Journal of Education and Practice www.iiste.org
ISSN 2222-1735 (Paper) ISSN 2222-288X (Online)
Vol.4, No.16, 2013

Effects of Jigsaw Cooperative Learning Strategy on Students' Achievement by Gender Differences in Secondary School Mathematics in Laikipia East District, Kenya

Naomi W. Mbacho[1] & Johnson M. Changeiywo[2]
[1]P.O Box 1792-20300 Nyahururu, Kenya: naomiwatetu@gmail.com
[2] Egerton University, P .O. Box 536-20115, Nakuru, Kenya; *jchangeiywo@yahoo.com

Abstract
Students' Gender differences in mathematics achievement have important implications for the underrepresentation of women in science. Typically, students' gender differences in mathematics achievement emerge at the beginning of high school, where female students have continued to perform poorly in the subject in the Kenya Certificate of Secondary Education (K.C.S.E) examinations. That has raised concerns among the stakeholders in education due to the importance attached to mathematics. The factors that are attributed to the female students' dismal performance in the subject include; poor attitude towards the subject by the students and teachers, gender stereotypes, lack of role models, and the instructional methods used by teachers. This study sought to address the problem of ineffective instruction methods by teachers. It was to find out if the use of Jigsaw Cooperative learning Strategy during instruction of Surds and further logarithm in mathematics to Form Three students had effects on their gender differences in performance. There is was as a result of inadequate information in research conducted in Kenya on effects of the use of Jigsaw Cooperative learning Strategy on students' achievement in mathematics by gender difference. Solomon Four non-equivalent control group design was used in the study. A simple random sample of four district secondary schools was selected from Laikipia East District. The sample size was 160 students out of population of about 20,000 students in the district. A mathematics achievement test (MAT) was used for data collection. The instrument was piloted in a school which was not used in the study in the same district and a reliability coefficient of above the required threshold of 0.70 was found. The instrument was validated by education experts from the University. Data was analyzed using t-test to test hypotheses at Coefficient alpha (ά) level of 0.05. The results showed that there is no statistically significant gender difference in mathematics achievement when students are taught using Jigsaw cooperative learning strategy. The findings may be useful to policy makers, curriculum developers and education officers in deciding on the appropriate learning strategy for learners to reduce gender disparities.
Keywords: Jigsaw cooperative learning strategy, gender differences in mathematics achievement in secondary schools

1.0 INTRODUCTION

Available literature has not been able to identify a single direction of difference in performance in mathematics between male and female students subject to the inequalities in their physiological structures (Kadiri, 2004). Although most researchers have found boys performing better than girls (Fennema & Sherman, 1978) especially on higher order knowledge, a few others saw girls out-performing boys while some others established no significant difference particularly during early education. A review of some gender based studies that were carried out between 1985 and 1995 by Brandy & Eister (1995) showed that there is a considerable inconsistency in the literature as to the nature, extent and sources of bias in the differential performances between boys and girls in mathematics. They noted that with the inconsistent findings and significant methodological flaws observed, more empirical researches are needed to investigate the existence of gender bias in the classroom. Report of Tyson's (1996) study on the differential performance of girls on standardized multiple choice mathematics achievement tests, compared to constructed response tests of reasoning and problem solving showed that males performed significantly better than females on the pretest although no significant differences were found on the post-test. The pretest difference was explained as a measure of difference in the pre-requisite knowledge of the two sexes.

Likewise the study of Blithe, Forbes, Clark & Robinson (1994) reports a consistent difference in mean performance in favour of boys at the secondary school level in New Zealand. However, the same analysis carried out on set of students taking certain first year mathematics courses in the University of New Zealand Essays in Education Volume 21, showed that gender differences in performance were neither as marked nor always in favour of boys. In the same vein, the work of Armstrong (1981) showed that no sex differences existed in mathematics achievement throughout the junior school but that at the end of high school males have higher achievement scores and perform better on higher level cognitive tasks. Manger (1996) investigated the relationship between gender and mathematical achievement with Norwegian 3rd graders using an achievement test covering numeracy problems, fraction problems, geometry problems and word problems. Boys were found to have higher total test scores than girls, but the difference was small. In Kenya, it is a common tradition to regard males as better problem solvers than females in general life issues. Mathematics is more or less regarded either wrongly or rightly as a subject in the male domain. There is therefore the tendency to believe that males will do better, Fennema & Sherman (1978) also reasoned along this line when they reported that the differential performance observed as a result of gender difference in mathematics is possibly attributable exclusively to the community in which the students live.

Table 1:
Students' Percentage Mean Score in Mathematics at KCSE for the years 2009 and 2010.

Year	Male	Female	Grand mean
2009	23.63	18.11	20.87
2010	25.75	19.71	22.73

Source: K.N.E.C, 2010

The issue of gender inequality in Science, Technology and Mathematics Education has produced inconclusive results, one meta analysis covering the period 1974 – 1987 on mathematics and gender led to two conclusions: the average gender gap is very small (statistically insignificant), and the fact that the differences tend to decline with time (Friedman, 1989). In Kenya, the gender difference in mathematics achievement is evident at the KCSE examination results (KNEC, 2010) as shown in table 1. During the years 2009 and 2010 the females performed more than 3 percentage points lower than boys in the country despite the fact that they constitute more than half of the country's population.

Table 2: Students' Mathematics Performance Index compared with that of other Subjects at KCSE

	2008		2009		2010		2011	
	M	F	M	F	M	F	M	F
ENGLISH	5.23	5.42	5.42	5.91	5.02	5.11	5.45	5.00
KISWAHILI	5.09	5.75	5.21	4.63	4.89	5.23	5.00	4.94
MATHEMATICS	**3.73**	**2.83**	**3.01**	**2.13**	**3.78**	**2.44**	**3.44**	**2.94**
BIOLOGY	4.32	4.01	5.21	4.65	5.23	5.21	4.02	4.00
CHEMISTRY	3.91	3.53	4.45	3.45	4.23	3.33	3.01	2.98
PHYSICS	6.31	4.92	5.86	5.01	5.89	4.76	4.43	4.40
GEOGRAPHY	4.93	4.64	5.26	4.79	4.79	4.66	4.98	4.80
HISTORY	5.45	5.98	5.34	5.86	5.91	5.99	5.45	5.43
C.R.E	6.34	6.94	6.60	6.42	6.77	6.78	6.42	6.14
BUSINESS	6.01	5.80	6.59	6.17	6.22	6.01	5.42	5.13
H/SCI	-	6.57	-	5.74	-	-	-	3.96
AGRICULTURE	5.88	5.83	6.78	6.18	6.09	5.94	6.22	6.02

Source: DEO's office, Laikipia East District.

The persistent poor performance in mathematics as compared to other subjects in terms of gender is also registered in Laikipia East District. The students' performance index in terms of gender in mathematics out of twelve points as compared to other subjects at K.C.S.E in the years 2008-2010 in the District are shown in Table 2. The female mean performance index in mathematics out of a maximum score of twelve points in Laikipia East District has been lower than boys for the past four years as indicated in Table 2. This underachievement and gender differences in mathematics performance is attributed to ineffective teaching methods employed in mathematics classrooms (O'Connor, 2000). Over the past decade, cooperative learning has emerged as a leading approach classroom instruction. Students completing cooperative learning group tasks tend to have higher academic test scores, higher self esteem, greater numbers of positive social skills, fewer stereotypes of individuals of other races or ethnic groups, and greater comprehension of the content and skills they are studying (Johnson, Johnson, & Holubee, 1993; Slavin 1991; Stahl and Vansickle, 1992). Students work in small groups thereby cooperating to ensure their own learning and the learning of all others in their group (Johnson, Johnson, & Holubee, 1993). This emphasis on academic learning success for each individual and all members of the group is one feature that separates cooperative learning groups from other group tasks (Slavin, 1991).
To be successful in setting up and having students complete group tasks within a cooperative learning framework, a number of essential elements or requirements must be met which includes: a clear set of specific student learning outcome objectives, clear and complete set of task-completion directions or instructions,

heterogeneous groups, equal opportunity for success, positive interdependence, face-to-face interaction, positive social interaction behaviors and attitudes, access to must-learn information, opportunities to complete required information-processing tasks, sufficient time is spent learning, individual accountability, public recognition and rewards for group academic success, post-group reflection (or debriefing) on within-group behaviors (Cohen, 1992). 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 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, the advantage of Jigsaw learning strategy is that students perform the challenging and engaging tasks in their experts groups with enthusiasm since they know they are the only ones with that piece of information when they move to their respective 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 to the learning of the topics Surds and Further logarithms was studied. These are major topics in the secondary school mathematics curriculum. The topics are taught at form three level (KIE, 2000).They have been among the difficult 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 3. According to K.I.E (2007) Surds and Logarithm was among the areas that students performed poorly in 2006 and 2007 national examinations.

Table 3:
Topics Found Challenging in Secondary School Mathematics during Baseline Survey by SMASSE Laikipia East Trainers, Kenya

Class / Topics	Form One	Form Two	Form Three	Form Four
Topics in order of difficulty	i) survey ii) Integers	i) Linear motion ii) Similarity iii) 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: Laikipia East SMASSE Baseline Survey, 2007 Kenya.

1.1 Purpose of the Study

The purpose of this study was to investigate whether gender affects achievement when Jigsaw Cooperative Learning Strategy is used in secondary schools mathematics classes.

1.2 Objective of the Study

The following specific objective guided the study;

i. To find out whether gender affects achievement when Jigsaw Cooperative Learning Strategy is used in secondary schools mathematics classes.

1.3 Hypothesis of the Study

The following Null hypothesis was addressed and tested at alpha level of 0.05 in the study.

Ho1; There is no statistically significant gender difference in achievement among secondary school students when taught Surds and Further logarithms using Jigsaw Learning Strategy.

1.4 Conceptual Framework

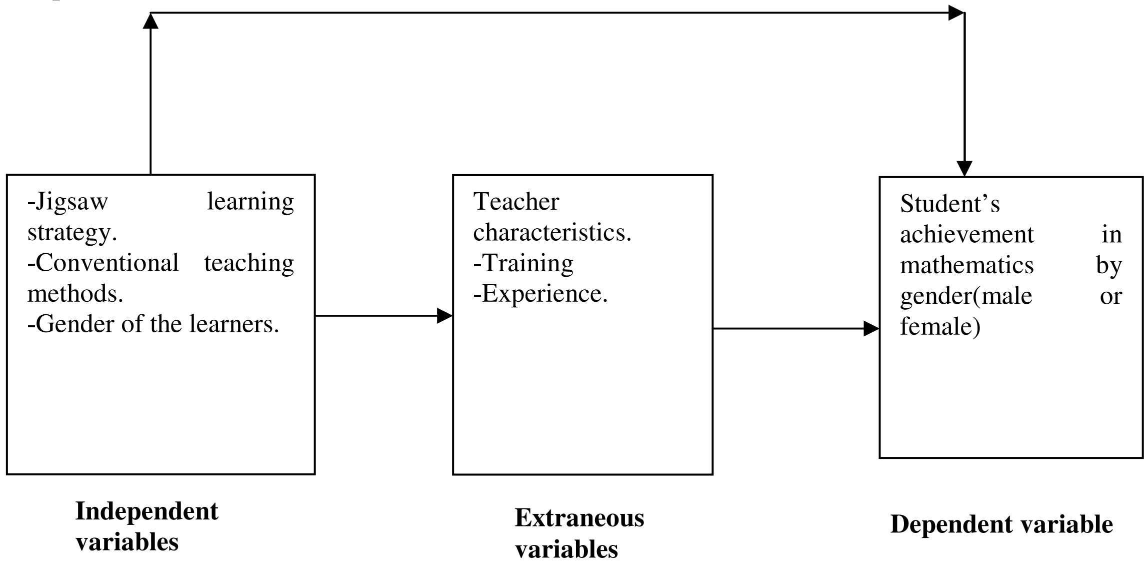

Figure 1: The Diagrammatic Representation of the Relationship Between the independent, extraneous and dependent variables of the Study.

The conceptual framework of the study was based on the Ausubel's model of meaningful reception learning and systems theory developed by Ayot and Patel (1987). The framework shows Jigsaw teaching strategy as an intervention in the teaching and learning process of mathematics. The representation of the relationship among variables within the conceptual framework is shown in Figure 1. The framework shows the dependent variable in this study as the students' achievement in Surds and Further Logarithm in terms of gender. The independent variables were the Jigsaw learning strategy presented to students, the 'conventional' or traditional learning/teaching methods and the learners' gender. Jigsaw cooperative learning strategy was hypothesized to influence positively students' achievement in mathematics in terms of gender as compared to the use of 'conventional' or traditional teaching method .The extraneous variables which could have influenced the outcome of the study were the teachers' characteristics which was controlled by using teachers who have a minimum qualification of a diploma in education and have taught form three class for at least 2 years.

2.0 RESEARCH METHODOLOGY

The study used a quasi-experimental method 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). This study used the Solomon 4-group, non equivalent control group design which 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.

Group	Notation			
E_1	0_1	X	0_2	(Experimental group)
C_1	0_3	-	0_4	(Control group)
E_2	-	X	0_5	(Experimental group)
C_2		-	0_6	(Control group)

Figure 2: The Solomon 4-group, non-equivalent control group design.

In Figure 2, the variables are defined such that: O_1 and O_3 are pretest; O_2,O_4,O_5,O_6 are post-test; and X is treatment. Group E_1 received pre-test, treatment and post test; 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 post test and pre-test. The other two schools were control schools and in the control schools, one received post test only while the other school received post test and pre-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 same teachers who had been teaching the students were used by the researcher teaching in the classroom. The treatment was administered to the whole form three classes to avoid Hawthorne effect. 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 topic by the researcher when students were on recess. However, only the results from one stream in each school were used in the analysis of data and for the acceptance or rejection of the hypotheses of the study.

2.1 Population of the Study

The schools that participated in the study were from Laikipia East District. The target population was secondary school students in Laikipia East District. The target population was 10,800 students. The accessible population was form three mathematics secondary school students in the District mixed-sex school in Laikipia East district because the topic surds and logarithms is taught at this level (KIE, 2000). Also Form three class is a mature group of students and not an examination class. The District has about 2000 form three students. There is 1 provincial school and 32 district schools in Laikipia East District. 27 of the 32 District schools are mixed-sex schools. The mixed-sex schools were used for this study so as to capture the boys and girls in the same class subjected to the same learning environments. Laikipia East District was chosen for this study because of its dismal performance in mathematics compared with other Districts in Rift valley Province.

2.2 Sampling Procedure and Sample Size

Simple random sampling was employed to select four schools out of the possible 27 mixed-sex District schools in the District. The names of the schools were written on small pieces of papers. The papers were then folded and put in a basket. The basket was then shaken and four papers chosen. Four schools were chosen because the Solomon 4 group design requires four groups. 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. The classes used for the exercise were composed of 40 students. According to Mugenda & Mugenda (1999) the required size is at least 30 per group.

2.3 Instrumentation

The Mathematics Achievement Test (MAT) was used to collect the required data. The same instrument was used to collect data for the pre test and the post test. The MAT was developed by the researcher. It was a 36 item instrument that tested the student’s knowledge, comprehension, application and mathematical skills on working out short answer questions that was set on all the subtopics of surds and further logarithms. The total score for the instrument were 80 marks. These scores were distributed to 36 items. The items were allocated between 1 to 3 marks each. It was pilot tested in a school that was not be used for study in Laikipia East District. Two schools, one experimental and the other control received a pre-test to enable the researcher to have knowledge of the entry level of the students before the experiment begins. Students in one of the schools were taught using Jigsaw learning strategy while those in the other school were taught in the conventional way. The other two schools that were involved in the study, one experimental and one control did not receive a pre-test.

2.4 How Jigsaw Learning Strategy was used to Teach

The topics that were taught by use of Jigsaw cooperative learning strategy are Surds and Logarithms to form three students. The subtopics of Surds are; rational and irrational numbers, operation on Surds, rationalizing the denominator and applications of Surds. The subtopics of Further Logarithms are logarithmic notations, laws of logarithms, logarithmic expressions and, logarithmic equations. Appropriate group work for each of the sub topics were constructed and used during instruction at the beginning of each mathematic lesson. For each of the subtopic to be taught the ten steps of creating and use of Jigsaw learning strategy as recommended by Aronson (2000-2010) were followed. The group work was assigned to the groups and each student in the group assigned questions. The students with the same questions formed the expert group where they discussed their questions. The students then went back to their initial group to present their findings to the other members of the group. All this was done with close supervision of the teacher. The teachers then evaluated the learners by asking questions and marking the students’ work. The teachers then at the end of the topic gave a post test which was distributed to them by the researcher.

3.0 RESULTS

Table 4:Comparison by Gender of Students' Pre-Test MAT Scores

Gender	N	Mean	SD	df	t-value	p-Value
Male	43	15.93	9.98	74	0.525	0.601
Female	33	14.54	13.02			

* Statistically significant at (ά) = 0.05 (2-tailed)
Critical values (df= 120, t=1.98, p<0.05) Calculated values (df=74, t=0.525, p=0.601)

The results in the Table 4 above indicate that there are no statistically significant differences between boys and girls in the pretest scores using t-value at alpha level (ά) of 0.05 since t crit > t cal. This is an indication that the groups are homogeneous and comparable. Hypothesis one of the study sought to find out whether there were statistically significant gender differences in achievement among secondary school students when taught surds and further logarithms using Jigsaw Learning Strategy. To test the hypothesis, the mean gain obtained by male and female subjects exposed to Jigsaw learning strategy were compared by use of t-value at ά = 0.05 level as shown in Table 5.

Table 5:Comparison of the Students' MAT Mean gain Score by Gender

Gender	N	Post-test	Pre-test	Mean Gain	df	t-value	p-value
Male	42	22.95	15.93	7.02	73	0.098	0.922
Female	33	21.83	14.55	7.28			

*Statistically significant at Alpha (ά) = 0.05 level, Critical values (df= 120, t=1.98, p<0.05) Calculated values (df=73, t=0.098, p=0.922)

The results presented in Table 5 reveal that boys' mean gain was 7.02 and girls' mean gain was 7.28 in the MAT. Further statistical tests show that there was no statistical significant difference between girls and boys achievement after using the Jigsaw learning strategy (P>0.05).The girls' mean gain was slightly higher than boys' mean gain. This may be attributed to the Jigsaw learning strategy which uplifted girls' performance in mathematics.

Table 6:Comparison by Gender of Students' Post-test MAT Scores

Gender	N	Mean	SD	df	t-value	p-Value
Male	85	24.9	14.68	158	0.80	0.423
Female	75	21.01	16.22			

* Statistically significant at Alpha (ά) = 0.05
Critical values (df= 120, t=1.98, p<0.05) Calculated values (df=158, t=0.80, p=0.423)

Table 6 indicates no statistically significant gender differences in the students' mathematics achievements. Both male and female students performed relatively the same. Further comparisons by gender of students' MAT mean scores in each group was done. Comparison by gender of students MAT mean scores in each group confirms no differences between performance of boys and girls as shown in Table 7.

Table 7:Comparisons of students' MAT mean scores by gender

Gender	N	Mean	SD	DF	t-value	p-value
Experiment 1						
Male	22	28.50	16.22	39	.449	.656
Female	18	30.89	17.34			
Experiment 2						
Male	24	32.96	13.08	40	.451	.654
Female	18	34.89	14.53			
Control 1						
Male	21	17.15	11.40	36	1.270	.212
Female	17	12.24	12.39			
Control 2						
Male	18	19.17	11.71	38	1.276	.210
Female	22	15.18	7.99			

*Statistically significant at Alpha (ά) = 0.05 level. $P<0.05$

3.1 DISCUSSIONS

The findings of this study showed that both girls and boys performed significantly better when exposed to Jigsaw learning strategy than those who were taught through conventional teaching methods. Though there are recorded gender differences in mathematics achievement at KCSE (KIE, 2001; KNEC, 2002), studies conducted by Mondoh (2001) indicated that girls can perform as well as boys if they are given the chance to interact and discuss mathematics concept freely in mathematics classrooms. In this study Jigsaw learning strategy proved a conducive learning environment in which their sex was disadvantaged in learning mathematics. The use of Jigsaw learning strategy in teaching secondary schools mathematics could be used to reduce gender disparity in KCSE mathematics examinations.

Much research has been done regarding gender differences in achievement in mathematics. According to Costello (1991) and Mondoh (2001), there is little gender differences in overall response to statements among 11-year-old children. However, during secondary school years, girls' attitudes towards mathematics deteriorate more than those of male students (Costello, 1991). At the age of 15 male students tend to underrate, while girls tend to overrate the difficulty level and devalue their own expertise in the subject (Costello, 1991, Mondoh, 2001).The conventional whole class teaching methods may not be able to address these differences. However, the Jigsaw learning strategy in this study proved it could close this gap. Boys' and girls' participation in mathematics studies at all levels of education refers to their enrolment and extent of being retained and active in mathematics classrooms and in mathematics related courses (Abagi,1995).Girls' enrolment in Kenya's Secondary schools and Public Universities is much lower than boys. However national figures indicate that girls account for 50% of primary schools enrollment with slight variations in individual districts (Abagi, 1995). Girls are under-represented in mathematics classrooms in mathematics related courses at Kenya's tertiary Institutions (Eshiwani, 1984: Mureithi, 2000; Mwathi, 2000). Furthermore, out of 157 mathematics lectures in Kenya's public Universities, only 9 (5.7%) were females compared to 148 (94.3%) males (Mwathi, 2000).

4.0 CONCLUSIONS

Based on the results of the study, the following conclusion was arrived at, with regard to District mixed-sex secondary schools in Laikipia East District of Kenya Gender does not affect students' achievement in mathematics when students are taught using Jigsaw learning strategy.

4.1 Implications of the Study

The use of Jigsaw learning strategy in teaching results in better students' performance in mathematics. The use of Jigsaw learning strategy is therefore a suitable method for teaching. Curriculum developers should encourage teachers to use this method in teaching mathematics to improve the current trend of dismal performance in mathematics especially in District schools. The teacher training colleges and universities should emphasis Jigsaw learning strategy as an effective method of teaching mathematics.

4.2 Recommendations

The findings of this study suggest that the use of the Jigsaw learning strategy can be an effective approach to mathematic instruction. From these findings, this study proposes the following recommendations:

i) Mathematics curriculum developers should include the teaching of mathematics using Jigsaw strategy as part of the teacher education syllabus during the training of mathematics teachers. This makes it part of the curriculum which may address the problem of dismal performance in the subject.
ii) Teachers should be encouraged by education stakeholders such as the inspectorate and the K.I.E to use Jigsaw learning strategy in teaching mathematics. However, it should be used to the topics where it is applicable.
iii) During in-service training of teachers organized by the Ministry of Education Science and Technology (MOEST), such as SMASSE, the use of Jigsaw learning strategy in teaching mathematics should be incorporated. This is because the quality of teachers and the kind of training they have is a major determinant of the quality of education in any nation.
iv) Teachers in other subjects may use the different strategies of cooperative learning. This is because, similar improvement in achievement and attitudes may be found.

4.2.1Areas for Further Research

This study suggests that the Jigsaw learning strategy can effectively improve mathematics instruction in District mixed secondary schools. However there are areas that warrant further investigations.

i) A study on other types of cooperative strategies and their effects on achievement and motivation to learn mathematics should be carried out.
ii) A comparative study should be conducted on the students' attitudes towards teaching using Jigsaw strategy versus when taught by conventional teaching methods.
iii) Research on the topics that can be taught effectively using Jigsaw strategy should be identified from mathematics curricula.

REFERENCES

Abagi. O.,(1995). Household-based factors and school participation of girls: Lessons from the existing Surveys. Academy Science Publishers, Nairobi, Kenya Abridged Research Report No.6.

Armstrong, J. M. (1981). Achievement and Participating of Women in Mathematics: Result of Tow National Surveys. *Journal for Research in Mathematics Education,* 12 (5), 356-372.

Aronson, E. (May/ June 2000). *Nobody left to hate Developing the emphatic Schoolroom. The Humanis*t, 60, 17-21.

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

Baird, J., White, R. (1984) "*Improving learning through enhanced metacognition: A classroom study*", Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA 1984.

Blith, T.; Forbes, S.; Clark, M. and Robinson E. (1994). Gender Differences in New Zealand Mathematics Performance of the Secondary-Tertiary Interface. *International Journal of Educational Research,* 21 (4), 427-428.

Borg, W.R. & Gall, M.O (1989). *Educational research: An introduction,* 5th Edn. Longman, White plains, N.Y.

Burns, M. (1984), "*The Math Solution*". Marilyn Burns Education Associates publishers, reprinted in "Cooperative Learning in Mathematics" Neil Davidson editor, 1990.

Brandy, K. E. and Eisten, R. M. (1995). Gender Bias in the Classroom. A Critical Review of the Literature and Implication for Future Research. *Journal of Research and Development in Education*, 29(1), 9-19.

Cohen, E,(1992). Restructuring the Classroom: Conditions for productive small groups.Madison, Wisconsin center for Education Research, 1992. ed 347 639.

Costello, J., (1991). Teaching and Learning mathematics 11-16. London: Routledge.

D'amico, M & Schumid, R.F. (1997). Psychology Applied to teaching (8th ed). New York, NY: Houghton Miffin Company.

David, Roger Johnson.,(2001) "An Overview of Cooperative Learning." [Online] Available: <*http://www.clcrc.com/pages/overviewpaper.html*>2 December 2010.

Eshiwani, G.S., (1984). *A Study of Women's Access to Higher Learning in Kenya with Special References to Mathematics and Science Education.* Bureau of Educational Research,, Kenyatta University college, Nairobi, Kenya pp 2-4, 55-56, 65-62.

Fennema, F. H. and Sherman, J. A> (1978). Sex-related differences in Mathematics Achievement and related Factors: A Further Study, *Journal for Research in Mathematics Education,* 9 (3), 189-203.

Gall, M.D., Gall. J,P. & Borg, W. R. (1996). Education Research: An Introduction (7th ed) Newyork: Person Education Inc.

Glassersfeld, E. V. (1991). *Radical Constructivism in Mathematics Education.* Boston. Kluwer Academic

Publishers.
Goodwin,M.W.(1999). Cooperative Learning and Social Skills to Teach and how to Teach them. Interventions in School & Clinic, 35, 29-34.
Hanze, E.& Berger W., (2007), "*Restructuring the classroom: Conditions for productive small groups",* Review of Educational Research Spring 1994 vol 64 pp1-35
Johnson, D.W, Johnson,R.T and Holubec.E.J.,(1993). Circles of learning: Cooperation in the Classroom, 4th edition. Interaction book.
Kadiri, S. A. (2004). The Effectiveness of the Personalized System of Instruction in Mathematics among Secondary School Students in Osun State. UnpublishedPh.D Thesis, Obafemi Awolowo University, Ile-Ife.
Kenya National Examinations Council (2010) *KCSE Mathematics reports in Kenya*, Government Printers, Nairobi, Kenya.
KIE (2000-2007), *Examination report*, Vol 1. Kenya Institute of Education, Nairobi, Kenya.
Kleinbaum, D.J & Kupper, L.L, (1998). Applied regression analysis and other multivariate methods. Massachsetts: Duxbury.
Manger, T. (1996). Gender Differences in Mathematical Achievement at the Novinegian
Elementary School level. *Psychological Abstracts*, 83 (3).
Mondoh, H.O. (2001). Comparative actitivities 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*.pg.59-61.
Mugenda, M.O. & Mugenda, A.G. (1999). Research methods. *Qualitative and quantitative approaches.* Nairobi, Kenya: CTS Press.
Mureithi, E. (2000). Women in Mathematics. Strengthening Mathematics and Computer Science Training and Research in Kenyan Universities. In Proceedings and recommendation of a workshop and Computer science: Chiromo Campus University of Nairobi: 27th February- 4th march.
Mwathi, C., (2000). Women lecturers in Mathematics: Strengthening Mathematics and computer science training research in Kenyan Universities. In: Proceedings and research.
Neer, M.R. (1987), "*The development of an instrument to measure classroom apprehension",* Communication Education 36, pp154-166.
Nelson, J. R. & Johnson, A. (1996). Effects of Direct Instruction, Cooperative Learning and Independent Learning Practices on the Classroom Behavior of Students with Behavioral Disorders: A Comparative Analysis. *Journal of Emotional & Behavioral Disorders*, 4, 53-63.
O' Connor, M. (2000). *The open-ended approach in mathematics Education.* Nairobi; Kenya SMASSE Project.
Ogunniyi, B.M., (1996). Science, Technology and Mathematics. The Problem of Developing Critical Human Capital in Africa. *International Journal of Science Education*, 18(3), 284.
Opolot-Okurot, C. (2005). Student attitudes toward mathematics in Uganda Secondary Schools. *African Journal of Research in Mathematics, Science and Technology Education*, 9 (2), 167-174.
Panitz, T (1996), "*Getting students ready for cooperative learning", Cooperative learning and College Teaching*, v6 N2, winter 1996.
Prater, M.A., Bruhl, S. & Serna, L.A. (1998). Acquiring Social Skills through Cooperative Learning and Teacher-Directed Instruction. *Remedial and Special Education*, 19, 160-172. *Review of Research in Education*; 8, 158-223. Federal Republic of Nigeria 2004: National Policy on Education (Revised), NERC.
Slavin, R.E. (1997). *Educatioal Psychology: Theory and practice* (5th ed).Boston: Allyn and Bacon.
Slavin, R.E.,(1991), "*Cooperative Learning: Student Teams*" 2nd Ed. Washington, DC: National Education Association.
Slavin, R.E.,(1991).Student Team Learning: A practical guide to Cooperative learning. Washington, DC: National Education Association, 339 518.
Slavin, R.E.,Leavy. N.L., & Madden, N.A. (1989). *Effective Programs for Students at Risk*. Boston: Allyn and Bacon.
Stahl, R. & Vansickle, R.L., (1992). Cooperative Learning in the Social Studies Classroom: an invitation to social study. Washington, DC: National Council.
Tyson, V.V. (1996). AN Analysis of the Differential Performance of Girls on Standardized Multiple-Choice Mathematics Achievement Tests Compared to Constructed Response Texts of Reasoning and Problem Solving. Unpublished Ph.D Thesis of University of Iowa. Dissertation Abstract International Order No. DA96030961, 56 (100), 3874A.