



Performance in Chemistry: A case study of students in Kakamega North Sub County, Kakamega County-Kenya

BY

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Abstract

Chemistry is one of the core science subjects offered in Secondary schools, in the current education system, in the Republic of Kenya. Chemistry is a STEM subject (Technology and Engineering). Kakamega North Sub County has been recording very good performance in other subjects, but very poor performance in Chemistry. To collect empirical data on the performance of chemistry in secondary schools this research as evolved. The conceptual frame work had independent and dependent variables. It conceptualized that the performance in chemistry depended on attitude, student teacher ratio and category of schools. Research design used was predictive. The research involved a population of 500. To ensure construct validity, short and straightforward close-ended questions were used. To ensure the reliability of the questionnaire, test retest method was used. The process of data analysis involved editing, coding and data entry into a computerized system for analysis. Qualitative data was grouped into themes corresponding with the study objectives. Data was presented in tables, frequencies and percentages. Average academic achievement in the Subject was due to an interaction of various factors as was postulated under the conceptual framework in chapter one of the project report. It was found that majority of candidates in secondary schools in Kakamega north prefer Chemistry to other science subjects, as was evidenced by 60.0%, however, the performance in the subject was not satisfactory. It was recommended that; Principals should give priority to teaching and learning resources: Proper lighting at home, using at least a lantern that doesn't interfere much with the health of the students was also another area recommended by this study.

Keywords: Chemistry, Science, Secondary School, Students, Teaching.

Abbreviation: KCSE- Kenya certificate of secondary education; TSC- teachers service commission; TPAD- Teachers' performance and appraisal development tool; CAT- Continuous Assessment test.

Article History

Received: 11/06/2024

Accepted: 29/06/2024

Published: 30/06/2024

Vol – 2 Issue – 6

PP: - 07-13

INTRODUCTION

It is on record that Chemistry represents a time frame from far history to this time. When civilizations brought the used of technologies that would generate the form of various branches of chemistry (Montenro, 2018). Humanity started the practice of chemistry when they learned to manage fire and appropriated it for cook, make pottery, and smelt metals. In furtherance, they started separating and using specific concepts of matter in their day to day life. A several classes of drugs like aloe, myrrh, and opium were separated from the

class of plants. In the like manner, Dyes, such as indigo and Tyrian purple, were obtained from plant and animal matter. Attempts were made to merge metals to form alloys like copper, also tin were put together to form brass. Others were elaborate smelting techniques which gave iron. It was recorded also that fermentation process yielded alcohol and purified through the process of distillation. Efforts were made to understand the characteristic of matter traced backward beyond 2500 years. Postulation of the fact that matter consist of earth, air, fire, and water was in place until subsequent work that led to an amalgamation of chemical technologies



and philosophical speculations spread abroad from nations like Egypt, China, and other parts of the world by alchemists, who made efforts through research to transform “base metals” such as lead into “noble metals” like gold, and to create elixirs to treat disease and extend human life through several supportive practices (OCRU, 2015). From this point, the study of Chemistry began to gain momentum, innovations, research in the three major branches of Chemistry (Physical, Organic and Inorganic) continue spreading from decade to decade until the present age. While the study of Chemistry advances, it became necessary to mandate students with Science to offers Chemistry as a basement in Science. Chemistry give perspective to the composition and structure and characteristic of matter. It is also often ironically said to be an unpopular subject among the students (Hofstein et al, 2011).

Teaching basically is meant to transfer knowledge, bring about an understanding to the learner the concept of the subject matter to create a positive change in human in but not limited to behavior, attitude, thinking and response. Teaching method adopted by an instructor is therefore critical to achieve goals. One of the traditional approaches in teaching which is predominant in Kenya and other Sub-Sahara countries is the chalk and talk approach. This method is central on the transfer of knowledge and evaluating the understanding of learners in the strength memorization for awards of grades and certificates. This approach encourages teacher to be the only one talking mostly and the student does the listening and writing notes with the sole aim of passing examination and to obtain certificates. This method rather encourages duplication of notes back to teachers and is more or less counterproductive (Mata, 2019). Class discursion, interaction and participation could make more meaning and the desired impact on the learners.

Some researchers traced the causes of the difficulty in learning Chemistry on the part of student to student to its abstract nature, inappropriate and irrelevant instructions pointing to nothing in reality in the life of man, this may not be absolutely correct because every aspect of the living begins with a cell and none living with an atom which are mostly unavailable to unaided eyes, misconceptions are possible with this. In a work, Matilde Malana (2020) also revealed that Chemistry is perceived in error as a hard to understand subject in science due to certain fundamentals concept like atoms and molecules are abstract in nature and appears unreal. It is a subject of fear when mentioned before certain secondary school students and this fear has constituted dislike and has translated to failure or poor performance (Enriquez, 1994, Horn and Walberg, 1984).

The difficulty perception of learning toward the subject is another factor that contributes. Low level of perception, interest and motivation can largely contribute to low performance in the subject and even overall deviation from Science (Inas et al, 2018, Hofstein et al, 2011, Ali, 2012).

Danit, M. B. (2016) in a work “Curricular Influences on College Students’ Intellectual Development” recommended Chemistry as a core Science subject which should prioritized

to match the global Science and Technology drive to ease life and to solve human problems.

Forms of Attitude that influences the performance of students in Chemistry

Attitudes as defined by Doppelt et al, (2016) is a psychological and philosophical orientations one developed as an outcome of experiences overtime which shapes a person’s interpretation to circumstance, issues, human and things that determine their resolve. It is a synchronization of beliefs, disposition, perception and behavioral tendencies on a person, thing or matter (Hogg, 2019). Attitude can be also defined as a positive or negative views about a person, object, subject, idea or situation that is capable of influences individual choice behavior or responses (Doris 2020). Emotion, cognitive and behavior are components of attitudes that defines how we fell, what we think and how we respond or react to issues, persons or situations (Higgins 2016 et al). The behavior of people are the outcome or product of their attitude which mostly are also produce or reactions due to their experiences especially when it has popular acceptance in a society or environment which can be positive or negative. Reinforcement in a positive direction has ability to create positive attitude towards a subject or an object (Mata R. 2019, Anioka, 1979).

Because of the way attitude is paramount among numerous factors that influence the performance of student in a subject, we can conclude that positive attitude towards chemistry will provoke more confident that could herald success in the subject (Doris 2020).

Teacher adequacy and performance in Chemistry.

Teacher inadequacy can compromise good performance in education. To figure out the adequacy of teachers in the learning environment, the student-teacher ratio (STR) need to be determined. Chemistry performance is greatly determined by the availability and adequacy of teachers. To assess the adequacy of teaching personnel in schools, the student-teacher ratio (STR) must be established. (Osokayo, 2003). Academic performance is also influenced by inadequate man power occasioned by event like teachers’ transfer, death, sack and resignation without replacements. These studies have been done in other Sub Counties in Kenya and none has been done in Kathiani Sub County. The current study intends to investigate the school-based factors influencing students’ performance in KCSE in public secondary schools in Kathiani Sub County, Machakos County with a view of making recommendations on how to improve performance in KCSE in the Sub-County.

The following were specific objectives of the study

To determine the extent to which learners attitude influences the performance of chemistry in Secondary schools in Kakamega North Sub County, Kakamega County.

To assess the extent to which teacher adequacy influences performance of chemistry in Secondary schools in Kakamega North Sub County, Kakamega County.

To determine the extent to which the school category affects the performance of Chemistry in Secondary Schools in Kakamega North Sub County, Kakamega County.

METHODOLOGY

Research design

Descriptive survey has been used as a design to achieve the set objectives on this work, subsequent answers were delivered to the research questions thereof. Descriptive research design adopt a stream mechanism to address qualitative and quantitative data acquisition in attempting resolving problems (Hogg 2016).

Area of study

The research was conducted in Kakamega North Sub County, in Kakamega County, located in Western Kenya. The study area covers **423.3km²**, and has a population of **205,166** according to the 2019 Census. Some of the schools where the research took place are located in the rural areas. The longitudinal and latitudinal grids of the sub county located in Kakamega County are: 0°17'3.19"N, 34°45'8.24"E respectively (KNBS, 2019).

Target population

This research covered five hundred students and four Chemistry teachers. Only form three and form four students were involved in this study. The research was carried out in three schools, in Kakamega North Sub County.

Samples, sampling techniques and instrumentation

This study adopted Doris 2020 formula to calculate the sample size for the students in form 3 and form 4. This method is suitable for a population which is below 1000. Furthermore, key informants were selected for interviews using saturated method. The 3 sampled schools, gave a representation of 15% of the secondary schools in the region. Questionnaires, interviews and observation were used as instrumentation (Matilde, 2020).

Questionnaire

Questionnaires were open ended, and written in a language that were very simple to understand. They did not require complex details from students and teachers. Closed ended questionnaires were made in terms of alternative answers that the respondents could choose from.

Interviews schedule

An interview is a structured conversation where one participant asks questions, and the other provides answers.

Validity

To ensure construct validity, short and straightforward close-ended questions were used. Content validity, on the other hand, expert judgment of lecturers of the university were fully sought.

Reliability

To ensure the reliability of the questionnaire, test retest methods were employed. The test instrument were administered twice to a particular group of respondents at the point of pilot study at two different occasions. Reliability of the above instruments were verified using pre-test method.

Ratings of the two tests were analyzed to obtain a reliability coefficient of not lower than a benchmark of 0.70.

Data collection

Prior to the collection of data from schools, permission was sought from appropriate school authority. An estimate of the budget for materials and facilities needed for the research was written. Issues and opportunities for collecting data were identified and also approach was adequately planned. Questionnaires were administered to principals, teachers and students to be interviewed. Their responses were recorded. Observation involved the use of senses to see what needed to be seen, as per this research. The researcher had one-on-one conversation with the interviewee and this formed part of the interviews as a research tool used herein. Data was then analyzed and interpreted **Matilde Malana (2020)**.

Data analysis procedure

To analyze data for the extent of school category, teacher-student ratio, and the attitude of teachers, the researcher examined raw data collected to detect any errors and omissions and corrected them where necessary, coding was done to put data into a limited number of categories by assigning numbers to symbols. Tabulation was later done in order to arrange the same data in concise and logical order. This facilitated the process of comparison, and also provided the basis for various statistical computations using SPSS version 20. Quantitative data was analyzed using descriptive statistics like mean and results presented in tables. Qualitative data collected from interview schedules is reported in terms of themes and sub-themes. Rating scales of likert scale of Strongly Agree-5, Agree-4, SHA- Somehow Agree-3, D- Disagree-2, SD- Strongly Disagree-1 were used for various measurements and determinations. The likert scale was interpreted as strongly agree- 4.5-5.00, agree - 3.5-4.4, somehow agree- 2.5 - 1.4, disagree- 1.5-2.4 and strongly disagree-1.3 -1.10.

Data analysis

The process of data analysis involved editing, coding and data entry into a computerized system for onward analysis. Qualitative data were grouped into themes corresponding with the study objectives, whereby outstanding themes from the statements provided by the interviews were formed from outcome of the specific question. The primary data collected from the questionnaires were registered, coded and translated so as to answer the research questions of the study. Descriptive and inferential statistics were majorly used in data analysis in this study (**Matilde Malana, 2020**).

DATA ANALYSIS, INTERPRETATION AND DISCUSSIONS

The study found out that negative attitude, category of schools and Teacher-student Ration greatly affect the performance of Chemistry in Kakamega North sub-county, Kakamega County in the republic of Kenya. Previous study conducted by Doris 2020 also found out that these factors are of great concern on matters of excellent performance in Chemistry.

The study also found out that Chemistry is the most popular among the three science subjects, and is compulsory in all Science Schools. 60% of the students gave first preference to Chemistry, 30% rated it second, while 10% considered it third (Table 2). However, the student's performance in Chemistry was generally found to be below average in the sampled schools, both internal and national examinations as summarized in the table 2. The above summary shows unsatisfactory score averaging C-grade among the candidates. This is below average, for it only translates into 5 points out of the possible 12 points total in KCSE. The end term exams were found to be fairly organized in most of the schools. 50% of the teachers indicated that they were giving two chemistry papers (paper 1 and 2) in the end term exams. The other 50% said they gave all the 3 papers including paper 3 (practical). They claimed that the papers were almost the standard of KCSE. Document analysis done on the previous KCSE results in Chemistry mean scores between 2018- 2021 were presented as shown in the bar charts.

It's clear from the graph (*Figure 2*) that the mean in chemistry was higher in 2021 and lower in 2018.

This was attributed to few teachers in the subject area. When teacher-student ratio doesn't meet the threshold, then there is reduced contact with the individual students, leading to poor performance in Chemistry. School category also had an effect here, with extra county schools performing best while sub county schools performing the least.

It's clear from the graph (*Figure 3*), that the mean of Chemistry was higher in 2020 and lower in 2018.

This was attributed to negative attitude towards the subject. A good number of students also perceived chemistry as a very difficult subject. They then developed negative attitude towards the same, leading to poor performance in the said subject.

The past results showed that, no school attained a mean score of 6.0 in Chemistry. Very inconsistent improvement were also noted in almost all schools. This is called positive deviation. The students who scored "A" parallel, were therefore unable to be admitted in highly competitive science courses (Table 3) The major research findings obtained from this study in line with its specific objectives can be analyzed and discussed as follows:

Attitude

Forms of attitude that affected the performance of students in Chemistry are of different forms: Confidence, Optimism, Sincerity, and Reliability are traits that represent positive attitude. Hatred, Pessimism, Resentment, and Doubt are traits that represent negative attitude. Indifference and Detachment are traits that represent neutral attitude. The learners who had positive attitude were found to be performing very well. The students who had neutral attitude were found to perform averagely, whereas the students that had negative attitude were found to perform very poorly. This was summarized in Table 4.73% of the students admitted that negative attitude in chemistry has adversely affected the performance in

Chemistry. 18% of the students admitted that neutral attitude affects the students' performance in the mentioned science subject, while 9% admitted that positive attitude has an effect in the performance of chemistry in the schools.

Teacher's Inadequacy

Teacher's inadequacy can compromise the quality to identify the adequacy of teachers in the learning environment, the student-teacher ratio (STR) need to be determined. STR tells whether an institution is having adequate teachers or not. The advantage of having low STR is reducing the number of students to be handled by a teacher in the classroom. This ensures the teacher's attention to the students and thus good academic performance. On the other hand, high STR will mean that a teacher will have to handle a large number of the students in the classroom at the same time. Students' academic performance is affected by the transfer of teachers from schools without replacements leading to lack of enough teachers' thus affecting teacher-student ratio.

The student teacher ratio in form four Chemistry class was summarized in Table 5. This gives an average of 32:1. This is a good ratio, since it is below 40:1 recommended by the Republic of Kenya (MOEROK, 2013). The student-teacher ratio was considered to have a great potential in boosting performance in Chemistry in the sub county, since it was likely to encourage individual attention to the students as well as enable the formation of reasonable group sizes especially during Chemistry practical lessons.

Teacher experience

Table 6 shows the length of service of the teachers that were involved in the study. The findings revealed that majority of teachers under the study (62.5%) had less experience of 5 years and below in the teaching of Chemistry. This could be attributed to high turnover rates of teachers in schools most of which mainly had temporary teachers employed by BOM and therefore would go for greener pastures, get employed by TSC, change profession by going for further studies. Teachers who left schools would be replaced by new ones, mainly under BOM. 12.5% of the teachers were found to have an experience of between 6-10 years, while 25% had taught the subject for 11 years and above. The constant changing of teachers for the subject might have impacted negatively on the students' performance in Chemistry due to inconsistency in the teaching process. For example, it takes a long time for students in a candidate class to adjust to a new teacher introduced to them just a few months to the KCSE.

School category

The school category in question were extra county, county and Sub-county. In this research, Malava Boys represented extra county schools, Malava Girls county schools and Friends school Namanja secondary represented Sub county schools. From the Table 7, it's evident that there was very low performance in a sub county school, and very high performance in an extra county school. It was found out that the following were the reasons for poor performance in a sub county school.

1. Inadequate facilities

2. Low student-teacher ratio
3. Socio economic background of the learners.

Summary

Most of the specific factors listed under the objectives of the study were found to be having significant influence on the performance of students in Chemistry in KCSE. However, some factors were found to be more significant than others. Most of the responses from the students were in agreement with those teachers in a number of areas like availability of resources, attitude towards Chemistry and Revision for KCSE. No single factor was found to solely influence students' performance in chemistry without other factors. Therefore, the below average academic performance in the subject was due to an interaction of various factors as was postulated under the conceptual framework in chapter one of the project report.

Conclusion

It can be said that the majority of candidates in secondary schools in Kakamega North prefer Chemistry to other science subjects, as was evidenced by 60.0%, however, the performance in the subject was not satisfactory. Many factors hindered the student's quest for high academic achievement in the subject. The factors that were found to have significant negative influence in the students' performance in chemistry included.

1. Inadequate teachers
2. School category
3. Students' attitude towards the subject

The following factors found outside the specific objectives of the study were also found to contribute to the negative trend in Chemistry performance in KCSE

1. Late syllabus coverage
2. Wide chemistry syllabus (especially form 3 work)
3. Poor revision
4. Lack of exposure to examination techniques
5. Lack of teacher and student motivation
6. Lack of /dysfunctional study groups

Recommendations

From the study, it can be recommended that;

1. More teachers should be employed by the government to bridge the gap on manpower shortage
2. Students should be guided on the importance of chemistry to the society so as to improve on the attitude on the same
3. Chemistry should be taught and taken seriously in all schools regardless of the category of schools.
 - i. Principals should give priority to teaching /learning resources and ensure strict and full use of the vote head allocated to resources like Chemistry text books and laboratory facilities.
 - ii. Parents and guardians should appreciate the valuable study time spent by students while at home, hence ensure the following:

- iii. Proper lighting at home, using at least a lantern that doesn't interfere much with the health of the students
 - iv. Set aside (special) rooms for studies where noise and other forms of disturbance are minimized
 - v. Give the students lighter and less time consuming duties to avoid exhaustion and time wastage hence maximum concentration of the students in academic work
4. The government should facilitate the employment of more teachers to curb teacher shortage in the subject.
 5. Conduction of more in-service training to the teachers to equip them with the various effective methods of teaching Chemistry
 6. Giving of loans to untrained teachers so that they can pursue professional training and acquire the necessary skills needed in the teaching profession
 7. PA should organize fund raisings to get money to build facilities like laboratories and adequately stock them with necessary resources.
 8. Formation of strong and active chemistry study groups by students with the assistance of the teachers
 9. Motivation of teachers by head teachers using various methods at their disposals.

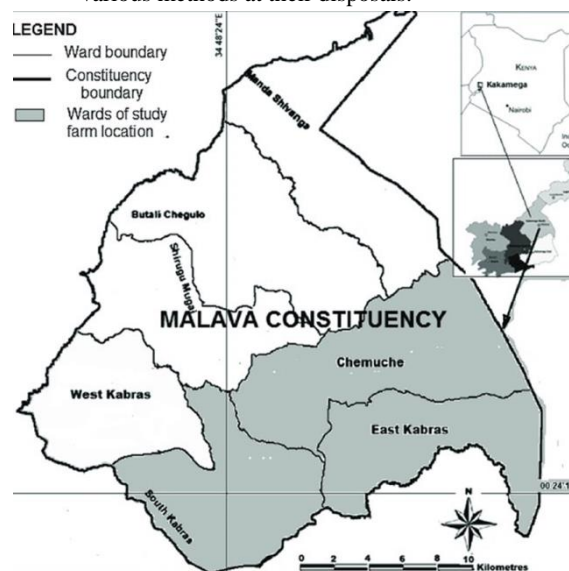


Figure 1. The Study area.

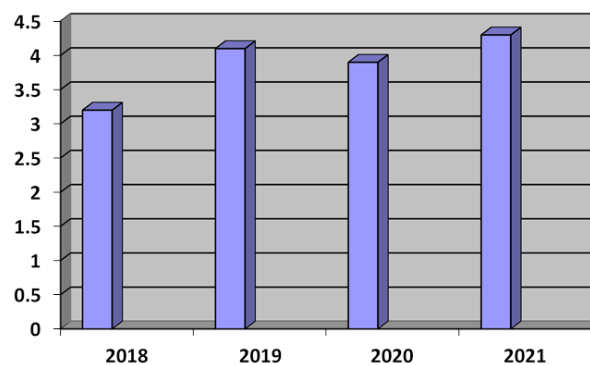


Figure 2. Showing mean scores in KCSE Chemistry in Malava Boys, Malava Girls and Namanja secondary schools (2018-2021).

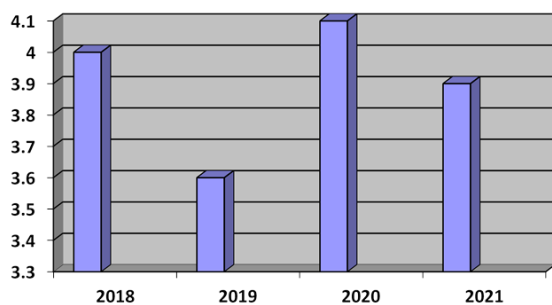


Figure 3. Showing mean scores in KCSE Chemistry in Malava Boys, Malava Girls and Namanja secondary schools (2018-2021).

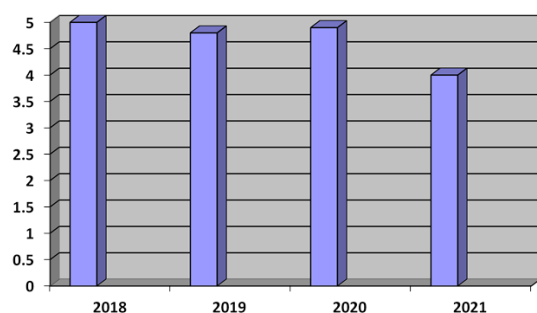


Figure 4. Showing mean scores in KCSE Chemistry in Malava Boys, Malava Girls and Namanja secondary schools (2018-2021)

Table 1. Distribution of study respondents.

School	Population size	Percentage	Sample size
Namanja secondary	200	40	150
Malava boys	200	40	150
Samitsi girls	100	20	80
Totals	500	100	380

Table 2. Students' preference of Chemistry to other science subjects and summary of the general performance in schools.

Preference of Chemistry	No. of students	Percentage	School	Mean grade in chemistry
1 st	300	60%	Namanja sec	D+
2 nd	150	30%	Malava boys	C
3 rd	50	10%	Samitsi girls	C-
TOTAL	500	100%		

Source: Data from the field.

Table 3. Data of students who scored "A" plain in Chemistry between 2018-2021.

	Namanja	Samitsi	Malava
2018	0	1	1
2019	0	2	3
2020	0	0	0
2021	0	3	5

Source: Data from the field.

Table 4. Showing how attitude affects the students' performance in chemistry (Students' views)

Response	No. of students	Percentage
Positive attitude	2	9%
Neutral attitude	4	18%
Negative attitude	16	73%
TOTAL	22	100%

Source: data from the field.

Table 5. Student teacher ratio in form four chemistry class.

School	Namanja	Malava	Samitsi
Student-teacher ratio	20:1	41:1	34:1

Table 6. Teacher experience

Experience	No. of teachers	Percentage
0-5 years	10	62.5%
6-10 years	2	12.5%
11 years and above	4	25

Table 7. The performance of chemistry in schools of different categories in the year 2021.

School	Mean grade In chemistry	Category of the school
Friends school namanja secondary	D+	Sub county
Malava Boys	C	Extra county
Samitsi Girls	C-	County

Source: Data from the field

REFERENCES

1. Ali T (2012). A Case Study of the Common Difficulties Experienced by High School Students in

- Chemistry Classroom in Gilgit-Baltistan (Pakistan), SAGE Open, vol. 2, pp 1-13, 2012.
2. Danit, M. B. (2016) Curricular Influences on College Students' Intellectual Development. *Journal of College Student Development*, 33 (3).
 3. Doppelt R. H., Cynthia, A.L., & Marie, D. C. (2016) Socio-emotional adjustment as a mediator of the association between exposure to community violence and academic performance in low-income adolescents; *Psychology of Violence*, 4 (3) 281-293.
 4. Doris (2020). Social-demographic, school, neighborhood, and parenting influences on the academic achievement of latino young adolescents. *Journal of youth and adolescence*, 2 (7).
 5. Higgins, J. W., Gaul, C., Gibbons, S., & Van Gyn, G. (2016) Factors influencing physical activity levels among Canadian youth. *Canadian Journal of Public Health*, 94(1), 45-51
 6. Hogg S. (2016). Factors contributing to the students' academic performance: A case study of islamia university sub-campus. *American journal of educational research*, 283-289.
 7. Horn, E.A. and Walberg, H. (1984). Achievement and Interest as Functions of Quantity and Level of Instruction. *Journal of Educational Research*. Vol 77, No. 4.
 8. Hofstein A, I. Eilks, and R. Bybee, "Societal Issues and Their Importance for Contemporary Science Education--A Pedagogical Justification and the State-of-the-Art in Israel, Germany, and the USA", *Int. J. Sci. Math. Educ*, vol. 9, pp 1459-83, 2011
 9. Inas Sausan, Sulisty Saputro, Nurma Yunita Indriyanti (2018). Chemistry for Beginners: What Makes Good and Bad Impression. Mathematics, Informatics, Science, and Education International Conference (MISEIC 2018) *Advances in Intelligent Systems Research (AISR)*, volume 157.
 10. Kenya National Bureau of Statistics (KNBS) (2019). Kenya Population and Housing Census: Volume II, Kenya National Bureau of Statistics. <http://www.knbs.or.ke>
 11. Matilde Lacambra-Malana (2020). Attitude and Level of Performance of Students in Chemistry. *International Journal of Psychosocial Rehabilitation*, Vol. 24, Issue 08, 2020 ISSN: 1475-7192.
 12. Mata R. E. (20119). Student achievement and cocurricular participation. *NASSP Bulletin*, 69(483), 17-20. Green (2019). Changes in college freshmen after participation in a student development program. *Journal of College Student Personnel*, 26, 310-314.
 13. Ministry of Education, Republic of Kenya (MOE, 2013). Basic Education No. 14 215. The Basic Education Act, 2013 No. 14 of 2013.
 14. Montenegro, J. (2018). Getting to know your students: The importance of learning students' thoughts and feelings in physical education. *Journal of Physical Education, Recreation & Dance*, 81(7), 42-49.
 15. OpenStax College Rice University (OCRU) (2015). Chemistry. OpenStax College Rice University production, 6100 Main Street MS-375 Houston, Texas 77005. © 2015 Rice University. <http://openstaxcollege.org>.
 16. Osokayo, (2003). Continuous Assessment in G.C. Unachukum (Ed.) *Methodology of Instructions*. Owerri; Totan Publishers Ltd.