Chuka University
info@chuka.ac.ke | 020 231 0512 / 020 231 0518

EFFECTIVENESS OF DIFFERENTIATED INSTRUCTION IN ENHANCING STUDENTS' ACADEMIC ACHIEVEMENTS TOWARDS LEARNING OF CHEMISTRY IN SECONDARY SCHOOLS IN MAARA

[1]Mugwiria Rose Gatune, [2]Mercy Wanja Njagi, and [2]Mwenda Eric Elias
[1]P. O. Box 76-60401, Chogoria, [2]Chuka University, P. O. Box 109-60400, Chuka
Email: mugwiriarose@gmail.com, mercynjagi70@gmail.com or mwanja@chuka.ac.ke;
eliasericmwenda@yahoo.com or eemwenda@chuka.ac.ke

How to cite:

Gatune, M.R., Njagi. M. W., Elias, M. E. (2022). Effectiveness of differentiated instruction in enhancing students' academic achievements towards learning of chemistry in secondary schools in Maara. *In: Isutsa, D. K. (Ed.). Proceedings of the 8th International Research Conference held in Chuka University from 7th to 8th Oct 2021 Chuka, Kenya. P.426-433.*

ABSTRACT

Students perform poorly in Chemistry examinations in Kenya. The teaching of Chemistry aims at developing scientific attitudes, concept, principles and skills in learners. Differentiated instruction consists of efforts of teachers to respond to the variance among learners in the classroom. This study investigated effectiveness of differentiated instruction in enhancing students' academic achievements in chemistry. Quasi-experimental research design was used, particularly Solomon's four group design. The research was done in four sub-county secondary schools in Maara. The target population was 12,187 chemistry students. The accessible population was 1,242 form two chemistry students. A purposive sampling technique was used to draw the participating schools. Simple random sampling was used to select and assign schools in experimental and control groups. The sample size was 165 form two chemistry students. The instrument used was Chemistry Achievement Test. It was piloted to determine it reliability, while validity of the instrument was ascertained by experts' opinions from Department of Education of Chuka University. Reliability coefficient for CAT was 0.74. The experimental groups were taught using differentiated instruction teaching approach while the control groups were taught through conventional teaching approach. Statistical Package for Social Sciences version 25 was used for data analysis. The raw data obtained was analyzed using descriptive statistics and inferential statistics. The level of significance for rejection of null hypotheses was at $\alpha = 0.05$. The findings indicated that differentiated instruction significantly improved the students' achievement towards learning chemistry. The finding is expected to form a frame of reference for further research on innovative teaching strategies in chemistry education.

Keywords: Effectiveness, Self-concept, Self-motivation

INTRODUCTION

Education is an important component for achievement of sustainable economic development. Education prepares and equips the youth of a country so that they can play an effective role in the life of a nation. Education ensures that opportunities are provided for the full development of individual talent and personality. Science is an economic force that together with land, labour, capital and managerial capacity, contributes to social and economic growth and development of nations (Validya, 2003). Science is of great importance internationally both for economic well-being of nations and because of the need for scientifically literate citizens (Fraser & Walberg, 1995). The importance of science education in different educational systems all over the world include, the effective use of scientific information in basic science, transmission of knowledge to school and university students and familiarity with correct inquiry methods and principles of dealing with problems and problem solving. There are many challenges requiring knowledge of science and technology, therefore a requirement in all countries and all people globally. Science as an instrument of development plays a dominant role by advancing technological development, promoting national wealth, improves health and industrialization (Validya, 2003).

In Kenya, Science Education is expected to impart on the student the necessary knowledge and skills required for national development, as well as incalcucate the right attitude to work and smoothly transitional the process of developing country (Republic of Kenya, 1981, KIE, 1992). In the Kenyan education system, Science subject is split into three main branches, that is, Biology, Chemistry and Physics at the secondary level. Chemistry provides the means by which the individual can organize his or her concepts and attitudes, classify experiences and communicate with others (Barchok, 2011). Chemistry is also important for understanding composition, properties and behavior

changes of matter that form the environment (Barchok, 2011). Chemistry contributes greatly to other fields of study such as Medicine, Engineering, Agriculture and technological areas for the improvement of the quality of life and generation of wealth for the good of the entire human life. The government of Kenya unveiled its grand plan (Vision, 2030) for changing the country into a newly industrialized, middle-income country, providing high quality life for its citizen by the year 2030 (Republic of Kenya, 2007). There is need to lay a strong foundation in science and technological Education to achieve the projected developmental goals.

In Kenyan secondary school education, chemistry is an optional science subject in form three and four. According to Arimba (2012), compared to physics and biology in KCSE examinations, the candidature in chemistry is very large and has continued to grow over the years. Despite the students' higher preference for chemistry, their performance in KCSE Examinations has remained below 40% which is considered below average (KNEC, 2010). According to Maara Sub-County education office, since the inception of Maara Sub County in 2008, the average percentage score in chemistry has been below 37% (Maara Sub County Education office, 2021). This shows that there is need to improve performance in chemistry. The performance in chemistry in Maara Sub County is shown in Table 1.

Table 81: Performance in Chemistry in KCSE in Maara SubCounty from 2016 to 2020

Year	Candidature	Percentage Mean Score
2016	2296	28
2017	2888	42
2018	3095	31
2019	2739	37
2020	3168	43

Source: Maara Sub County Education Office, 2021

The highest mean score was in the year 2020 whereas the lowest mean score was in the year 2016. A close analysis of questions performed poorly by the candidates show that students have weakness in answering questions which include poor interpretation of questions; poor scientific language; poor understanding of scientific concept; inability to relate chemistry knowledge to real life situations and inappropriate teaching strategies (KNEC 2007, 2009, 2010). These weaknesses are probably derived from poor teaching and learning approaches employed. According to Muthomi (2013), the teaching approach that a teacher adopts is one of the factors that may affect students' achievement. Therefore, use of appropriate teaching method is critical to successful teaching and learning of chemistry. The teachers should develop positive relationship with student and stress classroom activities that involve active teaching-learning process and students participation in the classroom (Muthomi, 2013).

According to Barchok (2011), learning is considered to be active, constructive, and cumulative, self-regulated and goal-oriented process in which the learner plays a critical role. Hence teachers need teaching approaches that engage learners actively in the process of acquisition of knowledge. Different approaches of teaching chemistry have been proposed by educators and the knowledge of these methods may help in working out a better teaching approach. It is not appropriate for a teacher to commit to one particular method. A teacher should adopt a teaching approach after considering the nature of students, their interest and maturity and the resources available. All the approaches may not be equally appropriate and suitable for all levels of chemistry teaching. After the teacher has known all the methods, their merits and demerits, he or she should be able to make his or her own method by imbibing the good qualities of all the approaches. The approach adopted by the teacher must ensure maximum participation of the student, proceed from concrete to abstraction and provide knowledge at the understanding level (Merchant, 2010). Differentiated instruction is an approach that assumes there is a diversity of learners in every classroom and that all learners can be reached if a variety of methods and activities are used.

Differentiated instruction, according to Allan and Tomlinson (2008) is the process of ensuring what a student learns, how he or she learns it, and how the student demonstrate what he or she has learned is a match for that students readiness level, interest and preferred mode of learning .Therefore , differentiation is an organized, yet flexible way of proactively adjusting teaching and learning methods to accommodate each child's learning needs and preferences in order to achieve his or her maximum growth as a learner (Tominson,2001). Differentiated instruction teaching approach assumes that there is a diversity of learners in every classroom and that all learners can be reached if a variety of methods and activities are used. All students are not alike, that is, students learn in different rates. The model of differentiated instruction requires teachers to be flexible in their approach to teaching and adjust the curriculum and presentation of information to learners rather than expecting students to modify themselves for the curriculum (Tomlinson, 2003). Muthomi (2013) found a positive effect on student's performance when instructed through differentiated Instruction teaching approach. McAdamis (2001) reported a significant

improvement in the test scores of low scoring students following the use of differentiated instruction. Koutselini and Gagatsis (2003) found out that differentiated teaching facilitated to construct students' knowledge by maximizing motivation for cognitive and meta cognitive growth that will eventually improve academic outcomes for all students.

Over the years, chemistry has continued to show downward trend in Mara Sub-County. Based on the ideal that a change in method of instruction can help overcome the ineffectiveness of educational systems and their malfunction in corresponding to students' needs, there is need to investigate if using the teaching learning approach of differentiated instruction can improve students' academic achievement towards learning chemistry in Maara SubCounty, Kenya.

Learners' achievement in Chemistry has been low in KCSE examinations in Maara Sub County. Poor performance in chemistry is likely to undermine attainment of development goals which are projected under Vision 2030 in Kenya. Research findings indicate that teaching methods is important factor affecting students learning and achievement. It is on this basis that the study investigated the effectiveness of differentiated instruction in enhancing student's academic achievement towards learning chemistry to fill the knowledge gap. The objective was to determine whether there is difference in academic achievement in chemistry between students taught using differentiated instruction and those who are not exposed to it. The hypothesis was that there is no statistically significant difference in academic achievement in chemistry between students who are taught using differentiated instruction and those who are not exposed to it.

METHODOLOGY

The study used Quasi-experimental design, particularly Solomon four-group design (Figure 1). The design enables the researcher to control and measure the main effects of testing. It also allows the researcher to carry out studies in natural and real-life setting. Solomon four-group design involves four groups (Ogunniyi, 1992). The design guards against both threat of internal and external validity. Solomon four-group design enables 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 are due to interactions effect between the pretest and treatment. It allows the researcher to exert complete control over the variables and to test that the pretest will not influence the results, (Shutttleworth, 2009).

E1	O1	X	O2
C1	O3	–	O4
E2	–	X	O5
C2	–	–	O6

Figure 1: The Solomon's Four Group design. Source: Shuttle worth, (2009).

Experimental group E1, was pretested (O1), received 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 C2, only received posttest (O6). C1 and C2 were taught using conventional teaching. Posttest O5 and O6 eliminated the interaction between testing and treatment.

According to Spector (1981), the various combinations of testing and untested groups allow the researcher to ensure that extraneous factor did not influence the result. The pretest was administered to students to determine the entry behavior before the experiment started. The students were taught by their teachers so that were not aware of the experimentation. The experimental and control groups were from different schools to avoid interaction of subjects.

The target population was 12,187 chemistry students in secondary schools in Maara sub- county, Kenya. The accessible population was 1,242 Form Two chemistry students in sub-county secondary schools where the study sample was drawn because these schools contain adequate resources. The units for sampling in this study were schools and not individual student. The Ministry of Education Science and Technology recommends 40 students per class giving an approximate sample size of study as 160 students. The actual sample size for this study was 165 students. Frankel and Wallen (2000) recommend at least 30 cases per group for experimental research. A total of four schools were drawn using purposive sampling technique. Purposive sampling was used to identify the schools with the desired characteristics from the list of schools in Maara sub county. The assignment of selected schools to either experimental or control group was done by simple random sampling. This was done to reduce the possibility of bias entering the selection of schools sampled.

To achieve content validity CAT was presented to a head of department of chemistry in secondary schools to judge

the extent to which the test items present a representative sample of the universe of the content that the test was designed to measure. The feedback was used to improve the CAT items. The instrument was piloted in a school in Meru South sub-county with similar characteristics in the population. The reliability of CAT was tested using the Kunder and Richardson formula 21 (KR-21). KR-21 is simpler and may be used for instrument developed by individual researchers. This method is suitable when test items are scored correct or incorrect. The reliability coefficient of the CAT was 0.74. A reliability coefficient level of at least 0.7 is considered sufficient and acceptable for social sciences (Fraenkel & Wallen, 2000). Therefore, the instrument was reliable. The researcher scored the pretest and posttest, organized, coded and entered in the computer for the analysis using the statistical package for social sciences (SPSS) version 25. Descriptive statistics and inferential statistics were used for data analysis. Descriptive statistics which include mean, percentage and standard deviation was used to summarize raw data. Inferential statistics deals with analysis, interpretation and decision on the basis of results (Nassiuma & Mwangi, 2004). In order to ascertain the initial differences among the groups in CAT, an analysis of Covariance (ANCOVA) was carried out using KCPE marks as covariates in all the four groups. Independent samples t-test was used to test if there was statistically significant difference between the mean scores of experimental and control groups. This is because of its superior quality in detecting differences between two means (Borg & Gall, 1996).

RESULTS OF THE PRE-TEST

The experimental group (E1) and control group (C1) were exposed to pre-test before the start of the treatment. Pre-test was carried 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) and the control group (C1). Table 2 shows the t-test results of the pre-test Mean scores in CAT for E1 and C1.

Table 2: T-test results of the pre-test mean scores on CAT

Group	N	Mean score (%)	SD	df	t-value	p-value
E1	43	15.53	3.718	80	2.67	0.36
C1	39	13.44	3.378			
Total	82					

E1 had a higher mean score 15.53% than C1 13.44%. The standard deviation was 3.718 while that of C1 was 3.378. The results indicate that the difference in means was not significant at α=0.05 significant level ($t_{(80)} = 2.67$, $p > 0.05$). Thus, experimental group (E1) and control group (C1) were similar on CAT measure, this implied that the level of achievement prior to administration of the intervention of the two groups were similar; the groups were equivalent before administration of treatment.

Effects of differentiated instruction on students' academic achievement in Chemistry

All the four groups took post-test CAT. Achievement was measured by use of CAT post-test. Experimental groups (E1) and (E2) were exposed to differentiated instruction approach. Control groups (C1) and (C2) were exposed to conventional teaching approach. The results of the students CAT post-test scores were as shown in Table 3

Table 3: CAT post-test mean scores obtained by students in the four groups

Group	N	Mean Score (%)	SD
C1	39	21.56	5.665
C2	41	23.37	5.576
E1	43	32.33	9.987
E2	42	33.67	8.502
Total	165	27.90	9.326

The mean scores of the E1 (32.33%) and E2 (33.67%) were higher as compared with those of the C1 (21.56%) and C2 (23.37%). This shows that experimental groups had higher scores than the control groups in CAT. The standard deviation of E1 was 9.987 while that of E2 was 8. 502.The standard deviations of the control groups C1 and C2 were 5.665 and 5.576 respectively. The findings indicate that students taught using DI achieved higher in CAT as compared to those students taught using CTA. Further illustration of the CAT means scores for the four groups are shown in Figure 2. The highest mean score was attained by Experimental group (E2) followed by Experimental group (E1) then Control group (C2) and finally Control group (C1). A comparison was done on students'

improvement from the pretest to the posttest. Data on Table 4 shows the mean scores and mean gain obtained by students in experiment group E1 and control group C1 in the CAT.

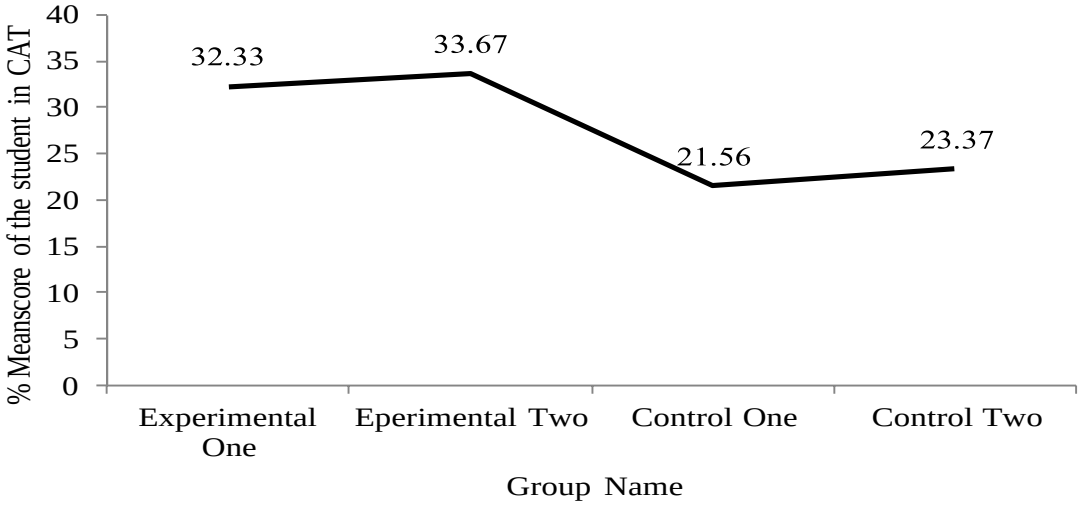

Figure 2: Relationship between post-test mean score in CAT in the four groups

Table 4: Mean scores and mean gain obtained by students in the CAT

Group	E1	C1
N	43	39
Posttest mean-score	32.33	21.56
Pretest mean-score	15.53	13.44
Mean Gain	16.8	8.12

Key: E1 – Experiment group with pre and posttest.
C1 – Control group with pre and posttest.

Results on Table 4 shows that the posttest means scores for experiment groups E1 and control group C1 were 32.33 and 21.56 respectively. The mean score for experiment group that was exposed to differentiated instruction is higher than the mean score for control group C1 that was instructed by conventional instructional approach. The pretest mean scores for experiment groups E1 and control group C1 were 15.53 and 13.44 respectively. Results on Table 4 shows that the experiment group E1 had a mean gain score of 16.8 and control group C1 had 8.12. This means that E1 had a higher mean gain and so gained more than C1. Thus, the group E1 that was taught using differentiated instruction had a higher mean gain score than the control group C1 that was taught by conventional instructional approach. The experiment group had increased their scores to a greater degree than the control group.

This implies that using differentiated instruction improved students' achievement in chemistry and the gains in score can help close the gap in performance and provide some students with points they may need to pass their KCSE chemistry in order to be promoted to the next level. The findings concur with the findings of Beecher and Sweeny (2008) who reported that achievement gains occurred across student groups that used differentiation. The results also concur with the findings of Tieso (2002) who posits that achievement gains are found across economic and achievement levels through pre/post-test results for students in effectively differentiated classrooms. Analysis of covariance of the post-test mean scores in CAT using KCPE as the covariates is shown in Table 5.

Table 5: Analysis of covariance of the post-test scores on CAT using KCPE marks as the covariates

Source	Sum of squares	df	Mean square	F	Sig
KCPE	183.23	1	183.23	0.62	0.39
Group	38471.18	3	246.21	4.32	0.01
Error	3162.32	160	998.37		
Total	158750	162			
Corrected Total	42733.12	163			

The ANCOVA results presented in Table 5 indicate that the differences between the post-test mean scores are statistically significant ($F(3,162) = 4.32$, $p < 0.05$), therefore, $H_0 1$ is rejected, which stated that there is no statistically significant difference in academic achievement in chemistry between students who are taught using differentiated instruction and those who are not exposed to it. To determine where the difference existed, a post -hoc analysis using Least Significant Difference (LSD) was run. The results are shown in Table 6. The results indicate that the differences in mean scores of groups E1 and C1, groups E1 and C2, C2 and E1, C2 and E2, E2 and C1 were statistically significant at 0.05 levels. The mean scores of E1and E2 and C1 and C2 were not statistically significant. This suggests that differentiated teaching approach had a significant and positive effect on students understanding among the students.

Table 6: Post hoc comparisons of post-test of CAT mean scores for the four groups

Group Name(i)	Group Name (j)	Mean difference(i-j)	Significance
E1	C1	10.82*	.000
	C2	9.12*	.000
	E2	-1.49	.425
C1	C2	-2.03	.299
	E1	-11.21*	.000
	E2	-12.79*	.000
E2	C1	12.46*	.000
	C2	9.88*	.000
	E1	1.02*	.425
C2	C1	4.23	.299
	E1	-7.62*	.000
	E2	-6.38*	.000

* Significant at 0.05 confidence level. Weighted by KCPE scores

The results suggest that the use of differentiated instruction promotes students' achievement in that the students exposed to it performed higher than those that were exposed to CTA. The results agree with those of Muthomi (2013) in secondary schools in Meru County research findings, which provided evidence for positive effects on students' achievement when exposed to differentiated instruction. The findings of the study are also consistent with the findings of Goddard and Goddard (2007) who demonstrated that differentiated instruction when fully implemented, can significantly improve student achievement in statewide study of fourth grade students in United States. The results coincide with Lewis and Batts (2005) findings, whose research revealed that more students have the chance to achieve academic success in classroom when instructions are differentiated.

The results also concur with the findings of Ferries (2007) whose research revealed that students in differentiated instructional classes were found to score significantly greater than their traditionally instructed peers in second-grade science classroom in elementary school located in a middle-class neighborhood in Midwestern United States. The results concur with McAdamis (2001) research findings that showed an important academic improvement from low academic outcomes after differentiated instruction. The results are also in agreement with the findings of Brimijoin (2001) who found evidence of strong achievement gains on a state standard test for students in an effectively differentiated elementary classroom.

The results agree with Kim (2005) research findings that provided evidence for positive effects on students' achievement when exposed to differentiated instruction. The results also concur with Tieso (2005) who posits that those students who were taught using a differentiated instruction demonstrated significantly higher achievement on the post test scores than did the students who were taught using traditional methods. The results coincide with Tieso (2005) who concluded that differentiating the curriculum, along with creating purposeful flexible grouping may significantly improve students' mathematics achievement. The results are also consistent with the findings of Brighton, Hertberg, Moon, Tomlinson and Callahan (2005) who found out that students in differentiated middle school classrooms showed statistically significant achievement outcomes compared to students in control group.

CONCLUSIONS

Differentiated instruction facilitates academic achievements towards learning chemistry better as compared to conventional teaching approach. This study encourages the use of differentiated instruction because of its substantial benefit to student who may be struggling in the classroom and is responsible teaching in that it acknowledges not

only the strengths and differences among learners, but also the increasing diversity in the modern classroom. Thus, science teachers should use instruction technique that involves students, which will excite and encourage students to study science.

RECOMMENDATIONS

Based on the results, it is recommended that: chemistry teachers should give more attention to differentiated instruction teaching approach as one way of addressing the perennial problem of underachievement in chemistry.

REFERENCES

Allan, S. & Tomlinson, C. (2008). *Leadership for Differentiating Schools and Classrooms.* Alexandria, V.A: Association for Supervision and Curriculum Development.

Arimba, A. (2012*). Effects of Advance Organizers on Secondary School Students' Achievement and Self-concept in Chemistry in Maara District, Kenya*. Unpublished M.Ed. Thesis. Chuka: Chuka University.

Barchok, H. (2011). *Effect of Collaborative Concept Mapping Teaching Strategy on Students Achievement, Motivation and Attitude toward Chemistry in Selected Secondary Schools in Kenya (Unpublished Ph.D. Thesis)*. Eldoret: Moi University.

Beecher, M. & Sweeny, S. (2008). Closing the Achievement Gap with Curriculum Enrichment and Differentiation: One school's Story. *Journal of Advanced Academics*. 19(3), 502-530.

Borg, W. & Gall, M. (1989). *Educational Research*. An Introduction (6th edition). New York: Long man.

Brighton, C.; Hertberg, H.; Moon, T.; Tomlinson, C.; & Callahan, C. (2003). Differentiating Instruction in response to student readiness, Interest and Learning Profile in Academically Diverse Classrooms: A review of the literature. *Journal of the Education of the Gifted*, 27(2/3), 119-145.

Brimijoin, K. (2001). Expertise in differentiation: A preservice and an inservice teacher make their way. A Dissertation Presented to the Curry School of Education, University of Virginia, Charlottesville, VA.

Ferrier, A. (2007). The Effects of Differentiated Instruction on Academic Achievement in a Second-Grade Science Classroom. Unpublished Doctoral Dissertation. Walden University.

Goddard, R. & Goddard, Y. (2007). A Theoretical and Empirical Investigation of Teacher Collaboration and Student Achievement in Public Elementary Schools. Teachers College Record, 109(4), 877-896.Retrieved on 10th December 2010 from http://www.ascd.org/publications/education

Kenya Institute of Education (K.I.E), (1992). *Secondary School Syllabus*. Nairobi: Kenya Literature Bureau.

Kenya National Examinations Council, (2007). KCSE Examination Candidate Performance vol 1. Nairobi, Kenya. Government Printers.

Kenya National Examinations Council. (2008). KCSE Examination Candidate Performance vol 1. Nairobi, Kenya. Government printers.

Kim, J. (2005). The Effects of a Constructivist Teaching Approach on Student Academic Achievement, Self-concept, and Learning Strategies. Asia Pacific Education Review 6(1):7-19.

Koutselini, M. & Gagatsis, A. (2003). Curriculum Development for the differentiated classroomin Mathematics, World Studies in Education, 4:1, 45-67

Lewis, S. & Bates, K. (2005). How to implement differentiated instruction. Journal of Staff Development, 26(4), 26-31.

McAdamis, S. (2001). Teachers tailor their instruction to meet a variety of student needs. Journal of Staff Development, 22(2):1-5.

Merchant, S. (2010). Methods of Teaching Mathematics. Hambard University, Karachi. HIESS.1-13. Retrieved on 10th December 2010 from http://www.scribd.com/doc/8528335/methods-of-teaching-mathematics.

Muthomi, M. (2013). *Effectiveness of Differentiated Instruction on Student Attitude and Achievement in Mathematics* (Unpublished PhD Thesis). Chuka: Chuka University.

Nachmias, C. & Nachmias, D. (2004). Research Methods in social sciences.5th ed. London. Replika Press Ltd. 44, 331.

Nassiuma, D., & Mwangi, J. (2004). *Statistical Methods for Information Analysis*. Njoro, Kenya. Egerton University Press.

Ogunniyi, B. (1992). Understanding Research in social Science. Nigeria: Ibadan University press.

Republic of Kenya (1981). *Report of Presidential Working Party on the Second University in Kenya*. Chaired by Mackay, C.D. Nairobi: Government Printer.

Shuttleworth, M. (2009). *Solomon Four-Group Design*. Retrieved on 11th march 2011 from http://www. experiment-resources.com/solomon-Four group-design.htm

Spector, P. (1981). Research Designs Series: Quantitative applications in the Social Sciences. Newbury Park, CA: Sage publications.

Tieso, C. (2002). The Effects of Grouping and Curricular Practices on Intermediate Students' Mathematics Achievement. Hartford, CT: National Research Center on the Gifted and Talented, University of Connecticut.

Tieso, C. (2005). The effects of grouping practices and curricular adjustments on achievement. *Journal for the Education of the Gifted*, 29(1):60-89.

Tomlinson, C. (2001). *How to Differentiate Instruction in Mixed Ability Classrooms*. Alexandria, VA: Association for Supervision and Curriculum Development. Retrieved on 15th December 2012 from http://www.netc.org/focus/challenges/instruction

Tomlinson, C. (2003). Fulfilling the Promise of the Differentiated Classroom: Strategies and tools for responsive teaching. Alexandria, VA: Association for Supervision and Curriculum Development.

Validya, N. (2003). *Science Teaching for the 21st Century*. New Delhi: Deep and Deep Publications PVT Ltd.