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Laboratory Adequacy and Chemistry Performance in Kisses Sub-County Secondary Schools, Uasin Gishu County Kenya

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Abstract: It has been observed that the general poor performance in science subjects is due to inadequate laboratory resources. This was an expository study to investigate laboratory adequacy and performance in secondary school Chemistry in Kesses Sub-County. The aim of the study was to determine how laboratory adequacy affects chemistry performance. The study assumed that the K.C.S.E performance was a true reflection of the effect of laboratory adequacy in chemistry. This study was guided by constructivist theory attributed to Jean Piaget. A sample of 30 percent of the target population was used to conduct the study. The students were involved through questionnaires while an inventory checklist for laboratory apparatus and reagents was filled by laboratory assistant/Chemistry teacher. The D.O.S also provided school means for K.C.S.E chemistry performance for three consecutive years: 2014, 2015 and 2016. Analysis of data was done using descriptive statistics. A correlation between laboratory adequacy and performance of chemistry was computed using Pearson product moment coefficient which gave an index of +0.973. A t-independent test for two sample means was used to test the hypothesis. The study established that most schools in Kesses Sub-County had general laboratories, few of them had no laboratories at all and yet some of those with specific and sufficiently equipped modern laboratories underutilized them. Consequently, the study recommends that the Ministry of Education should set up minimum laboratory resource requirements for any school to be allowed to offer pure chemistry at K.C.S.E level. Teachers' Service Commission should also consider employing laboratory assistants since this would go a long way in helping teachers in planning and organizing regular practicals.

Keywords: Laboratory Adequacy, Chemistry, Performance, K.C.S.E

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I. BACKGROUND INFORMATION

The primary purpose of education is to bring about a desirable change in behaviour through acquisition of skills, attitudes, competencies, critical and creative thinking. However, students' learning outcome is influenced by appropriate utilization of the school resources. Investing in school resources is therefore key to ensuring that schools become institutions where students work together, learn from each other and benefit from a supportive environment, and consequently maximize learning so that all can achieve their full potential (UNESCO, 2007).

According to Adesoji (2008), chemistry teaching is supposed to be result oriented and student centered. Students by nature are curious, they need to be actively involved in learning process in which they are continuously equipping, testing, speculating and building their own personal construct and knowledge. This

study argues that it is by personalizing such knowledge that it becomes valid, meaningful and useful to them Abayomi and Olukayode (2006), add that resources like laboratory in schools are important in education because learning takes place best through discovery, exploration and interaction with environments. The study therefore concurs with what has been observed that adequacy of the physical resources and teaching materials as well as their effective utilization has been a matter of serious concern to the educators.

Statement of the Problem

Abdul-Kareem (1989), observes in his study that, availability and utilization of the school laboratory resources determine the efficiency of the school in the teaching and learning of chemistry. Thus in order to ensure students' success, Chemistry teachers requires adequate laboratory resources. Consequently, this study assessed the adequacy of the chemistry laboratory relative to the teaching of Chemistry.

Objective of the Study
To evaluate the effect of laboratory adequacy on chemistry performance in K.C.S.E. examination.

II. LITERATURE REVIEW

Introduction

Chemistry has been identified as a very important science subject. It was as a result of recognition given to chemistry in the development of the individual and the nation that it was made a core subject among the sciences in secondary schools in Kenya (Adesoji, 2008).

Laboratory Adequacy

Eshiet (1996) holds that the adequacy of laboratory facilities makes teaching of chemistry concrete and stimulating. Lagoke (1997) adds that science education needs to be build on the knowledge and skills acquired by the learner so that students can understand the scientific principles, laws and theories. Moreover, Abuseji (2007) recommends practicals as an integral part of the subject.

Chemistry is a subject that involves a lot of demonstrations and can only be effectively taught in the laboratory for easy access to instructional materials. However, most schools in Nigeria lacked the essential facility (Edomwonyi-Otu & Avaa, 2011).Moreover Ngure (2013), observed that despite the teaching learning resources being available in most schools and being properly utilized, laboratories are inadequate therefore recommends for allocation of more funds to equip them. Certainly, resources such as the laboratory stimulate students learning as well as motivating them.

The Role of Science Laboratory

Laboratory is an ideal environment for both active and cooperative learning (Hass, 2000). Hass explains that active engagement in laboratory exercise promotes understanding of the concepts. Moreover, a further enhancement of the laboratory can be gained by encouraging students to interact with each other during the practical activity process. Hass adds that experiments in the laboratory help students understand concepts and also increase their ability to solve problems.

Raw (2003) adds that appropriate utilization of resources in schools controls dropout rates, maintains student discipline and makes students remain motivated for longer periods. Indeed according to Raw, these resources should be provided in quality and quantity in schools for effective teaching-learning process.

Relative to the role of the Science laboratory in teaching and learning process, Omiko (2007) listed five groups of educational objectives that may be achieved through the use of the laboratory in science teaching and these are:

i. Skills: manipulative skills, inquiry skills, investigative skills, organizational skills and communicative skills.
ii. Concept of mastery: for example, hypothesis, theoretical model, taxonomic category.
iii. Development of cognitive abilities: critical thinking, problem solving, application, analysis, synthesis.
iv. Understanding the nature of science – scientific enterprises, scientists and how they work, existence of a multiplicity of scientific methods, inter-relationships between science and technology and among the various disciplines of science.
v. Development of scientific attitudes: For example, curiosity, interest, risk taking, objectivity, precision, confidence, perseverance, satisfaction, responsibility, consensus, collaboration, and liking science.

Omiko further gives eight (8) aspects of scientific attitudes that exist and can be nurtured in the science laboratory in the school. They include; curiosity, open mindedness, objectivity, intellectual honesty, rationality, willingness to suspend judgment, humility and reverence for life. Moreover Ojimba (2013) elaborate that students learn more from scientific lessons when they are given opportunity to learn through doing work themselves than when they are simply allowed to watch.

In addition, Omike (2015) and Ufondu (2009) concur in their observation that laboratory teaching is sometimes used in conjunction with large lecture courses so that students may acquire technical skills and apply concepts and theories presented in the lecture. In addition they observed that the use of the laboratory in science teaching has the following benefits:

(a) Laboratory teaching makes the students/learners to learn about the nature of science and technology in order to foster the knowledge of human enterprise of science and this enhances the aesthetic and intellectual understanding of the child.

(b) Learning scientific inquiry skills that can be transferred to other spheres of problem solving that are acquisition of problem solving skills.

(c) Students learning to appreciate and in fact, emulate the role of the scientist through acquisition of manipulative skills.

(d) Developing interests, attitudes and values by considering what science entails, it is clear that a field experience has the best potential for stimulating a life time interest in science in the students when accorded the chance for personal experience by handling the real thing. This further increases students' interest in science as they yearn to investigate and explore more about their environment.

Omike further adds that laboratory instruction is considered essential because it provides training in observation, supplies detailed information, and arouses pupil's interest. Omike goes further to say that developing and teaching in an effective laboratory requires as much skill, creativity, and hard work as proposing and executing a first-rate research project.

Omike (2015) also listed the following number of possible goals that can be achieved through a developed laboratory programme:

(a) Develop intuition and deepen understanding of concepts
(b) Apply concept learned in class to new situations
(c) Experience basic phenomena
(d) Develop experimental and data analysis skills
(e) Learn to use scientific apparatus
(f) Learn to estimate statistical error and recognize systematic errors
(g) Develop reporting skills (written and oral).

Consequently, in order for the laboratory to be effective, students need to understand not only how to do the experiments, but also why the experiment is worth doing, and what purpose it serves for better understanding of a concept, relation, or process.

Laboratory Adequacy and Student's Performance

Dan-Azuma (cited in Donelly,1998), laments on students poor performance in chemistry, stating that one of the most repeatedly mentioned problem causing poor performance in the subject is lack of resources like equipments and materials to conduct practicals. Similarly, according to Festus and Ekpete (2012), in order to solve chemistry problems in an acceptable manner, the problem solver must have conceptual, scientific and procedural knowledge. Again, Jimoh (2002) points out that the use of laboratory activities outweighs other methods of teaching science. This is to mean that the efficacy of frequency of practical teaching to unravel the mystery behind perception of chemistry concepts is not in doubt. Jimoh further adds that the frequency of practical classes is also an important school factor since scientific process skills such as observation and prediction involves 'doing' and doing means practical activity. As a result it is assumed that frequent use of laboratory for practical lessons by the teacher can translate chemical knowledge to the understanding of scientific facts, laws and theories.

Adeyemi (2008) explains that a laboratory is a critical variable in determining the quality of output from secondary schools. As a result schools with laboratories perform better in examinations. Adeyemi further adds that shortage of laboratory facilities could have serious implication on the quality of schools output. Therefore inadequate provision of science laboratory and equipment in secondary schools has significant relationship with quality of output.

III. RESEARCH DESIGN AND METHODOLOGY

Introduction

This chapter presents the background of the study area, study design and sampling procedures. It also looks at data collection, procedures, data analysis and ethical considerations.

Location of the Study

The study area was Kesses Sub-County, Uasin Gishu County, Kenya (Appendices 10a and 10b)..

Table 1: Summary of area, Locations and Sub-locations in Kesses Sub County

Constituency	Area (sq. km)	Locations	Sub locations
Kesses	299.0	4	15
Kapseret	451.0	5	26
TOTAL	750	9	41

Source: (G.O.K CBS 2008-2012)

Education Indicators

The sub county has several secondary schools and primary schools as well as tertiary level colleges and universities. Higher level of institutions of learning in Kesses include: Moi University, Catholic university of East Africa (GABA), Eldoret polytechnic, among others. The table below gives a summary of schools in the region.

Table 2: The Number of Learning Institutions in Kesses

Primary schools	Secondary schools	Tertiary colleges	Universities
150	60	5	2

Study Design

The study design adopted is quantitative research designs which comprising of correlation approach. Data analysis was done by use of correlation coefficient to determine the strength of relationship between variables and to evaluate the effect of laboratory adequacy on performance in K.C.S.E Chemistry examination as suggested by Mugenda & Mugenda (2003).

Target Population

The target population comprised of all the form three's and form four's students in all the secondary schools in Kesses Sub County. This is because they have stayed long in school hence having appropriate information and while their content involves more practical work.

Sampling Procedure

The study used stratified random sampling to identify the schools from the various categories. The secondary school categories included; boys, girls and mixed. Simple random sampling was then used to pick the schools and participants from the various categories.

Sample Size of the Study

Kothari (2003) says a sample of 30% is appropriate and can produce generalizable findings. The study therefore derived a 30% of each of the categories of the target population as shown in the table below:

Table 3: **Showing the Target and Sample Population**

School Category	Number of schools	Target Population	Sample population
Boys Sec. Schools	4	400	120
Girls Sec. Schools	4	400	120
Mixed Sec. Schools	45	4500	1350
Total	53	5300	1590

DATA COLLECTION TOOLS

Questionnaires

The researcher developed and used two questionnaires. The first questionnaire was administered to the students. This research instrument was in two parts; section A, which solicited the bio data of the respondent while section B comprised of 10 items presented in a Likert scale.

Supplementary Questionnaire

The second questionnaire had six items whose responses were used to supplement responses by the students; this questionnaire was administered to Chemistry teachers only.

Chemistry Laboratory Inventory Checklist

An inventory checklist was developed to capture data on available basic apparatus and reagents in the chemistry laboratory. The data obtained were used to establish the level of laboratory adequacy.

K.C.S.E Chemistry Results Capture Form `

A form was designed to capture the scores, grades and school means for K.C.S.E chemistry performance for three consecutive years: 2014, 2015 and 2016. These scores were used to categorize the sampled schools into high performing and low performing for the purpose of correlation between laboratory adequacy and Chemistry performance.

VALIDITY AND RELIABILITY OF RESEARCH TOOLS

Validity of the Tools

In-depth study was carried out on available relevant questionnaires on the area of study. Items elicited from the review were adapted and refined in consultation with research supervisors from the University of Eldoret.

Reliability of the Tools

Mugenda and Mugenda (2003), define reliability as a measure of consistency in which the instrument will measure. This study concurs with Mugenda and Mugenda (2003), and adopted test -retest method to ascertain the reliability of the tools.

Piloting of the Research Tool

Test-retest method was used to ascertain the capacity of the research instrument to produce consistent results. Three schools with same characteristics with target population were visited and the tool administered. The instrument was re-administered after two weeks. The administration scores were manually computed using Pearson Product Moment Correlation Coefficient which yielded an index of 0.77.

Data Collection Procedure

Questionnaires were administered carefully to the sampled students. The respective Directors of Studies (D.O.S) were requested to fill the K.C.S.E Chemistry results capture form. Finally the laboratory assistant/ chemistry teacher was requested to fill the chemistry laboratory checklist.

Data Analysis

The structured Likert scale questionnaires from the selected schools were scored. Hypothesis testing was then computed using t-independent test for two sample means.

Ethical Considerations

The relevant authorities were contacted and research authorization was obtained while all protocol was observed in conducting the research.

HYPOTHESIS TESTING

The null hypothesis stated that laboratory adequacy had no significant influence on chemistry performance in K.C.S.E.

In computing a correlation of scores from responses of high performing against low performing schools, a t-test for independent two samples where variance was assumed unequal was used. The computation realized a t_3 – value of +3.3958 which was compared against a critical value of $\pm$ 2.262. Since +3.3958 occurred on the rejection region of a normal distribution curve, the null hypothesis was rejected. The level of significance for the computation stood at $\propto$ =0.05. Hence there was sufficient evidence to support the claim in the third hypothesis that laboratory adequacy has a significant influence on chemistry performance in K.C.S.E examination. This claim is also supported by the tabulated data in Table 4 below.

Table4 shows from the first statement that stated, 'Chemistry practicals play an important role in my understanding of chemistry'. To this statement, 48% of the respondents from the H.P category strongly agreed with, another 24% agreed, and 7% were undecided while 21% disagreed. This fairly contrasts with the respondents from the H.P category where 32% strongly agreed with the statement, while 19% agreed. Five percent were non-committal while a significant percentage, 44% disagreed with the statement. The study attributes this to the latter scenario, that is, inadequate laboratory equipment has made the learners uncertain on the role of practicals in chemistry performance

The second statement, 'Chemistry practicals make chemistry a difficult subject', contrasted the first statement. The responses to this statement reaffirm those of the earlier statement. Indeed, an average of 78.5% of the entire sample population (high performing and low performing schools) disagreed with the statement while 17% agreed and only 5.5% were undecided. To the study, these responses serve to reinforce the study hypothesis.

Further, many respondents from the two categories agreed with the 3rd statement that 'Chemistry practicals make learning of Chemistry enjoyable'. In fact, a total of 79% of respondents from H.P category agreed which compares well to 71% from the L.P category, while 4% from H.P disagreed with statement against 5% from theHowever, a significant number of the respondents remained none committal with 17% and 21% from the H.P schools and L.P schools respectively remaining undecided.

On the application of the knowledge acquired from chemistry practicals, the 4th statement, 'Chemistry practicals help me understand many natural phenomena associated with chemistry' was provided. On this statement, an average of 30% of the total sample, from H.P schools and L.P schools, agreed with the statement while 47.5% disagreed with the statement. A significant number, 22.5%, of the total sample from H.P schools and L.P schools, also remained undecided. From these responses, it is apparent that the learners could not be able to adequately link chemistry practicals to the real life situations. Marginal differences were however observed between the responses from the H.P and L.P categories.

Similarly to determine the efficacy of laboratory adequacy on students' performance, the 5th statement was provided, 'Chemistry practicals equip me with better skills in answering chemistry questions'. Mixed responses were observed with only 35 % of the respondents from the H.P category agreeing against 25% from the L.P category. However, a significant number of the respondents from the two categories remained non-committal where 19% and 26% from the H.P and L.P categories respectively remaining undecided. From the H.P category, 46% disagreed with the statement, while 49% from L.P category also disagreed.

Moreover, a large number of the respondents from both categories agreed with the 6th statement that, 'Chemistry practicals enable me understand concepts clearly'. A total of 87% of respondents from the H.P category agreed with the statement against 81% from the L.P category, while 13% of the respondents from each of the two categories disagreed with the statement. None of the respondents from the H.P category was undecided while 6% of the respondents from the L.P category were undecided.

A big variation was observed between the two groups (HP and LP categories) on the responses to the 7th statement, 'We always have sufficient laboratory equipment for our chemistry practicals' where majority of the respondents, 63%, from the H.P category agreed with the statement compared to only 24% from the L.P category. On the other hand, only 26% of the respondents from the H.P category disagreed compared to their counterparts from the L.P category where 64% disagreed.

The data from the 7th statement correlated well with those of the 8th statement linking laboratory adequacy to performance, 'Lack of sufficient laboratory resources in our school affects my performance in chemistry negatively'. To this, 78% of the respondents from the L.P category concurred with the statement, compared to only 23% from the H.P category. It is also important to note that 23% of the respondents from the H.P schools were undecided while 54% disagreed with the statement.

Table 4: Distribution of Subject Responses Based on Questions for H0$_3$

Code	SA	A	U	D	SD
1H.P	382(48%)	191(24%)	56(7%)	103(13%)	64(8%)
L.P	254(32%)	151(19%)	40(5%)	215(27%)	135(17%)
2H.P	56(7%)	87(11%)	16(2%)	246(31%)	390(49%)
L.P	40(5%)	87(11%)	72(9%)	310(39%)	302(38%)
3H.P	382(48%)	246(31%)	135(17%)	32(4%)	0(0%)
L.P	342(43%)	223(28%)	167(21%)	40(5%)	24(3%)
4H.P	119(15%)	191(24%)	103(13%)	167(21%)	215(27%)
L.P	143(18%)	95(12%)	159(20%)	191(24%)	207(26%)
5H.P	87(11%)	191(24%)	151(19%)	215(27%)	151(19%)
L.P	48(6%)	151(19%)	207(26%)	223(28%)	167(21%)
6H.P	453(57%)	239(30%	0(0%)	72(9%)	32 (4%)
L.P	366(46%)	278(35%)	48(6%)	40(5%)	64(8%)
7H.P	167(21%)	334(42%)	87(11%)	135(17%)	72(9%)
L.P	48(6%)	143(18%)	95(12%)	246(31%)	262(33%)
8H.P	87(11%)	95(12%)	183(23%)	262(33%)	167(21%)
L.P	588(74%)	32(4%)	32(4%)	87(11%)	56(7%)
9H.P	0(0%)	32(4%)	64(8%)	294(37%)	405(51%)
L.P	191(24%)	135(17%)	111(14%)	215(27%)	143(18%)
10H.P	389(49%)	294(37%)	24(3%)	56(7%)	32(4%)
L.P	326(41%)	223(28%)	80(10%)	111(14%)	56(7%)

H.P – high performing **L.P** – low performing **n** = 795
SA – Strongly Agree, **A** – Agree, **U** – Undecided, **D** – Disagree, **SD** – Strongly Disagree

L.P- schools.

Again, a significant variation in responses from students in the H.P and L.P categories was observed when given the 9th statement, 'Lack of chemistry practical lessons does not affect my performance in Chemistry'. A total of 88% of the students from H.P category disagreed with the statement against 45% from the L.P category. Only 4% of the students from the H.P category agreed with the statement compared to 41% from L.P category. Similarly, only 8% of the students from H.P category remained undecided compared to 14% from the L.P category.

Lastly, indeed, equipping chemistry laboratories in schools is paramount if learners are to perform well. This is supported by the data received from the statement, 'I can only perform well in chemistry if I do many chemistry practicals'. To this statement, 86% of respondents from the H.P category agreed while 69% from the L.P category also agreed. Consequently, laboratories should be sufficiently equipped and the resources prudently used for good grades to be realized in chemistry examinations.

Relationship Between Laboratory Adequacy and Performance

To establish laboratory adequacy, several factors were considered: type of chemistry laboratory in the sampled schools, presence or absence of a laboratory assistant and basic requirements necessary for optimal chemistry performance. In regard, a total of 42 basic laboratory apparatus were identified. A checklist of laboratory apparatus was provided to the schools where laboratory assistant/ chemistry teachers indicated the available apparatus and their quantities.

In order to compute the correlation between laboratory adequacy and performance, the following criteria were used to assign scores for the laboratory adequacy:

i. a) Availability of a specific laboratory in the school – 10 points
ii. b) Availability of a science laboratory in the school – 5 points
iii. c) Lack of laboratory in the school – 0 points
a) Presence of a laboratory assistant in the school – 6 points
b) Lack of a laboratory assistant in the school – 0 points laboratory adequacy;
availability of at least 10 items of the identified basic apparatus; a maximum of 2 points each for 42 items = 84 points
below 10 items of the identified basic apparatus = 1 points
Lack of the identified basic apparatus = 0 points.

A well endowed school based on the above criteria would score a maximum of 100 points. On the other hand, a school that did not possess any factor considered a prerequisite for laboratory adequacy scored zero points. The scores received from the schools based on these criteria were correlated against average scores received from the schools K.C.S.E in the past three consecutive years. For ease of computation, the average scores were converted into percentages using the formula $\frac{x}{12} \times 100$ where x is the average mean for each school, while 12 equal the maximum score. The data obtained are represented in table 5 together with subsequent computation of correlation coefficient using Pearson product moment correlation coefficient formula:

$$\gamma xy = \frac{n \sum xy - \sum x \sum y}{\sqrt{[n \sum x^2 \ - (\sum x)^2][n \sum y^2 \ - (\sum y)^2]}}$$

Table 5: Correlation of Laboratory Adequacy and Performance Scores

Schools	**X**	**Y**	**Xy**	**x^2**	**y^2**
A	100	72	7200	10000	5184
B	74	50	3700	5476	2500
C	46	40	1840	2116	1600
D	40	37	1480	1600	1369
E	25	32	800	625	1024
V	24	28	672	576	784
W	23	26	598	529	676
X	19	18	342	361	324
Y	10	10	100	100	100
Z	10	11	110	100	121
n=10	$\sum 371$	$\sum 324$	$\sum 16842$	$\sum 21483$	$\sum 13682$

Computation of data:

γxy =

$$\frac{(10 \times 16842) - (371 \times 324)}{\sqrt{[(10 \times 21483) - (371)^2][(10 \times 13682) - (324)^2]}}$$

= $\frac{\mathbf{48216}}{49578.29}$

= 0.973

From the computation, it is evident that there is a very strong positive correlation of 0.973 between laboratory adequacy and performance. Consequently, laboratory adequacy is a prerequisite to good performance in chemistry at K.C.S.E level.

IV. DISCUSSION

Student's Interaction with Laboratory Resources

The frequency of the students' interaction with laboratory resources in the teaching and learning of the chemistry is critical if good performance is to be realized in K.C.S.E. In affirmation of this claim, learners from high performing category unanimously agreed (89%) with first assertion that they carried out chemistry practicals often. On the contrary only 12% from the low performing category agreed with the statement compared to 81% who disagreed. This correlates well with the performance index obtained from K.C.S.E results (table 4) and may help explain the variation in performance between the two categories. The need to expose learners to hands on participation during chemistry practicals was also tested in the 2nd statement. Significant differences in responses were observed with 81% of the learners from the H.P category compared to 35% from the L.P category agreeing to the statement that 'Our teacher organizes practical lessons for our class regularly.' Indeed, 68% of learners from L.P category disagreed with the statement.

Mixed reactions were observed in students' response to the statement 'I need to do more chemistry practicals.' From the H.P category, 56% of the respondents agreed with the statement, while 39% disagreed with the statement. Thus, although the students did not think doing chemistry practicals was a waste of time, a significant number was not certain if they needed more practical sessions than they already had. It is likely that they thought what they already had was adequate; nevertheless, a significant majority thought they needed more practicals from the H.P category. On the other hand, only 44% of the students from the L.P category agreed with the statement while another 47% disagreed with the statement and 9% were undecided. Consequently, 56% of the students from the L.P category did not see the need the need for more practicals.

To this study, these findings may imply that learners from the L.P category were disillusioned and were not clear on the role of practicals in their conceptualization of learning content in chemistry. It is thus the contention of this study that adequate exposure of learners to chemistry practicals prompts their realization of the role of practicals in understanding and performance in K.C.S.E.

Indeed, in one of the best performing schools included in the study, a chemistry teacher was observed to be overtly passionate about the teaching of chemistry particularly the practical aspect of the subject. The teacher explained that many chemistry practical lessons were organized during the weekends thus increasing the frequency of learners' interaction with laboratory resources to enhance their competencies, which resulted in extremely good grades in the subject; an average mean of 8.63, equivalent to grade B.

In another well performing school, the chemistry teacher was found organizing a practical session after school hours in a day school. Consequently, it became apparent that the official scheduled practical lessons may not be sufficient for learners to attain quality grades in chemistry. Thus the study suggests that more chemistry practical sessions are a prerequisite to good performance. From the research, the study disclosed that no low performing school reported extra practical lessons for chemistry.

The study further revealed that teachers from schools under the H.P category also employed creative and innovative ways of teaching chemistry which included intra and inter- group learning in school. For instance a chemistry teacher in the best performing school organized several inter-school chemistry practical competitions which endeared students to chemistry as a subject thereby dramatically changing their attitudes towards the subject. This resulted in excellent performance.

The study therefore concludes that for better performance, schools need to sufficiently equip their laboratories with the basic, modern and up to date resources. This would provide sufficient opportunities to every student to perform the practicals. More importantly, schools should employ laboratory assistants.

V. SUMMARY

This study was guided by the Constructivist theory as postulated by Jean Piaget. Agreeable to this study, Piagetian Constructivism argues that learner should be exposed to a variety of hands-on-experience which consequently enables them to construct new levels of understanding (Miller, 2011).

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