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EFFECT OF CASE BASED LEARNING AND REGULAR TEACHING METHODS ON SECONDARY SCHOOLS STUDENTS' ACHIEVEMENT IN CHEMISTRY IN MAARA, THARAKA NITHI COUNTY

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Abstract

Most concepts in Chemistry are abstract. Case Based Learning may help improve achievement in Chemistry. The purpose of this study was to find out the effect of Case Based Learning (CBL) and Regular Teaching Methods (RTM) on secondary school students' achievement in Chemistry in Maara Sub- County where performance is below average percentage mean scores. The study used a two by two pre-test post- test quasi-experimental factorial design. Purposive sampling was used to select 70 students from a population of 18,611students in three co-educational secondary schools. Simple random sampling method was used to assign groups to experimental and control groups. Pre-test was administered to two groups. The instrument was validated by science education experts from Egerton University Faculty of Education and Community Studies and examiners in the Kenya National Examinations Council. Pilot testing was done in Meru South Sub-County. The reliability of the instrument was 0.79. After eight weeks, a post-test was administered and data analyzed using descriptive and inferential statistics at $\alpha = 0.05$. The study found that the mean differences in post-test were statistically significant between those exposed to CBL and RTM, $p<0.05$ the experimental group performed better than RTM group. Based on this study, chemistry instructors may use CBL in teaching chemistry.

Key words: *Regular Teaching Methods, Case Based Learning, Chemistry Achievement Test*

Introduction

Chemistry is an important subject in many scientific fields of human endeavors and therefore, it should be given serious attention in secondary school education (Agboola & Oloyede, 2007). Despite the important potentials embedded in learning chemistry, its importance to mankind and the efforts of researchers to improve the quality of its teaching and learning especially at the secondary a school level, the performance of students in the subject in recent times is not impressive (Oluwatesin & Bamidele; (2014). According to Joje (2019) leading economies in Asia namely: Hong Kong, Japan, Singapore, South Korea and Taiwan have their chemistry achievement significantly higher than the world's mean achievement. Malaysia and Thailand had average and below average achievements in chemistry respectively which are attributed to the nature of teaching- learning process. Statistics from Nigeria showed that performance of candidates in senior secondary from (2001-2014) attested to students' poor achievement in chemistry to the use of ineffective teaching methods by chemistry teachers (Fatokum, Egya & Uzoechi, 2016). Marissa and Elizabeth (2014) revealed that students in South Africa performed poorly chemistry when various concepts

were analyzed. It is significant to note that the trend in chemistry achievement in Kenya is similar to other countries like Zanzibar, South Africa and Uganda. Amir and Habiba (2016) reported similar poor performances in chemistry as compared to other sciences in Uganda. A recent study in Zanzibar by Ochieng', Hemed and Sebtuu (2019) showed that the performance in chemistry is also below average percentage mean scores.

According to Kenya National Examinations Council Reports for years 2009 to 2019 performance in Chemistry in most secondary schools in Kenya was below average in the Kenya Certificate of Secondary Education (KCSE). Kamonjo, Okere and Wachanga (2015) indicated from their findings that that students' academic achievement plays a significant role in developing or enhancing scientific creativity in chemistry. They concluded that educational institutions should strive to improve students' academic achievement in chemistry as a strategy of enhancing scientific creativity in chemistry. A Study by Muiruri, Wambugu and Wamukuru (2016) showed that pupils taught through Advanced Organizers had significant improvement in achievement in Poetry compared to these taught through conventional teaching methods. Verena and Genevieve (2014) stated that there was lack of comprehensive research on the effectiveness of CBL over other active learning techniques or traditional lectures as well as absence of evidence regarding the degree of success of CBL at teaching content.

The effects of CBL on secondary school students' achievement have not been adequately established and in particular Maara Sub County, Kenya. The current study sought to investigate the effects of CBL on student's achievement in Chemistry in Maara Sub County, Kenya where performance is below average.

Research Objective

To determine whether there was a difference in students' achievement in Chemistry between those taught through Case Based Learning (CBL) and those taught through Regular Teaching Methods (RTM)

Research Hypothesis

There is no statistically significant difference in students' achievement in Chemistry between those taught through Case Based Learning (CBL) and those taught through Regular Teaching Methods (RTM)

Research Methodology

This study used a Quasi-experimental Factorial Design with one experimental group and one control group (Kothari, 2004). Case based learning (CBL) was used in the experimental group while Regular Teaching Methods (RTM) was adopted in the second group to serve as a control. The two groups were compared two- by –two to find out the group that caused the difference. A pre-test was initially administered to chemistry students in the two groups before the treatment. The treatment was conducted for eight weeks. At the end of eight weeks of treatment, a post test was administered to the two groups. The design involved a random assignment of intact classes to two groups. The Research Design is presented in Table 1.

Table 1
Quasi - Experimental Factorial Design

Group	Pre-test	Treatment	Post-test
Experimental	O_ICBL	XCBL	O_2CBL
Control group	O_IRTM		O_2RTM

Key:
OICBL represents the pre-test scores for the CBL group
O2CBL represents the post-test scores for CBL group
XCBL Represents the treatment for the CBL group
OIRTM represents the pre-test scores for the RTM group
O2RTM represents the post-test scores for the RTM group

Population of Study

The population of this study comprised all secondary school students in Maara Sub- County, Kenya. The target population was 18,611 students in all secondary schools in Maara Sub County which had 52 secondary schools with a total of 38 co-educational schools. The schools which had a class size of less than 30 students per class were 6 while 15 schools had between 30 to 40 students per class. There were also 17 co-education schools with more than 40 students per class. In addition, 12 schools had a gender disparity of more than 10 students while 4 schools had more than 60 students per class. The accessible population was 2,378 Form Two chemistry students from co-educational secondary schools in Maara Sub- County.

Treatment of Study

Chemistry teachers were trained by the researcher on the use of CBL and TBL in chemistry teaching for one week. The schemes of works, lesson plans and teaching materials were prepared by both the researcher together with the chemistry teachers. The experimental group was presented with CBL separately. A total of 5 cases were used to teach a selected topic in chemistry. Students wrote the answers of these study questions on the worksheets, which were distributed to all students. The role of the teacher was to move from one student to another and assist the students when they needed help in understanding the presented cases or related questions. After all the students explain their answers to the questions, the teacher summarized the correct answers.

Validity of Instruments

The two instruments were validated by chemistry teachers who were KNEC examiners and science educational experts from Egerton University in the Department of Curriculum, Instruction and Educational Management (CIEM). The experts checked the language used in

items, difficulty of test items, ambiguity, test length and arrangement of items. This was done to ensure that the items in the CAT corresponded with topic Salts in chemistry.

Instrumentation

In this study the test items were based on what the students covered during the study period in Chemistry. The items were developed using a test blue print that included the topics covered alongside the domains of learning. The item tested knowledge, comprehension, application, analysis, synthesis, and evaluation. The Chemistry Achievement Test (CAT) was used as the instruments for the study. The instrument was developed by the researcher to assess academic achievement in Chemistry. To compare the effect of CBL and RTM on achievement a similar content was covered in the three groups. This was performed by reviewing instructors' teaching materials to verify that the students were exposed to similar content in the CBL and RTM classes and that the topics aligned with questions on the pre-test and post-tests.

Chemistry Achievement Test (CAT)

The Chemistry Achievement Test (CAT) was used to measure student's achievement in Chemistry in Form Two Kenya Institute of Curriculum Development (KICD) chemistry syllabus. The CAT was developed using a test blueprint in order to test knowledge, comprehension, application, analysis, synthesis, and evaluation. The total number of structured items was 10 comprising 30 marks. The CAT consisted of only items that were covered in topic Salts during the study period. The test was administered at the beginning of the study as a pre-test and also at the end of study as the post test. The reliability coefficient for CAT was estimated using the Cronbach's coefficient Alpha method and was found to be 0.79.

Data Collection Procedures

The authority to undertake research was first sought with the approval by Egerton University Board of Postgraduate Studies. The researcher then sought permit to conduct research in the sampled schools from the National Commission for Science, Technology and Innovation (NACOSTI). A pre-test was administered at the beginning of the experiment to the two groups. The experimental group was taught using CBL while the control group was taught using RTM. After the eight weeks of teaching the post-test was administered two groups. Data was collected using Chemistry Achievement Test. The instrument was administered by the researcher with the assistance from chemistry teachers in the sampled schools. The researcher then used scores of the tests to get quantitative data to use for data analysis.

Data Analysis

Descriptive statistics (mean, standard deviation, percentages) and inferential statistics (t-test) were used for data analysis. The Statistical Package for Social Sciences (SPSS) Version 25

was used in data analysis. The level of significance for acceptance or rejection of null hypotheses was $\alpha = 0.05$.

Results and Discussion

Results of Pre-test CAT Mean Scores

Data in Table 1 shows the results obtained by the three groups in the pre-test in chemistry.

Table 1

Pre-test CAT Mean Scores of Students in the Two Groups

Group	N	Mean	Std. Deviation	Std. Error
RTM	39	16.00	7.34	1.18
CBL	36	19.92	10.47	1.75
Total	112	17.07	8.31	0.79

The mean scores of the RTM were 16.00% while that for CBL was 19.92% in the Pre-test CAT. The standard deviation for RTM and CBL were 7.34 and 10.47 respectively. The results indicated that the mean score in CAT for CBL was higher than that of RTM. The standard error for RTM and CBL were 1.18 and 1.75 respectively. The results also indicated that the two groups started the experiment at the same entry level of achievement as evidenced in CAT mean scores.

Effect of Case Based Learning on Student's Achievement in Chemistry.

The first objective of this study was to determine whether there was a difference in students' achievement in Chemistry between those who were exposed to CBL and those exposed to RTM. The corresponding hypothesis was that there was no statistically significant difference in students' achievement in Chemistry between those taught using CBL and those taught using RTM. The results are shown in Table 2.

Table 2

Post – test CAT Mean Scores of Students Exposed to CBL and those Exposed to RTM

Groups	N	Mean	Std Deviation	Std Error Mean
CBL	34	37.15	18.82	3.23
RTM	36	23.50	11.39	1.90

The results indicated that CBL had a higher mean score of 37.15% while RTM had lower mean score of 23.50%. The standard deviation for the CBL was 18.82 while that RTM was 11.39. The standard error mean for CBL was 3.23 while that for RTM was 1.90.

In order to determine whether there was a significant difference in mean scores in CAT between RTM and CBL, independent samples t-test was used. The results are as shown in Table 3.

Table 3

t-test Results for the Post-test CAT Mean Scores of Students Exposed to CBL and those Exposed to RTM

	F	Sig	t	Sig (2-tailed)	Mean difference	Std Error difference
Equal Variances Assumed	8.11	0.01	-3.70	0.00	-13.65	3.70

Table 3 shows that the mean differences between RTM and CBL was -13.65 while the standard error difference was 3.70. The mean differences when equal variances were assumed between were statistically significant, $t(74) = -3.70$, $p < 0.05$. CBL contributed to higher achievement in Chemistry as compared to RTM by helping learners to construct knowledge more meaningfully. Therefore, H_O1 stating that there was no statistically significant difference in students' achievement in Chemistry between those taught using CBL and those taught using RTM was rejected. Hence the alternative hypothesis stating that there was statistically significant difference in students' achievement in Chemistry between those taught using CBL and those taught using RTM was accepted. CBL contributed to higher achievement in Chemistry as compared to RTM by helping learners to construct knowledge meaningfully. The use of case studies in teaching chemistry enhanced learning through case scenarios which were applicable to everyday situations that helped learners to easily connect classroom learning with the daily life experiences. Based on the outcome of this study CBL was observed to be more effective in enhancing student's chemistry achievement compared

with RTM. The use of case studies in teaching chemistry enhanced learning through case scenarios which are applicable to everyday situations that helped learners to easily connect classroom learning with the daily life experiences. CBL was more effective in enhancing student's chemistry achievement when compared with RTM.

The findings of the present study are supported by that of Francis and Mabel (2015) who found that inquiry-based strategies such as CBL often provide a better platform as well as the environment for more meaningful learning to take place. Kelvin (2015) noted that case studies were significantly more effective than other methods of content delivery at increasingly performance on examination questions. Studies by Kulak and Newton (2015) and Bevan, Chan and Tabber (2014) showed that using case studies was associated with favorable learning approach change across time as compared to a non-CBL learning techniques. Sendur and Aysel (2015) noted that there was significant difference between experimental groups taught using CBL than through activities defined in chemistry curriculum and that CBL was more effective in promoting conceptual change and assuring higher level of understanding for students.

Conclusion and Recommendations

Conclusion

This study found that CBL improved students' achievement in chemistry better than RTM. The mean differences between RTM and CBL were statistically significant at $\alpha = 0.05$ level. This suggests that CBL enhanced students to learn chemistry better as compared to RTM. The conclusion of the study was that there was statistically significant difference in students' achievement in Chemistry between those taught using CBL and those taught using RTM. Students exposed to CBL outperformed the students taught using RTM.

Recommendations

Based on the outcomes of this study the researcher recommends the following:

i. Chemistry educators should incorporate the use of CBL teaching strategy in order to improve achievement in chemistry among students in secondary schools. Furthermore, chemistry trainers in the Universities and Colleges should train future chemistry teachers on the benefits of CBL in chemistry teaching.
ii. Science education researchers may also compare CBL with other strategies in science teaching to find out which strategies are more superior in enhancing students to learn better.

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