International Journal of Social Science and Economic Research

ISSN: 2455-8834

Volume:01, Issue:08

EFFECT OF JIGSAW COOPERATIVE LEARNING STRATEGY ON STUDENTS' MATHEMATICS ACHIEVEMENT IN SECONDARY SCHOOLS IN LAIKIPIA COUNTY, KENYA

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ABSTRACT

Despite the important role mathematics plays in the society, there has been persistent poor performance in the subject in the Kenya Certificate Secondary Education (KCSE). This raises concern to all stakeholders in education due to the importance they attach to mathematics. Among the factors that are attributed to the students' poor performance in the subject includes the ineffective instructional methods used by teachers. This study sought to address the problem by finding out if the use of Jigsaw Cooperative learning Strategy during instruction of Surds and Further Logarithms in mathematics to Form Three secondary school students has an effect on their mathematics performance. Surds and further logarithms are topics that are performed poorly in the KCSE. The study used Solomon four non-equivalent control group design. A simple random sample of four co-educational secondary schools consisting of 188 students was selected from the possible 67 schools with about 5000 students in Laikipia County. A mathematics achievement test (MAT) for students was used to collect the required data. The MAT was piloted in a school which was not used in the study in Laikipia County and its reliability coefficient estimated to be 0.95 using KR-21 formula. MAT was validated by education experts from the Department of Curriculum and Education Management, Laikipia University. Hypothesis was tested using t-test and ANOVA at alpha (ά) level of .05. The study revealed that students who were taught mathematics using Jigsaw learning strategy performed better than those taught with conventional teaching methods. Curriculum developers and education officers are likely to benefit from this study in deciding on the appropriate learning strategy for learners to improve the quality of mathematics education in the country.

Keywords: Jigsaw learning Strategy, mathematics achievement.

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INTRODUCTION

Mathematics is applied in various fields and sectors that contribute towards the socio-economic development of any country. Furthermore, it takes a significant position in human civilization as a medium of social function in our everyday world (Mondoh, 2005). The social functions include buying and selling, banking, social gatherings among others. Mathematics helps to develop powers of logical thinking, accuracy and spatial awareness (KIE, 2002). Mathematics is one of the school subjects in South East Asia in which many students often perform poorly at both national and public examinations (Mundia, 2010). The poor performance in mathematics, year-in year-out, has similarly been a constant source of concern, worry and anxiety to all stakeholders in the education sector in Ghana (Adetunde & Asare, 2009). According to Mashile (2001) the recurring learners' poor performance in mathematics in South Africa's schools also calls for concerted effort on measures that will help in its improvement. This perceived usefulness of mathematics in one's life has forced the Kenyan Government to make the study of mathematics compulsory for all primary and secondary school students in the country. However, despite the emphasis, students continue to perform poorly in the subject in national examinations. This is reflected in the Kenya Certificate of Secondary Education (KCSE) mathematics examinations results (KNEC, 2016). The students' mean score in mathematics at KCSE national examinations by gender in the year 2013 and 2015 are shown in Table 1.

Table 1. ***Students' Percentage Mean Score in Mathematics at KCSE for the years 2013 and 2015***

Year	Male	Female	Grand mean
2013	35.46	28.79	32.43
2014	33.00	26.76	30.11
2015	34.52	28.64	31.78

Source: KNEC (2016)

The report of the Kenya National Examinations Council (2016) indicated a grand mean score of less than 35 percent. This underachievement and gender differences in mathematics performance is partly attributed to ineffective teaching methods employed in mathematics classrooms (Ogunniyi, 1996). Despite the importance of mathematics in attaining the educational goals for instance, education in Kenya should promote social, economic, technological and industrial needs for national development (KIE, 2002), there has been poor performance in the subject. There have been serious implications, which could lead to lack of admissions into mathematics

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related careers at institutions of higher learning in future (Shikuku, 2009). A multiple of causes for the students low achievement in mathematics has been attributed to: Learners lack of motivation to learn the subject (Githua & Mwangi,2003), ineffective teacher-centered teaching methods, learners' negative attitudes towards the subject (Miheso, 2012) and inadequate mathematics syllabus coverage (Shikuku, 2009).The persistent poor performance in mathematics is also registered in Laikipia County as shown in Table 2.

Table 2. ***KCSE Mathematics Results for Laikipia County for the years 2011 to 2015***

Years	2011	2012	2013	2014	2015
Mean score	3.545*	3.950*	3.898*	3.614*	3.731*

Note: * Mean score range (0-12) points.

Source: County Education's Office, Laikipia County(2016)

The mathematics KCSE examination results from Laikipia County shown in Table 2 indicate that the performance index was below 4 points out of 12 points for five consecutive years. According to Aronson (2000), Jigsaw is a cooperative learning strategy that enables each student of a 'home' group to specialize in one aspect of a learning unit. Students meet with members from other groups who are assigned the same aspect and after mastering the material, return to the 'home ' group and teach this material to the group members. Jigsaw can be used whenever learning material can be segmented into separate components. Each group member becomes an expert on a different concept or procedure and teaches it to the group (Panitz, 1996).Just like a Jigsaw puzzle, each piece (student part) is essential for the completion and full understanding of the final product. Therefore, each student is essential for the understanding of the whole concept being taught. According to Aronson (2000), the advantage of Jigsaw learning strategy is that students perform the challenging and engaging tasks in their expert groups with enthusiasm since they know they are the only ones with that piece of information when they move to their respective home groups. Students who tutor each other must develop a clear idea of the concept they are presenting and orally communicate it to their partner (Neer, 1987).

The Jigsaw learning strategy can be used to learn most of the topics in secondary schools mathematics syllabus. The effect of the strategy in the learning of the topics Surds and Further logarithms was studied. These are major topics in the secondary school mathematics curriculum. The topics are regularly tested in the KCSE for the past years as shown in Table 3. The topics are taught at secondary Form Three level (KIE, 2000).

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Table 3. ***Testing of Surds and Logarithms at KCSE (2008-2014)***

Year	2008	2009	2010	2011	2012	2013	2014
Paper	1,2	2	2	1,2	2	1,2	2
Question No.	9,13	14	8	6,10	15	4,14	11

Source: KCSE (2008-2014) Mathematics past papers

In Table 3, question number denotes the question in either paper one or two that tested the topics surds and logarithms. The Table 3 shows that the topics surds and logarithms were tested annually from 2008 to 2014, indicating the importance attached to the topics. They have been among the challenging areas for students to learn in the secondary school mathematics syllabus in Kenya. This is evident in the baseline survey by SMASSE Laikipia East trainers where the topics Surds and Logarithms were second and third respectively in order of difficulty to the learners as shown in Table 4.

Table 4. ***Topics found Challenging in Secondary School Mathematics during Baseline Survey by SMASSE Laikipia East Trainers, Kenya.***

Topics	Form One	Form Two	Form Three	Form Four
Topics in order of difficulty	i) Survey ii) Integers	i) Linear motion ii) Similarity ii) Indices and Logarithms (Negatives)	i) Vectors ii) Surds iii) Logarithms iv) Errors and approximation v) Compound proportion	i) Linear Inequality ii) Locus iii) Transformations

Source: SMASSE (2000a)

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The findings of the research are relevant to Laikipia County because Laikipia East is an administrative District in the county. According to KIE (2000-2007), Surds and Logarithms was among the areas that students performed poorly in 2006 and 2007 national examinations. In the present study, Jigsaw learning strategy was used to learn the topics Surds and Logarithms and assessed if it would affect the students' mathematics achievement in Laikipia County, Kenya.

Statement of the Problem

Despite the important role mathematics plays as a subject for preparation of learners to fully participate and function well in the society, the performance of the subject in most secondary schools especially in Laikipia County has been poor. Studies show that there are a number of factors that can be attributed to this poor performance such as ineffective teaching strategies among others. In this study, the effect of Jigsaw learning strategy on the learners in secondary schools was explored in order to determine its effect on mathematics achievement in secondary schools in Laikipia County, Kenya.

Hypothesis of the Study

The following null hypothesis was tested at .05 level of significance;

Ho1: There is no statistically significant difference in students' mathematics achievement between those taught using Jigsaw Cooperative Learning Strategy and those taught using Conventional Teaching Methods in secondary schools in Laikipia County, Kenya.

RESEARCH METHODOLOGY

Research Design

The study used a quasi-experimental research design to explore the relationship between variables, as the subjects are already constituted and school authorities don't allow reconstitution for research process (Borg & Gall, 1989). Solomon 4-group; non-equivalent control group design was used because it is appropriate for experimental and quasi-experimental studies (Ogunniyi, 1992).The design overcomes external validity weaknesses found in other designs and also provides more vigorous control by having two control groups as compared to other experimental designs. This design involves a random assignment of intact classes to four groups.

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GROUP	NOTATION
E_1	o_1 x o_2 (Experimental group)
C_1	o_3 - o_4 (Control group)
E_2	- x o_5 (Experimental group)
C_2	- - o_6 (Control group)

Figure 1. The Solomon 4-group, non-equivalent control group design

In Figure 1, the variables are defined such that: o_1 and o_3 are pretest observations; o_2, o_4, o_5, o_6 are post-test observations; and x is treatment. Group E_1 received pre-test, treatment and posttest; Group C_1 received pre-test and post-test without treatment; Group E_2 received the treatment and post-test; Group C_2 received post-test only. Two schools were experimental schools and in the experimental schools one received post-test only while the other received pre-test and post-test. The other two schools were control schools and in the control schools, one received post-test only while the other school received pre-test and post-test. The effects of maturation and history were controlled by having two groups taking pre- test and post-tests. To avoid contamination, the treatment and control groups were from different schools. The regression effects were taken care of by two groups not taking pre-tests. The pre-test was treated as a normal classroom test that students regularly take in the course of instruction while the post test was taken as a normal test that is administered after a topic has been covered. The mathematics teachers in the two experimental schools were given a guide on how to teach the topics by the researcher when students were on recess. However, only the results from one stream in each school were analyzed and used for the testing of the hypotheses of the study. This is because the sample size was one stream.

Population of the Study

The schools that participated in the study were from Laikipia County. The target population was secondary school students in Laikipia County. The accessible population was form three students in the co-educational secondary schools in Laikipia County. According to Laikipia county data sheets (2013), the County had about 5000 form three students and there are 67 secondary schools among them 4 boys schools, 6 girls schools and 57 co-educational schools. The co-educational schools were used for this study because they constituted the highest percentage of secondary schools in the county and also so as to capture the boys and girls in the same class subjected to the same learning environments.

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Sampling Procedure and Sample Size.

Purposeful sampling was used to sample out 57 co-educational secondary schools out of the possible 67 secondary schools in the county. This is because this study required the co-educational schools only. Simple random sampling was employed to select four schools out of the possible 57 co-educational schools in the County. Balloting was used to select the sample schools with a total of 188 students. Four schools were chosen because the Solomon 4 group design requires four groups (Ogunniyi, 1992). Each school formed a group in the Solomon 4 group design so that interaction by the subjects was minimized during the exercise. The assignment of groups to either experimental or control groups was done by simple random sampling. One class in each of the group was used for the study. According to Mugenda and Mugenda (1999), the required sample size is at least 30 per group.

Instrumentation

The Mathematics Achievement Test (MAT) was used to collect the required data. The pre-test and post-test MAT was developed by the researcher. The pre-test MAT was a 36 item instrument which tested the student's knowledge on the preliquisite knowledge of the topics surds and further logarithms with a total score of 80 marks. The post-test MAT was a 36 item instrument which tested the student's knowledge on the topics surds and further logarithms after learning with a total score of 80 marks. They were set on all the subtopics of surds and further logarithms with the questions distributed according to the table of specification of blooms taxonomy. The items were allocated between 1 to 4 marks each in their scoring.

RESULTS

Pre- Test Analysis

Data was collected before treatment to the E1 and C1 groups using a pre-test MAT to assess the homogeneity of the groups in achievement. The means were compared as shown in the Table 5.

Table 5. ***The pre-test mean score on achievement***

	Learning group	N	Mean	Std. Deviation	Std. Error Mean
Achievement Pre-test score	E1	44	25.7	12.03982	1.81507
	C1	44	30.1628	13.40208	2.04380

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The mean of E1 was found to be slightly lower than the mean of C1 thus there was need to establish whether that difference was significant using t-test as shown in Table 6.

Table 6. ***Independent Samples t-test of pre-test scores on MAT based on groups E1 and C1***

	t-test for Equality of Means		
	t	Df	p(2-tailed)
Achievement Pre-test score	-1.600	86	.113

Note: t not significant at α = .05 (2 tailed)

The independent sample t-test of pre-test scores on MAT based on achievement showed that the mean scores for E1 and C1 were not significantly different, ($t(86) = -1.600$, $p= .113$) as shown in the Table 6, implying that the groups had comparable characteristics.

The effect of Jigsaw learning strategy and Conventional teaching methods on students' achievement in mathematics in secondary schools

The objective of the study was to compare the effect of Jigsaw learning strategy and Conventional teaching methods on students' achievement in mathematics in secondary schools. The following null hypothesis was formulated in order to accomplish this objective:

Ho1: There is no statistically significant difference in students' mathematics achievement between those taught using Jigsaw Cooperative Learning Strategy and those taught using Conventional Teaching Methods in secondary schools.

The hypothesis, therefore presumed that Jigsaw learning strategy has no effect on students' mathematics achievement. To ascertain this assumption, post mean scores of the MAT were analyzed. First, the post-test means and standard deviation were obtained for the four groups as shown in the Table 7.

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Table 7. ***Achievement Post-test Score***

	N	Mean	Std. Deviation
E1	44	43.2500	13.20874
E2	50	47.2800	8.90320
C1	44	32.5227	12.03964
C2	50	27.8200	10.92963
Total	188	37.7074	13.77375

Table 7 reveals that post-test mean scores of E1 and E2 were higher than the post-test mean scores of C1 and C2 groups. The difference in the combined post-test means of the control (i.e., C1 and C2) and experimental groups (i.e., E1 and E2)was analyzed using t-test to find out whether it is significant. The result of the test is shown in Table 8.

Table 8. ***The t-test of the MAT post-test Mean Scores***

	t-test for Equality of Means			
	t	Df	p (2-tailed)	Mean Difference
Achievement Post-test score	9.207*	186	.000	15.37234

Note:*means significant at α = .05

Table 8 confirms that the differences between the two experimental groups (i.e., E1 and E2) and the two control groups (i.e., C1 and C2) was statistically significant (t (186) = 9.207, p= .000) in favour of experimental groups. This difference was also analyzed by ANOVA to establish whether it was statistically significant. The results obtained are as shown in the Table 9.

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Table 9. ***ANOVA of achievement Post-test score***

	Sum of Squares	Df	Mean Square	F	p-value
Between Groups	12004.222	3	4001.407	31.367*	.000
Within Groups	23472.687	184	127.569		
Total	35476.910	187			

Note:*means significant at α = .05

Table 9 indicates that the differences in achievement between the four groups (i.e., E1, E2, C1, C2) were statistically significant(F (3,184) = 31.367, p = .000). The post hoc test of multiple comparisons using Scheffe's method was then done to find out where the difference occurred. The results obtained are as shown in the Table 10 that the pairs of MAT scores of groups E1 and C1, E2 and C1, E1 and C2, and between E2 and C2 are significantly different at alpha level of .05. However, the mean scores of groups E1 and E2, and C1 and C2 are not significant different at alpha level of .05. Further analysis by ANCOVA was deemed necessary to reduce the effects of initial group differences statistically by making compensating adjustment to post-test means of the groups involved (Borge & Gall, 1989). The adjusted post-test means of the groups was done using the Kenya Certificate of Primary Education (KCPE) results and are as shown in the Table 11.

Table 10. ***Scheffe's Multiple Comparisons of Achievement Post-test Score***

(I) Groups	(J) Groups	Mean Difference (I-J)	Std. Error	p-value
E1	E2	-4.03000	2.33467	.397
	C1	10.72727*	2.40803	.000
	C2	15.43000*	2.33467	.000
E2	E1	4.03000	2.33467	.397
	C1	14.75727*	2.33467	.000

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	C2	19.46000*	2.25893	.000
C1	E1	-10.72727*	2.40803	.000
	E2	-14.75727*	2.33467	.000
	C2	4.70273	2.33467	.259
C2	E1	-15.43000*	2.33467	.000
	E2	-19.46000*	2.25893	.000
	C1	-4.70273	2.33467	.259

Note:*means significant at α = .05

Table 11. ***Adjusted Students Achievement mean scores using KCPE grades as the Covariate***

Group	N	Mean	Standard Error
E1	44	43.12	1.661
E2	50	46.20	1.641
C1	44	31.58	1.686
C2	50	30.02	1.700

Table 11 shows that the post-test means of the experimental groups, E1 and E2 were 43.12 and 46.20 respectively which was higher than the post-test mean scores of the control groups, C1 and C2 (31.58 & 30.02 respectively). Further analysis using ANCOVA was done to establish whether the difference is significant. The results are as shown in the Table 12.

Table 12. ***Analysis of Covariance (ANCOVA) of the Achievement by Learning groups with KCPE as Covariate***

Source	Sum of squares	Df	Mean square	F- ratio	p-value
Contrast	8546.271	3	2848.757	23.485*	.000
Error	21955.858	184	121.303		

Note:*means significant at α = .05

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The ANCOVA test results shown in Table 12 indicate that there is a statistically significant difference between the mean score of the four groups (i.e., E1, E2, C1, C2)($F (3,184) = 23.485$, $p = .000$). However these results do not give us the differences between the specific groups. Hence, there was need for further analysis using Scheffe post HOC test which yielded the results presented in Table 13.

Table 13. ***The ANCOVA Pairwise comparison of MAT posttest by learning groups***

Paired [Group	Mean Difference	Standard Error	p-value
E1 vs E2	-3.064	2.329	0.190
E1 vs C1	11.558*	2.362	0.000
E1 vs C2	13.116*	2.387	0.000
E2 vs C1	14.621*	2.302	0.000
E2 vs C2	16.180*	2.478	0.000
C2 vs C1	-1.558	2.476	.530

Note: * means significant at $\alpha = .05$

Table 13 indicates that there was no significant mean difference between the post-test mean scores of two control and two experimental groups (i.e., E1 vs E2 & C1 vs C2) at alpha level of .05 respectively. However, there was a significant mean difference between a control and an experimental group (i.e., E1 vs C2, E2 vs C2, E1 vs C1, & E2 vs C1). Table 13 confirms the same results obtained by ANOVA (see Table 9). Therefore, the null hypothesis Ho_1 suggesting that there is no statistically significant difference in students' mathematics achievement between those taught using Jigsaw Cooperative Learning Strategy and those taught using Conventional Teaching Methods in secondary schools was rejected at .05 level of significance.

DISCUSSION

The study found that there was statistically significant difference in students' mathematics achievement between students who are taught mathematics using Jigsaw Cooperative Learning Strategy and those taught using Conventional Teaching Methods. These findings support earlier studies that concluded that the use of the Jigsaw learning strategy improved achievement scores compared to the conventional teaching methods (Hanze & Berger, 2007).

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Similarly, Zakaria, Solfitri, Yusoff and Abidin (2013) showed that students prefer jigsaw cooperative learning than other methods of learning. The students in the study perceived that Jigsaw cooperative learning was more beneficial to them. In short, they were willing to help and to cooperate with each other and to promote each other's learning. These attitudes help to build group identity and create an environment conducive to learning (Slavin, 1987). Teachers should be aware of students' preferences in learning. In all, the findings in this study and in other cited studies support the idea that Jigsaw learning strategy is important in improving students' mathematics achievement in schools.

CONCLUSION

In the findings of this study, students who were taught mathematics using Jigsaw learning strategy performed better than those taught with conventional teaching methods. Hence, Jigsaw learning strategy can be an effective teaching method in secondary school mathematics in Kenya.

REFERENCES

Adetunde, A.I. & Asare, B. (2009). Comparative performance of day and boarding students in secondary school certificate mathematics examinations: A case study of Kasena-Nankana and Asuogyaman Districts of Ghana. *Academia Arena,* 1(4).

Aronson, E. & Osherow, N. (1980) `Prosocial behavior and academic performance: experiments in the classroom', *Applied Social Psychology Annua*l,1(4), 163-196.

Aronson, E. (2000). Nobody left to hate developing the emphatic schoolroom. Beverly Hills, CA: Sage Publication.

Arra, C. T., D'Antonio, M. D., & D'Antonio Jr., M. (2011). Students' preferences for cooperative learning instructional approaches: Considerations for college teachers. *Journal of Research in Education,* 21(4),114-126.

Ayot, H.O. & Patel, M.M. (1987) *Instructional methods*. Nairobi, Kenya: Kenyatta University.

Cockcroft, W.J. (1982). Mathematical counts report of the committee of inquiry into the teaching of mathematics in schools in England and Wales. London: HMSD.

Coolican, H. (1994). *Research methods in psychology* (2nd ed.). London: Hodder and Sloughlon Education.

David, K. & Roger, J. (2001). *An overview of cooperative learning.* Retrieved from <http://www.clcrc.com/pages/overviewpaper.html>2 December 2010.

ISSN: 2455-8834

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Dictionary, Encyclopedia and Thesaurus (Jan 20, 2012). *The free dictionary*. Retrieved from www.thefreedictionary. Com.

District Education's Office, Laikipia East District (2012). *KCSE Examination Report*. Nairobi: University Press.

Gall, M.D., Borg, W.R., & Gall, J.P., (4th ed.). (1989).*Education Research: An introduction.* New York: Person Education Inc.

Gay, L.R. & Airasian, P. (2003). *Education research: Competences for analysis and application*. Upper saddle River: Merit prentice Hall.

Githua B. N. & Mwangi J. G. (2003). Students' mathematics self-concept and motivation to learn mathematics: relationship and gender differences among Kenya's secondary school students in Nairobi and Rift Valley Provinces. *International Journal of Educational Development, 23* (3), 487-499.

Githua, B. N. (2002). *Factors related to the motivation of learn mathematics among secondary school students in Kenya's Nairobi Province and three districts of Rift valley.*(Unpublished phd Thesis). Egerton University, Kenya.

Hanze, E. & Berger W. (2007). Restructuring the classroom: Conditions for productive small groups. *Review of Educational Research*, 994 (64), 1-35.

Joyce, B., & Well, M., (1999). *Models of teaching.* Fourth Edition. Englewood Cliffs, NJ: Prentice-Hall.

KCSE (2008-2014). *Mathematics past papers.* Nairobi: KNEC.

KIE (2002). *Secondary education syllabus vol.2.* Nairobi: KIE.

KIE (2000-2007).*Examination report*, Vol 1. Nairobi, Kenya: Kenya Institute of Education.

KNEC (2004).*KCSE Examination Report2002*: Nairobi: KNEC.

KNEC (2016). *KCSE Mathematics reports in Kenya.* Nairobi, Kenya: Government Printers.

Laikipia County Data Sheets (2013). *List of public and private secondary schools in Laikipia County.* Retrieved from https://www.opendata.go.ke/.../counties/..

ISSN: 2455-8834

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Laikipia County Education Office (2016). *KCSE Mathematics Results for Laikipia County secondary schools.* Retrieved from https://www.kcse.go.ke/.../counties/..

Mashile, E.O (2001). Science achievement determinants: Factorial structure of family variables. *South African Journal of Education,* 21, 335-338.

Miheso, K. M. (2012). *Factors affecting mathematics performance among secondary schools students in Nairobi Province Kenya. (*unpublished PhD thesis). Kenyatta University, Kenya, Retrieved fromhttp://ir-library.ku.ac.ke/etd/handle/123456789/2485.

Mondoh, H.O. (2001). Comparative activities carried out by boys and girls during their free time in relation to their achievement in mathematics: A Case study of Eldoret municipality , Kenya, *Journal of Education and Human Resources*. 3, 59-61.

Mondoh, H.O. (2005). *Methods of teaching mathematics*. Njoro: Egerton University press.

Mugenda, M.O. & Mugenda, A.G. (1999). *Research methods. Qualitative and quantitative approaches.* Nairobi, Kenya: CTS Press.

Mundia, L. (2010). Problems in Learning Mathematics Comparison of Brunei Junior High School in classes with or without repeaters: *Journal of Mathematics Research.*2(3), 150-160.

Neer, M.R. (1987). The development of an instrument to measure classroom apprehension. *Communication Education*, 36, 154-166.

Ogunniyi, B.M. (1992). Science, technology and mathematics. The problem of developing critical human capital in Africa. *International Journal of Science Education*, 18(3), 284.

Panitz, T. (1996). *Getting students ready for cooperative learning. Cooperative learning and College Teaching*, 6 (2), 96.

Schmuch, R.A. (1997). *Handbook of organization development in schools*. California: Mayfield Publishing Co. pp. 138-142.

Shikuku, B. N. (2009). *Effects of syllabus coverage on students' performance at KCSE mathematics: A case of Kakamega South District Kenya*. Retrieved from www.rehagmbh.de.

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Slavin, R.E. (1987). *Cooperative Learning: Student teams*. Washington, DC: National Education Association.

SMASSE (2000a). *Laikipia east baseline survey*. Nairobi: Laikipia SMASSE printing press.

SMASSE (2000b). *Mathematics teaching methods*. Nairobi: SMASSE.

Zakaria, E., Solfitri, T., Yusoff, D., & Abidin, Z. (2013). Effect of cooperative learning on Secondary School Students' Mathematics Achievement. *Journal of Research in Science*, (4),2,98-100.

Zemelman, S., Daniels, H. & Hyde, A. (1988). *Best practice: New standards for teaching and learning in America's schools* (2nd edition). Portsmouth, NH: Heineman

