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Learner and Environmental Factors Influencing Students' Academic Achievement in Chemistry in Public Day Secondary Schools in Nandi East Sub County Kenya

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ABTRACT
The study sought to establish the influence of learner characteristics on learners' academic achievement in Chemistry and to establish the extent to which the learning environment influence learners' academic achievement in chemistry in public day secondary schools in Nandi East Sub County. This study used Ex post facto research design. The study target population was 1164 students, 20 chemistry teachers, and 20 principals. A sample size of 18 public day secondary schools was selected for this study. A total of 255 learners were selected proportionately, to avoid biasness, eighteen chemistry teachers and 18 principals making a total of 255 respondents. Simple random sampling technique was used in selecting the learners who took part in the research. Purposive sampling technique was used when selecting the Chemistry teachers and the principal due to their role as teachers of Chemistry and administrative role respectively. A questionnaire, an interview schedule and a document analysis were the main instruments of data collection. Validity and reliability of these instruments was ascertained before the actual data collection in the field. This was done through piloting of questionnaire instruments in the neighbouring Nandi Central Sub County. Qualitative and quantitative data were collected in the selected Public Day Secondary Schools. The qualitative data was analysed using content analysis, while quantitative data was analysed using descriptive statistics and inferential statistics. Learner characteristics had a positive and significant effect on learners' academic achievement of (β=.828, $p < 0.05$) and learning environment had a positive and significant effect on learners' academic achievement of (β=.093, $p < 0.05$). The study further concluded that Learner characteristics and learning environment affects learners' academic achievement. Frequent practicals done, Charts, models and other teaching aids should be used during chemistry lessons because they enhance learners' academic achievement.
KEY WORDS: learner and environmental factors, influencing, student academic achievement.
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1.0 INTRODUCTION

1.1 Background of the study

Globally, Chemistry is one of the science subjects that play a significant role in learners' future career aspiration even as it is deemed a challenging course of study (Sirhan, 2007). In USA, Vilia et al. (2021) posit that most public schools had been recording an improvement in academic achievement of students in chemistry in the last one decade. Factors such as teacher characteristics affect learners' academic achievement in Chemistry. In India, Tanwar (2021) posits in both public and private secondary schools, there is a significant difference between students' academic achievement in chemistry and learner factors. The factors that influence learners' academic achievement in Chemistry in Public Day Secondary Schools include teacher characteristics, adequacy of teaching and learning resources and learner characteristics, learning environment among others.

In Nigeria, Akani (2020) opines that in secondary schools, Students 'academic achievement in Chemistry differs from one public school to the other. The academic achievement of students in Chemistry is some schools is high, while in other schools it is low in Ebonyi State. The scholar further posits that learners' academic achievement in Chemistry is influenced by adequacy of teaching, learner characteristics and learning environment. In Kenya, Alavi, and Hoseini (2022) opined that Chemistry is a curriculum whose academic achievement depends on learners' competencies such as making observations while doing experiments, and deriving innovations from its results and findings. Chemistry subject is one of the compulsory and a basic subject taught in Kenya secondary schools' curriculum, as it plays an important function in society. In this regard, a study in Chemistry is necessary for meeting our basic needs such as food, shelter, clothing, energy, health, clean air, water and soil. Through chemical technologies that emerge globally, the living standards of people can be improved and life challenges that arise from health, land, air and water as a result of use of materials and energy conversions can be solved. Study of chemistry also provides information about the universe we live in.

1.2 Statement of the Problem

From the foregoing background, it is noted that the mean score in percentage for learners in Chemistry in the country has been dropping from 26.88% in 2018, 26.09% in 2019 to 22.50% in 2020 and 21.01% in 2021. The previous academic achievement in Chemistry for the past five years in a row has remained below average. In Nandi County, and nationally, statistics from Kenya National Examination Council (KNEC) have indicated dismal performance. From the foregoing data in the background of the study, there is a worrying trend in dismal learners' academic achievement in Chemistry in KCSE in the 8-4-4 education system. This is an important study since it forms a foundation for learners' success in the 21st century especially in Science, Technology, Engineering and Mathematics (STEM) career orientation. Academic achievement in Chemistry is important as it might strengthen the coming Competence-Based Curriculum (CBC) in science subject. Academic achievement in Chemistry endows one with developmental skills drawn from science subjects which might help students to apply the competencies acquired to real-life situations. Therefore, there was need to establish the underlying factors that contribute to low academic achievement of Chemistry in Public Day Secondary Schools in Nandi East Sub County.

1.3 Purpose of the study

This study intended to investigate factors influencing learners' academic achievements in Chemistry in public day secondary schools in Nandi East Sub County as measured by mean score in Kenya Secondary Education Examination, (KCSE)

1.4 Objectives of the study

The objectives of this study were:

- To establish the influence of learner characteristics in learners' academic achievement in Chemistry in Public Day Secondary Schools in Nandi East Sub County.
- To establish the extent to which the learning environment influence learners' academic achievement in Chemistry in Public Day Secondary Schools in Nandi East Sub County.

1.5 Research Hypotheses

$H_0$1 There is no significant relationship between the learners' characteristics and the learners' academic achievement as measured by mean grade in Chemistry in KCSE.

H_a1 There is a significant relationship between the learner characteristics and the learners' academic achievement as measured by mean grade in Chemistry in KCSE

$H_0$2 There is no significant relationship between learning environment and the learners' academic achievement as measured by mean grade in Chemistry in KCSE.

H_a2 There is a significant relationship between learning environment and the learners' academic achievement as measured by mean grade in Chemistry in KCSE.

1.6 Significance of the study

Given the significance of Science, Technology, Engineering and Mathematics (STEM), this study helped generate information that may be used to make decisions for establishing and maintaining adequate teaching and learning resources for Chemistry and by extension STEM career aspiration. The study will provide knowledge that could be used to enhance teaching and learning process and environment. Additionally, the findings of this study will be published and the recommendation can be shared with parents, teachers and learners for future reference.

1.7 Limitation of the study

The study was limited in scope as it will focused on one sub-county in Nandi County and yet there are several sub-counties in Nandi County. However, part of the sampling techniques adopted were probabilistic sampling technique which helped to limit the level of bias and therefore, enhanced generalizability of the findings to other sub-counties in Nandi County, other Counties and public secondary schools around the world. Anxiety among the learners was noticed during the filling of the questionnaires, but, the researcher established a good rapport to reduce it.

1.8 Delimiation of the study

The research was carried out in selected Public Day Secondary Schools in Nandi East sub county, Kenya. Form

four students, chemistry teachers and principals from the selected schools were the respondents. Form four students were targeted because they are more exposed than other students and they comprehend well the factors that may affect their academic achievements in Chemistry in the year of examination. The study was guided by ex-post facto design

2.0 LITERATURE REVIEWED

2.1 Introduction:

This chapter deals with the reviewed literature on the following: the concept of academic achievement, learner characteristics and academic achievement and learning environment and academic achievement and theoretical framework.

2.2 Concept of Academic Achievement

Academic achievement refers to a standard in terms of grades assigned to Chemistry marks attained by a learner in an examination in Kenya; KCSE examination is done after completion of forth year coursework in the compulsory and selective subjects (Cherop, 2023). Therefore, the learners' mean grades show the intensity of knowledge and skills acquired while undertaking the secondary curriculum. According to, Simiyu (2019), learners' academic achievement refers to the KCSE mean grade attained by a learner in Chemistry subject.

2.3 Learner Factors and Academic Achievement

Attitude is a major factor affecting teaching and learning processes. General perception of a learner towards Chemistry indicates learners' readiness to pursue excellence in Chemistry. According to Halladyna, and Shaughness (2021) as referenced by Ogembo, Otunga, and Taki (2022), learner attitude is related to the following factors: teaching method, teachers' perception of the learner, parental background, age, gender, earning modes of a student, future aspirations and significance of Chemistry as perceived by the society. Langat (2021), observed that the learning outcomes of a learner improves with the value attached to Chemistry subject at individual level. However, several studies done in countries such as Brazil have found out that there is a high correlation between learners with good perception towards Chemistry and their Chemistry achievements. The study further concludes that high academic achievement can easily be attained as long as the learners develop positive attitude towards Chemistry subject (Diana, 2022). Gender of the student also has an impact on the learners' academic achievements in Chemistry. Bittok (2019) posits that female students had a more negative attitude towards the importance of Chemistry in their future work. This therefore shows that they will not try to learn and understand the meaning of Chemistry concepts that are being taught. The career choice of a learner in Chemistry influences the learners' academic achievements in Chemistry subject. A study carried out in Tanzania by Diana (2022), on the relationship between a career choice and student achievement found out that one's' career choice is greatly affected by their mean grade posted in Chemistry. In Kenya, a research was done in Trans-Nzoia County by Cherop (2023), on the relationship between students' career aspirations and student achievements in Chemistry, concluded that students' career aspiration is strongly connected to his or her academic achievements in Chemistry. Therefore, student academic achievement in Chemistry subject has an impact on their career choice later in life.There are other factors affecting student academic achievements. They include: distance from home and learners' socio-economic background. It is evident from previous studies that school location influences participation of learners in schools and subsequently in academic achievement (Ebinum, Akamagune, & Ugbong, 2020; Thapa, 2019; Getachew, 2022). Whereas learner's academic achievement may have been influenced by school location, other factors may also be responsible therefore the need to investigate. Currently Public day secondary institutions are encouraged to enrol learners with 300 marks and below out of 500 marks in KCPE. Hence there is need for value addition to the learner entry grades especially in KCSE. This study endeavours to investigate how these learner characteristics influences learner academic achievements in Chemistry.

2.4 Learning Environment and Academic Achievement

A study done by Adesoji and Olatunbosun (2022) as cited by Cherop (2023) in Nigeria revealed that the locality of the school, adequate practical sessions, teachers' perception towards Chemistry teaching and teacher's attendance have significant contribution towards greater academic achievements in Chemistry. Factors such as learner enrolment, number of subjects, subject combination workload, number of streams and teacher involvement in administrative work affects the teacher-student ratio. Better learning environment with adequate resources have been proved to have a positive effect on academic achievement among Kenyan primary school learners. It is evident that an instructor's contribution to their learners' mean grade in Chemistry. When students perceive that their teachers have a high expectation on their academic achievement, they tend to be motivated to perform best in the subject consequences these learners work extra hard to march their teachers' expectations. A study done in Alliance National secondary schools showed the magnitude in which learning environment affects

individual score of learners in a Kenyan context (Gitogo 2018). A supportive and enabling learning environment which exhibit a wide range of practical work in Chemistry subject enhance high academic achievement in Chemistry.

2.5 Theoretical Framework

Hull's Reinforcement theory by Hull (Siddiqui, 2011) guided this study. According to Hull, the need would produce behaviour and the particular behaviour that minimises the need would be learned gradually. Therefore, a reward or reinforcement is important in order to trigger the behaviour. Globally curricularists view globally indicates that learning, as a drive, can be demonstrated through behaviour hence the significance of student's behaviour in the teaching and learning processes as reinforcement for that behaviour, strengthening the connection between the drive and behaviour.

3.0 RESEARCH METHODOLOGY

3.1 Introduction

This section consists of research design of the study, target population, sampling procedure and sample size, research instruments, validity and reliability of the research instruments, and data analysis techniques.

3.2 Research design

The study was guided by ex post facto research design which attempts to determine the connection between an independent variable and dependent variable. The study examined how independent variable (factors) affects the dependent variable (the learners' academic achievement). Factors cannot be manipulated or altered; hence the choice of the ex post facto design looked at how a particular characteristic, trait or past occurrence affects the dependent variable, the learner academic achievement.

3.3 Target Population

The research took place in Nandi East Sub County, Nandi County, Kenya. Its neighbours Tindiret, Nandi Central, and Nandi North Sub Counties. The Sub County contains 20 public day schools; therefore, this study targeted 20 public day secondary schools consisting of 20 principals and 20 Chemistry teachers. Form four learners were targeted too, a total of 1160 learners in the 20 public day secondary schools, because they have learnt most of the content in Chemistry curriculum and experience the different factors which influence their academic performance. Hence the total target population was 1200 respondents

3.4 Sampling Procedures and Sample Size

Sampling involves the selection and analysis of part of the population. A sample size of 291 selected from 18 public day secondary schools in the 20 public day schools in Nandi East Sub County was used. A total of 255 learners were selected using proportionate sampling technique. The principal and one Chemistry teacher were purposively selected in the sampled schools due to their roles as administrative role and Chemistry teacher respectively. This was achieved using Yamane formula (Yamane, 1967) below and Krejcie & Morgan Sample Determination Table.

$$n = \frac{N}{1 + N(e)2}$$

Where;
n= sample size
N= Population size
e=level of precision of sampling error which is 0.08%
18=20/ (1+20(0.08)2)

3.5 Instrumentation

Questionnaires, interview guide and document analysis were the main tools for collecting data in this study. Learner questionnaires were structured into two parts. Part one involved items on learner background information, while part two highlighted items on; learner characteristics, learning environment, availability of teaching and learning resources and teacher characteristics. Chemistry teacher questionnaires was structured into two parts. Part one was used to collect data on teacher demographics and part two on variables such as learners' characteristics, learning environment, teacher characteristics, and availability of teaching and learning resources. A 5-point Likert scale was adopted and it was of the form '1' represented strongly disagree while 5 represented strongly agree. Moreover, an interview schedule based on the four objectives and other probing questions was used to collect data from the selected school principal. KCSE results document analysis template was used to collect learners' KCSE grades in Chemistry for the past five years.

3.6 Instrument Validity

The study adopted content validity which was tested using experts' opinion. The supervisors' opinions were used to improve on the contents of the research instruments. For validity of the research instruments to be tested, a pilot study was conducted in the neighbouring Nandi Central Sub County. The feedback from the respondents was used to improve on the accuracy status for the questionnaire's items. The supervisor confirmed that the instruments used captured the information required. The essence of content validity was to confirm the accuracy of the instruments (Best & Kahn, 2019).

3.7 Instrument Reliability

In every research, determination of instrument reliability reflects the strength or weakness of the research. The reliability test for questionnaire items was determined by split-half technique of the item in a pilot study and then ascertained that there is no contradiction in the responses given (Wanjala, 2021). If the reliability is between -1 and 1, then there is a high correlation and, in this regard, the instrument is reliable for use. As shown in Table 3.1, the composite Cronbach alpha was .743 for the learner's questionnaire and 0.749 for the teacher's questionnaire which implied that the questionnaires were reliable.

3.8 Data analysis techniques

Data from questionnaires which is quantitative was analysed using both descriptive statistics and inferential statistics. The descriptive statistics adopted include frequencies, percentages, mean and standard deviation. The inferential statistic adopted was multiple regression analysis.

4.0 FINDINGS AND DISCUSSION

4.1 Learner factors and academic achievement

The first objective was to establish the influence of learner characteristics on learners' academic achievement in Chemistry in Public Day Secondary Schools in Nandi East Sub County. Two sets of questionnaires were also used to collect data on learner characteristics. Findings were presented in the Table below. The study sought to determine whether the learners enjoyed learning Chemistry and this favourably influenced their academic achievement in Chemistry, 126 (60.9%) strongly agreed, 35 (16.9%) agreed, 17 (8.2%) were not sure, 16 (7.7%) disagreed while 13 (6.3%) strongly disagreed. Enjoying learning Chemistry was further established to affect learners' academic achievement with (mean= 1.8164, std. Dev. = 1.24055). Findings resemble that of Ogembo et al. (2022) that enjoying learning Chemistry affects learners' academic achievement. In regards to whether since Chemistry is a difficult subject, the respondents do not perform in School, 31 (15.0%) strongly agreed, 62 (30.0%) agreed, 17 (8.2%) not sure, 55 (26.6%) disagreed while 42 (20.3%) strongly disagreed. Difficulty of Chemistry was further established to affect learners' academic achievement with (mean= 3.0725, std. Dev. = 1.40718). Findings resemble that of Langat (2020) that difficulty of Chemistry affects learners' academic achievement.

Table 1: Learner's responses on Learner factors

n=207		SA	A	NS	D	SD	Mean	Std. Dev
23. I enjoy learning Chemistry and this favourably influence my academic achievement in Chemistry	F	126	35	17	16	13	1.8164	1.24055
	%	60.9	16.9	8.2	7.7	6.3		
24. Since Chemistry is a difficult subject, I do not perform in School.	F	31	62	17	55	42	3.0725	1.40718
	%	15.0	30.0	8.2	26.6	20.3		
25. Since Chemistry is useful in my future career, I will perform favourably in KCSE.	F	65	58	16	39	29	2.5604	1.44980
	%	31.4	28.0	7.7	18.8	14.0		
26. Chemistry is not useful in my future career.	F	35	65	29	30	48	2.9565	1.43907
	%	16.9	31.4	14.0	14.5	23.2		
27. My favourable KCPE performance in science contributes to high academic achievement in Chemistry in KCSE examinations.	F	51	63	29	34	30	2.6570	1.38761
	%	24.6	30.4	14.0	16.4	14.5		
28. My low KCPE grade in science negatively influence my academic achievement in Chemistry in KCSE examinations.	F	47	72	16	30	42	2.7488	1.46966
	%	22.7	34.8	7.7	14.5	20.3		

4.2 Learning Environment and Academic Achievement

The second objective sought to establish the extent to which the learning environment influence learners' academic achievement in Chemistry in Public Day Secondary Schools in Nandi East Sub County. Two sets of questionnaires were used to collect data on Learning Environment and how it affects learners' academic achievement in chemistry. Findings were presented in the table below. The study sought from the learners whether spacious classrooms in their school contribute to high academic achievement in Chemistry in KCSE, 26 (12.6%) strongly agreed, 17 (8.2%) agreed, 17 (8.2%) were not sure, 44 (21.3%) disagreed while 103 (49.8%) strongly disagreed. Spacious classrooms in the school were further established to affect learners' academic achievement with (mean= 3.8744, std. Dev. = 1. 42572). The study is in agreement with that of Adesoji and Olatunbosun (2022) that spacious classrooms in the school affects learners' academic achievement.

Table 2: Learner's responses on Learning Environment

n=207		SA	A	NS	D	SD	Mean	Std. Dev
29. Spacious classrooms in our school contributes to high academic achievement in Chemistry in KCSE.	F	26	17	17	44	103	3.8744	1.42572
	%	12.6	8.2	8.2	21.3	49.8		
30. Inadequate classrooms in our school contributes to low learners' academic achievement in Chemistry in KCSE.	F	39	37	16	76	39	3.1884	1.42388
	%	18.8	17.9	7.7	36.7	18.8		
31. Adequate Chemistry teacher-student ratio (1:40) in our school contributes to high academic achievement in Chemistry in KCSE.	F	33	50	14	55	55	3.2367	1.47042
	%	15.9	24.2	6.8	26.6	26.6		
32. Inadequate Chemistry teacher-student ratio (1:50 and more) in my school contributes to low academic achievement among learners.	F	72	30	33	42	30	2.6522	1.48611
	%	34.8	14.5	15.9	20.3	14.5		
33. Practical's when frequently done during Chemistry lessons favourably influence learners' academic achievement in KCSE.	F	42	123	17	13	12	2.1787	1.01538
	%	20.3	59.4	8.2	6.3	5.8		
34. Practical's when rarely done during Chemistry lessons negatively influence learners' academic achievement in KCSE.	F	129	33	16	16	13	1.7971	1.24143
	%	62.3	15.9	7.7	7.7	6.5		

In regards to whether inadequate classrooms in the school contribute to low learners' academic achievement in Chemistry in KCSE, 39(18.8%) strongly agreed, 37(17.9%) agreed, 16(7.7%) not sure, 76(36.7%) disagreed while 39(18.8%) strongly disagreed. Inadequate classrooms in the school was further established to affect learners' academic achievement with (mean= 3.1884, std. Dev. = 1. 42388). Findings resemble that of Gitogo (2018) that in adequate classrooms in the school affects learners' academic achievement.

4.3 Conclusion

On learner characteristics, the study concluded that learner characteristics enhances learners' academic achievement in Chemistry in Public Day Secondary Schools. Enjoying learning Chemistry enhances learners' academic achievement in chemistry in KCSE. Chemistry affects learners' academic achievement. Usefulness of Chemistry in the future career affects learners' academic achievement and KCPE performance in science influences learners' academic achievement. When KCPE grade in science is low, it affects learners' academic achievement.

On learning environment, the study concluded that learning environment influences learners' academic achievement in Chemistry in Public Day Secondary Schools. When the classrooms are spacious, it affects learners' academic achievement. Inadequacy of classrooms in theschool affects learners' academic achievement. Learners perform better in Chemistry when the schools have adequate Chemistry teacher-student ratio (1:40). Learners' academic achievement improves when practicals are done frequently during Chemistry lessons.

4.4 Recommendation

On learner characteristics, the study recommended that Learners should enjoy learning Chemistry for them to record an improvement in learners' academic achievement in Chemistry in KCSE. The learners should consider the usefulness of Chemistry in their future career because it affects their career aspirations.

On learning environment, the study recommended that classrooms in schools should be spacious, and adequate. Schools should have adequate chemistry teacher-student ratio (1:40). The practicals should be done frequently during Chemistry lessons.

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