided-discovery method contributed more to the significant difference between the performance of male and female students in the application of Light waves.

A study by Ugwu (2011) investigated the relationship between gender and achievement of senior secondary students in Physics. Correlation research design was used and stratified proportionate random sampling technique was employed. 494 subjects used for the study were randomly selected from 25 secondary schools across the six education zones of Enugu State. Intact classes were used. One intact was selected by simple balloting for schools that have more than one stream studying Physics. Test of Understanding of Physics Concepts was the instrument in the study while the school certificate physics examination was the achievement test. Results showed from the simple correlation and regression analysis a weak negative relationship between gender and Test of Understanding of Physics Concepts and no relationship between gender and school certificate physics examination results. Gender did not correlate significantly with students' achievement in school certificate physics examination. In conclusion, gender was significantly related to senior secondary school Physics students' understanding of physics concepts but not a significant predictor of their attainment in school certificate physics examination.

A study by Aina and Akintunde (2013) carried out an analysis of gender performance in physics in colleges of education. The study employed descriptive survey study of male and female performance in physics in four Colleges of Education in Kwara state, Nigeria. One hundred students were sampled for the study. Pearson Product Moment Correlation Coefficient, frequency counts and percentages were used to analyse the data collected. The results showed no relationship between male and female performance and male students performed better than female in physics. The study concluded that Students' performance in physics in College of Education is no gender bias; however, male students are better in performance than female students.

A study by Echie and Ihenko (2017), investigated the influence of gender on interest and achievement of integrated Science students in Obio Akpor local government area of Rivers State. Two research questions and two hypotheses were raised, the population comprised of all secondary school students in the local government area and a total of 600 students took part in the study. Two instruments were used to collect data: the test scores and a likert scale like interest scale. Mean, standard deviation and t-test were used to analyse the data. The findings showed that gender has a significant influence on the interest but does not have a significant influence on achievement of Integrated Science students. The identification of the best teaching approach for a given set of students must be done if the best result must be achieved. To improve performance in physics effective teaching approach that actively engage the students should be encouraged. Academic achievement has been highlighted to be influenced by gender among students by researchers Sar Abadani Tafreshi (2006) found a substantial variation in academic achievement between female and male learners, while Zembar and Blume (2011) discovered girls on average outperformed boys in secondary schools. Others discovered a statistically meaningful weak relationship between academic performance and gender, implying that gender was an insignificant factor when evaluating students' academic achievements (Hanan, Shabana & Mona, 2016; Bacon, 2011).

Difference in physics achievement due to gender has caused a lot of concern to educationist. Several initiatives have been undertaken to attract girls and women in science and technology education, including continuous sensitization and lobbying of policymakers and legislators; promoting gender mainstreaming in policy and gender related programs; incentives such as scholarship award systems; special internships for

female students; career guidance and mentoring in institutions of learning, adaptation of curricula, and interaction of teachers and parents (Ceci *et al.*, 2014). However, boys have continued to outperform their female counterparts in physics. Thus, the current study sought to determine the effect of cooperative mastery learning approach on students' achievement based on gender.

STATEMENT OF THE PROBLEM

The analysis of the pattern and trends in achievement in physics in KCSE examination based on gender clearly indicates that there is gender disparity in students' achievement which is also below an average score of 50%. The gender disparity in achievement in physics has continued to trigger a lot of concern among educationists and other stakeholders nationally and also in Kirinyaga County over the years. This gender disparity in achievement in physics is attributed to inappropriate teaching approaches. Even though student centered approaches such as cooperative mastery learning approach have been shown to reduce gender disparity in achievement in Chemistry, Biology and Mathematics, such information is little in relation to the teaching of physics. Specifically, there was need to know how cooperative mastery learning approach would influence student's achievement in physics based on gender. Therefore, it was on this basis that the study assessed the effect of cooperative mastery learning approach on student academic achievement in physics based on gender in Kirinyaga County, Kenya.

OBJECTIVE OF THE STUDY

The objective of the study was to investigate whether there is gender differences in academic achievement in physics when students are taught using co-operative mastery learning approach

HYPOTHESES

There are no statistically significant gender differences in achievement in physics when students are taught using co-operative mastery learning approach.

METHODOLOGY

The study used Quasi-experimental design, specifically Solomon four-group design. The design enables the researcher to control and measure the main effects of testing. It also allowed the researcher to carry out studies in natural and real-life setting as the students are already constituted by the school administration and the researcher worked with existing streams (Nachmias & Nachmias, 2004). The design enabled the researcher to make a more complex assessment of the cause of the change in the dependent variable and even tell whether changes in the dependent variable was due to interactions effect between the pretest and treatment. In addition, it allowed the researcher to exert complete control over the variables and to ensure that the pretest did not influence the results, (Shuttleworth, 2009). Solomon four-group design involves four groups. The Experimental group E1, was pretested (O1), receive treatment (X) and post tested (O2). Control group C1, was pretested (O3), no treatment and received posttest (O4). Experimental group E2, received treatment (X) and posttest (O5). Control group C2, only received posttest (O6). C1 and C2 was taught using conventional teaching approach while E1 and E2 was taught using cooperative mastery learning approach. Posttest O5 and O6 eliminated the interaction between testing and treatment.

The units for sampling were secondary schools rather than individual students because secondary schools operate as intact groups (Borg & Gall, 1996). The republic of Kenya consists of 47 counties. Kirinyaga county was purposively selected from the list of counties that are performing poorly in physics. Kirinyaga county consists of 160 single gender and mixed schools. Purposive sampling technique was used to select

the schools with the desired characteristics from the list of mixed schools in Kirinyaga County. The desired features for the schools that qualified for the study was class size of more than forty-five form two physics students and mixed Sub-county secondary school. The sub county schools were selected because nearly all schools in the county fall into the sub county schools’ category (over 68% of schools in the county) thus, by picking the sub county schools, the findings were more generalizable to the whole county. A total of four schools were drawn using simple random sampling from a list of mixed sub county schools. The assignment of selected schools to either experimental or control group was done by simple random sampling. The stream that was considered for analysis where the sampled school had multiple streams was selected using simple random sampling. The ministry of education science and technology recommends 45 students per class. The schools that were sampled were assumed to have an enrolment of 45 students per class. Frankel and Wallen (2000) recommend at least 30 cases per group for experimental research. The researcher picked four schools randomly.

The physics achievement test was used to measure student’s achievement in physics. The test (PAT 1) contained items to assess the students’ general students’ achievement in physics before the treatment. The test (PAT 2) contained items to assess the students’ and also the conceptual understanding of the topic; Magnetic Effect of an Electric Current after the treatment. The PAT 1 consisted of 12 test items and was marked out of a total score of 30 marks. The PAT 2 consisted of 12 test items and was marked out of a total score of 30 marks. The items tested knowledge, comprehension and application levels of blooms taxonomy.

RESULTS AND DISCUSSION

Results of the Pre-test

The experimental group (E1) was exposed to pre-test before the start of the treatment to ascertain whether the students selected to participate in the study had comparable characteristics before the study. The independent samples t-test was used to analyze whether there were significant differences in the mean scores of experimental group (E1) based on gender. Table 1 shows the t-test results of the pre-test mean scores in PAT for experimental group (E1) based on gender.

Table 1: PAT Experimental Mean Score and t-test Pretest Results of Students by Gender

Gender	N	Mean	Std. Deviation	t	df	p-value
Male	30	43.13	14.024	0.902	43	0.372
Female	15	45.83	14.040			

The results in Table 1 indicated the pretest mean score and t-test results of physics based on gender for experimental group one. Experimental group (E1) mean score for boys was 43.13, standard deviation of 14.024 and that of girls was 45.83 with a standard deviation of 14.040. The mean scores were slightly different where the girls had a slightly higher pretest mean score than the boys. This shows that learners in both genders had comparable means implying that the learners had similar characteristics before the intervention and were appropriate for the study.

Effect of Cooperative Mastery Learning Approach on Student’s Academic Achievement Based on Gender

The researcher also sought to compare the experimental group posttest mean scores results of students so as to ascertain the effect of cooperative mastery learning approach on the achievement of students based on gender. The findings from the analysis were presented in Table 2.

Table 2: PAT Experimental Group Mean Scores and t-test Posttest Results of Students by Gender

Gender	N	Mean	Std. Deviation	t	df	-value
Male	63	57.42	11.567	0.265	88	0.792
Female	27	58.12	10.428			

The results in Table 2 indicated the experimental groups posttest mean score of physics based on gender. In the experimental group (E2) the mean score of boys was 57.42 with a standard deviation of 11.567 and that of girls was 58.12 with a standard deviation of 10.428. The highest mean score was attained by the females and the males had the least mean score. The mean score for boys and girls slightly varies which implies that girls fared as well as boys. This means that there was no gender gap when cooperative mastery learning approach was used. This suggest that cooperative mastery learning approach is an ideal approach for improving achievement in physics for both boys and girls. The findings in Table 24 reveals that at 0.05 alpha level ($t(88) = 0.265, p > 0.05$). The p value was greater than 0.05 which is indicative of that there is no statistically significant difference in the achievement in physics subject between boys and girls when taught using cooperative mastery learning approach. Therefore, the study null hypothesis was accepted, which states that there is no statistically significant difference in student academic achievement in physics based on gender when taught using cooperative mastery learning approach.

A comparison was done on students' improvement from pretest to the posttest based on gender. Figure 1 shows the mean scores obtained by students in experimental group E1 in the pretest and posttest in PAT based on gender.

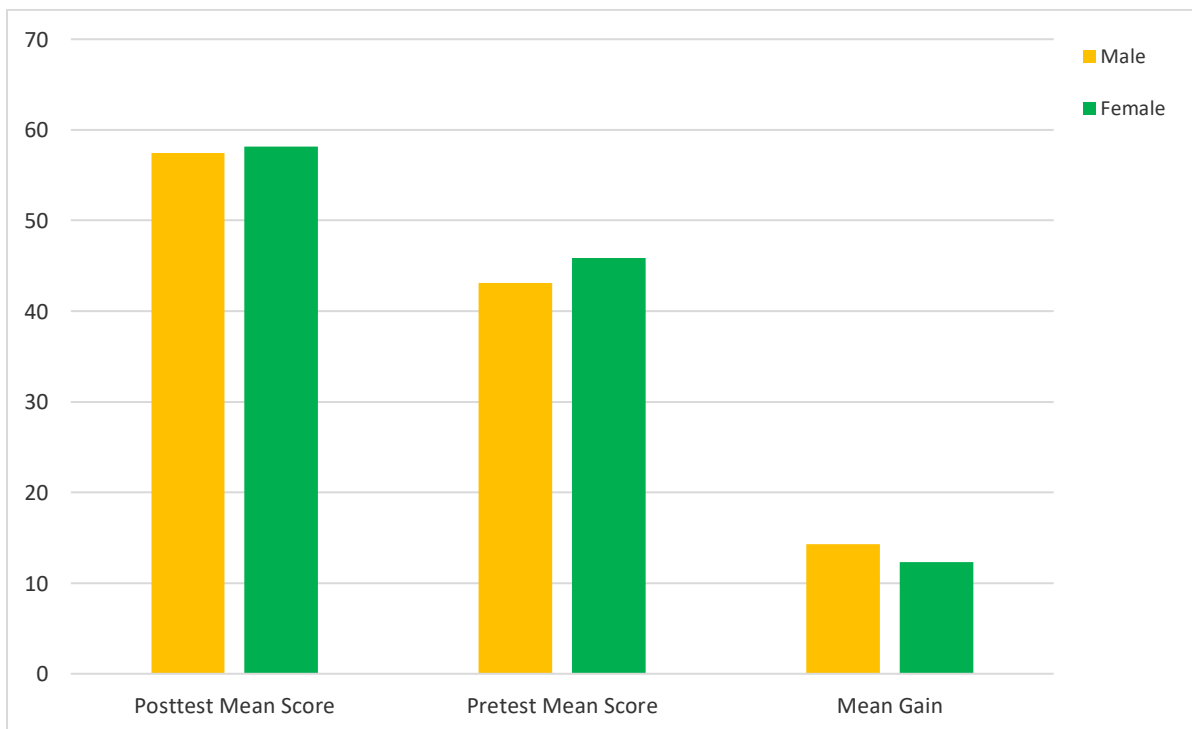


Figure 1: Posttest and Pretest Mean score for Male and Female.

The results on Figure 1 shows that the pretest mean scores for boys and girls were 43.13 and 45.83 respectively in the experimental group E1. The mean scores for boys and girls in the posttest were 57.42 and 58.12 respectively in the experimental group E2. The posttest mean scores for both boys and girls were higher than the pretest means scores. This implies that cooperative mastery learning approach as a positive effect on students' achievement in physics for both boys and girls.

A comparison was done on students mean gain on posttest and pretest mean scores based on gender. Figure 2 shows the mean gain for both male and female after being taught using cooperative mastery learning approach.

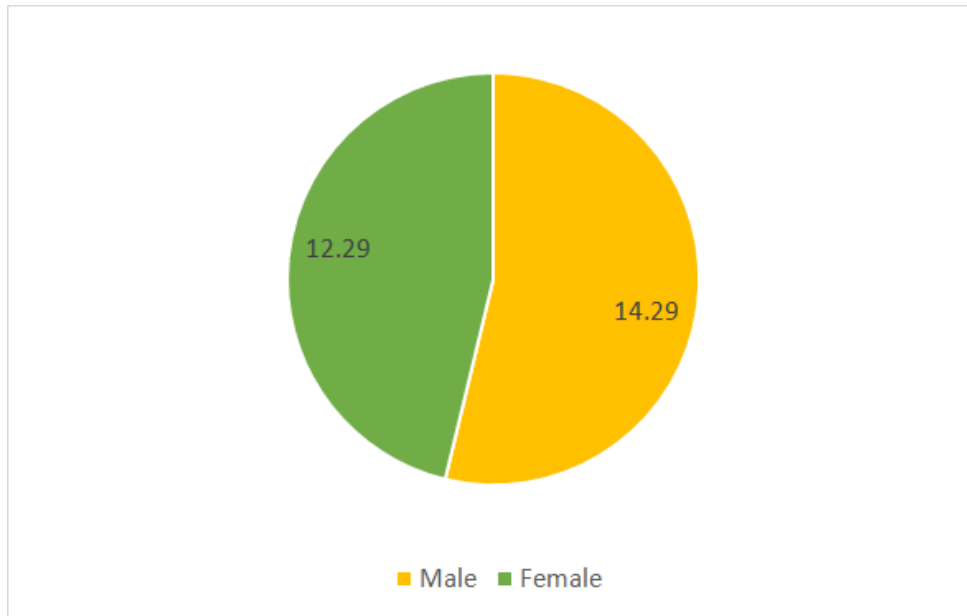


Figure 2: Posttest Mean Gain for Male and Female

Results in Figure 2 shows that the mean gain for boys and girls was 14.29 and 12.29 respectively. The mean gain for boys in the experiment group that were taught using cooperative mastery learning approach was higher than the mean score for girls. The results in Figure 2 illustrates the improvement of both boys and girls in posttest in experiment group students' achievement scores over pretest. This implies that cooperative mastery learning approach is capable of enhancing students' achievement in physics. The findings further reveal that cooperative mastery learning approach improves students' achievement in physics regardless of the gender implying that that cooperative mastery learning approach is a suitable approach for teaching both boys and girls.

The findings of the study agree with the results of a study by Keter and Ronoh (2016) that investigated the impact of cooperative mastery learning approach on students' academic achievement in chemistry by gender in Bomet County. The findings from the study indicated that the achievement level was high for students taught using cooperative mastery learning approach compared to those taught using Conventional Teaching approach. The results also indicated that there was no gender difference in achievement when boys and girls were taught through cooperative mastery learning approach. The results of the study concur with the results of a study by Keter (2018) on effects of computer based cooperative mastery learning on secondary school students' skills acquisition, motivation and achievement in chemistry practicals in Bomet County, Kenya that revealed that gender has no significant effect on student achievement and motivation towards learning of chemistry.

The results of the study are in line with the findings of the study by Echie and Ihenko (2017), that investigated the influence of gender on interest and achievement of integrated Science students in Obio Akpor local government area of Rivers State. The findings showed that gender has a significant influence on the interest but does not have a significant influence on achievement of Integrated Science students. The findings of the study also concur with the results of the study by Aina and Akintunde (2013) that carried out an analysis of gender performance in physics in colleges of education. The results showed no relationship between male and female performance and the study concluded that Students' performance in physics in

College of Education is no gender bias.

The results of the study contrast with the findings of a study by Onah and Ugwu (2010) that identified gender as having significant effect on students' performance in physics at the secondary school. The findings of the study concur with the findings of a study by Akinbobola and Afolabi (2010) that indicated that gender is not a strong determinant of students' academic achievement in physics rather the teaching approaches adopted which should not discriminate any gender. Findings of the present study also concur with the findings of Gambari (2014), on a study on effect of computer animations and geometrical instructional model on mathematics achievement and retention among the junior secondary school students in Minna, Nigeria. The study examined the influence of gender on achievement of students taught geometry with computer animation packages and geometry instructional model respectively. The findings from the study showed that there was no gender effect on the achievement of males and females students taught geometry using computer animations and geometry instructional model. Therefore, this implies that irrespective of the instructional approach, male and females' students benefit equally.

The findings of the study differ with the results of a study by Sar Abadani Tafreshi (2006) that found that there was a significant difference in the academic achievement of male and female students. The results of the study also disagree with the findings of a study by Zembar and Blume (2011) which revealed that on average girls did better in school than boys. The findings of the study concur with the findings of a study by Hanan, Shabana & Mona, 2016 that found a significant statistical low correlation between gender and academic performance, implying that gender was not a significant factor to consider when measuring academic achievements of students. This shows that, use of gender appropriate teaching approach is critical to the successful teaching and learning of Physics.

CONCLUSIONS

The study found that teaching physics to boys and girls through cooperative mastery learning approach improves academic achievement. The results indicated that when boys and girls were taught physics adopting cooperative mastery learning, there was a slight difference in accomplishment scores, and yet not statically relevant. This meant that when students are taught physics using cooperative mastery learning, gender does not matter. The analysis revealed that cooperative mastery learning improves students' physics proficiency irrespective of gender. Both male and female students can benefit from cooperative mastery learning. Thus, cooperative mastery learning approach can help decrease the physics achievement gap among boys and girls.

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