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Level of Students Exposure to Biology Practicals in Public Secondary Schools in Lugari Sub County, Kakamega County, Kenya

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Abstract: **Despite the advice from quality assurance, Biology subject has continued to perform poorly in National examination in Kenya. It is not known whether teachers teach practically or not. In the KCSE biology examination if a candidate fails the practical paper he or she cannot score an A grade. This means practical paper has great influence on biology performance at KCSE as a whole. This study investigated level of student's exposure to p practicals in public secondary schools in Lugari Sub County, Kakamega County, Kenya. A descriptive survey design was used to study the extent of student participation in biology practicals by class level and school type. The study was undertaken in Lugari District, western province, Kenya. Lugari district is one of the districts where poor performance in biology has been reported over the past five years in K.C.S.E. (KNEC Report 2019). The study population was made up of students taking Biology in forms four. Thirteen schools were randomly sampled comprising of 262 form four students. Primary data was collected using structured questionnaire. All research questions were analyzed using quantitative techniques provided by Statistical Package for Social Sciences (SPSS) version 24. The results revealed that only 38.35 of the 113 practical sessions were conducted by public secondary schools in Lugari Sub County. Majority of the practicals were done in form one (41.7%) and form three (48.1%) while few practical sessions were conducted in form two (30.3%) and four (33.3%). There was significant variation in number of practicals conducted among schools as some school management more than half of the practicals while other schools managed less than a quarter of total practical session in four years. Therefore, the study concluded that the extent to which learners are exposed to biology practicals in Lugar sub County is at low extent. In this regard, the study recommended that there is need to increase number of functional laboratories in the said school, acquisition of reagents and laboratory equipment. Further, the schools need to have at least one laboratory assistant to aid in preparation of laboratory session. Lastly, the study recommended that there is need for policy formulation which will ensure students are adequately exposed to biology practicals in Kenya.**

Keywords: **Biology, Biology Practicals, Exposure, Public Secondary Schools.**

1. INTRODUCTION

The introduction of paper contains the nature of research work, purpose of work, and the contribution of this paper. Globally it is well known that science education is indispensible and should be effectively taught in schools. Biology is one of the science subjects taught in schools and it is important subject in the secondary curriculum since it prepares the learner to deal with life situations (Jegstad & Sinnes, 2015) .Through research biological knowledge has been produced and applied to control diseases like smallpox, HIV and AIDS measles and tuberculosis. In this era of Covid 19 pandemic there is a lot of research going on about the corona virus using biology knowledge. Biology knowledge helps us to conserve our natural resources by understanding the inter-relationship between plants and animals. Biology knowledge prepares learners for careers such as medicine, agriculture, teaching and many others.

The Vision 2030 aims to transform Kenya into a middle income country offering its citizens a high quality of life in a safe and secure environment. Both the social and economic pillar in the vision 2030 has strong links with biology subject. The Social Pillar of Vision 2030 aims at investing in the people of Kenya through high quality education and training, water and sanitation, housing, social equity, better care of the environment, poverty reduction, gender equity and support for vulnerable groups in society such as the physically handicapped. The quality of education can only be raised if the teaching and learning of science subjects in schools and colleges is properly done. Most of the tenets in the social pillar are linked to biology and therefore quality teaching and training in biology is expected in order to achieve better water and sanitation, care of the environment for instance control of pollution, deforestation, human diseases (GoK, 2017).

The Economic Pillar aims at a rapid growth rate averaging 10 percent annually, driven by flagship projects all over the republic. These projects will be in key sectors like agriculture, manufacturing, tourism, wholesale and retail trade, business processes off-shoring, and the financial sector. Not only will these projects change the economic face of Kenya, but they have been selected on the basis of their ability to provide gainful employment to our people. Biology is also important here because agriculture and tourism involves flora and fauna and therefore provides a base for careers in these fields hence providing employment. Food processing and technology in manufacturing industry has its base from biology and chemistry. With poor performance in sciences and biology the country will not attain the goals for vision 2030.This calls for quality teaching and learning in our schools in the biology subject (Oyoo, 2010).

The importance of biology in school curriculum is also enshrined in the Sustainable Development Goals (SDG). Goal 1 of no poverty in all its forms, goal 2 of Zero hunger- end hunger, achieve food security and improved nutrition is about knowledge in biology. Goal 3 is about good health and well being where biology is also required. SDG goal 14 and 15, is about life below water and on land .This means we must preserve biodiversity and use ecosystems sustainably to ensure the survival of our own species. Without biology knowledge we cannot preserve our biodiversity hence biology is very vital in our secondary curriculum (Mochama, Obuba & Omwenga, 2020).

Yet in recent years from 2016 to 2019 there has been a national outcry about the poor performance of biology among the science subjects in KCSE examination. This will definitely impact negatively on the future of our society given the importance biology has. The biology KCSE examination consists of three papers, 1, 2 and 3. Paper one consists of theory short questions of 80 marks, paper 2 consists of structured questions in section A of 40 marks and section B comprises an interpretation question of 20 marks and essay question of 20 marks adding up to 40 marks. Paper 3 is the practical paper and consist three questions adding up to 40 marks. Yet in all these papers students have consistently scored low marks (Miheso, 2020).

Studies conducted by Rotich (2012), Ndirangu (2006) and Ombati (2009) reveal that performance of students in biology before and after SMASSE programme has been below average; students' involvement during the lesson has been partially achieved; and that classroom practices have improved but have however, not translated into improved performance of the subject. Table 1 below is a comparative presentation of the candidate's overall performance in Biology in the years 2009 - 2017.

Table 1: Biology KCSE performance between 2009-2017

Year	Paper	Candidature	Max Score	Mean Score	Standard Deviation
2009	1		80	20.14	12.31
	2	299,302	80	18.41	10.30
	3		40	15.86	8.43
	Overall		**200**	**58.39**	**28.80**
2010	1		80	20.14	13.76
	2		80	18.41	10.82
	3	317,135	40	15.86	8.31
	Overall		**200**	**58.39**	**30.44**
2011	1		80	22.74	12.41
	2	363,817	80	23.31	13.04
	3		40	18.84	8.10
	Overall		**200**	**64.87**	**31.05**

2012	1 2 3 **Overall**	389,523	80 80 40 **200**	19.77 20.70 11.97 **52.41**	12.84 12.09 6.59 **29.43**
2013	1 2 3 **Overall**	397,319	80 80 40 **200**	28.03 22.36 12.88 **63.26**	14.49 12.70 7.64 **32.06**
2014	1 2 3 **Overall**	432,977	80 80 40 **200**	23.91 18.92 20.82 **63.65**	14.49 11.83 8.39 **32.57**
2015	1 2 3 Overall	465,584	80 80 40 **200**	27.42 19.56 22.62 **69.59**	14.46 11.86 9.15 **31.55**
2016	1 2 3 **Overall**	509,982	80 80 40 **200**	27.30 20.11 18.99 **58.37**	16.40 14.14 6.76 **35.16**
2017	1 2 3 **Overall**	545,663	80 80 40 **200**	13.74 16.43 7.68 **37.85**	10.24 10.37 5.05 **23.45**

Source: KCSE KNEC Report 2017

From the table it can be observed that while there has been continuous increase in candidature for the past 9 years, the performance in biology has continued to be poor with the year 2017 being the lowest. The standard deviation values indicate that the papers adequately discriminated learners of different abilities. Thus there has been minimal improvement in performance in biology even after introduction of SMASSE in-service training.

A circular from the Director of Quality Assurance and Standards in the Ministry of Education Science and Technology (MOEST) in Kenya dated 2nd march 2012 to all principals of secondary schools indicated that the performance of biology in KCSE examinations in the last five years was poor in the following topics: Classification, Ecology, Support and Movement, and evolution (INS/B/13/1/299). Students have persistently and consistently posted low scores in these topics and therefore affecting general performance in biology. The Director advised that biology teachers should use a practical approach to teaching and that the highlighted topics require learners to be extensively exposed to experimental tasks that enhance development of scientific skills.

The purpose of the circular was to appraise and advice teachers to lay emphasis on practical teaching approach in biology. Secondly the highlighted topics require learners to be extensively exposed to experimental task that enhance development of scientific skills such as observation, comparing, drawing and labeling, and data collection, analysis and interpretation. The analysis showed that learners displayed weaknesses in spelling of technical terms, relating structure to their functions, interpreting data and graphical information, making correct observations on provided specimens following experimental procedures and giving unsolicited information

However despite the advice from quality assurance the subject has continued to perform poorly. It is not known whether teachers teach practically or not. In the KCSE biology examination if a candidate fails the practical paper he or she cannot score an A grade. This means practical paper has great influence on biology performance at KCSE as a whole. This paper aimed at finding out the extent to which the learners are exposed to biology practicals from form one to form four in Lugari sub county. The biology syllabus has listed practicals to be covered within every topic. It is not known whether the students are exposed to them or not.

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2. RELATED STUDIES

Studies conducted globally have shown the pivotal role played by laboratory work in enhancing science concepts' teaching and learning in educational institutions (Motlhabane & Dichaba 2013). A successful practical lesson should be inquiry based than deductive based learning (Rocard, Csermely, Lenzen & Hemmo, 2007).There is a unanimous agreement among eductionists universally that for students to better understand the natural phenomena and learn how science attempts to understand and clarify these issues, science teachers should afford students opportunities to engage with and fully participate in practical work (Gott & Duggan, 2009). Recent studies advocate for a change in the teaching methods so that students participate fully and understand difficult science concepts (Millar, 2010). Hunde and Tegenge (2010) reported that, despite the fact that laboratories have multiple deprived of such opportunities.

Many countries have given attention to the effective implementation and practice of science education in secondary schools (Beyessa, 2014). A study by Ruffato (2012) in united states of America showed that when students were using hands on methods of learning biological processes, they were more engaged than with previously used methods like lecture and following drawings on the board and performed well in short term assessments of knowledge. One way to increase student engagement is the use of manipulative materials during instruction (Mwangu & Sibanda, 2017)

3. METHODOLOGY

A descriptive survey design was used to study the extent of student participation in biology practicals by class level and school type. The study was undertaken in Lugari District, western province, Kenya. Lugari district is one of the districts where poor performance in biology has been reported over the past five years in K.C.S.E. (KNEC Report 2019). The study population was made up of students taking Biology in forms four. Thirteen schools were sampled comprising of 262 form four students. Primary data was collected using structured questionnaire. All research questions were analyzed using quantitative techniques provided by Statistical Package for Social Sciences (SPSS) version 24. This entailed descriptive statistics such as percentage and frequencies as well as chi-square of association. The results were presented using tables.

4. FINDINGS AND DISCUSSIONS

Data was collected from learners on dichotomous scales (Yes/No). This section presents overall extent of learners' exposure to biology practical in Lugari Sub County, extent of leaner exposure to biology practicals per topic and extent of leaner exposure to biology practicals per practical activities.

4.1 Overall Extent of Learners Exposure to Biology Practical in Lugari Sub County

The study sought to establish to extent to which thirteen secondary schools in Lugari Sub County have conducted 113 practical from form one to form four. However, not all practical sessions were undertaken as indicated by overall 76.95% practical done during study period. The distribution of practical per class is as shown in Table 1 below

Table 1: Overall Extent of Learners Exposure to Biology Practical in Lugari Sub County

Class	Number of Practical	Percentage
Form 1	26	41.7%
Form 2	26	30.3%
Form 3	35	48.1%
Form 4	26	33.3%
Total	**113**	**38.35%**

There are a total of 26 practical sessions in Form one, however, averagely, 41.7% of them were conducted during the study period. The study also established that there was significant variation in number of practical lessons conducted from one school to another. For instance, three schools conducted 13 practical sessions in form one while one school conducted 26 practical lessons. Similarly, there are a total of 26 practical sessions in Form two, however, averagely, 30.3% of them were conducted during the study period. The study established that there was significant variation in number of practical lessons conducted from one school to another. For instance, three schools conducted 4 practical sessions in form two while two schools conducted 21practical lessons. None of the schools conducted all 26 practical session in form two. Most of the practical sessions are in form three (35), averagely, 48.1% of them were conducted

during the study period. However, three schools conducted only 6 practicals in form three while one conducted maximum practicals (35). Form four have 26 practical sessions, averagely, 33.3% of them were conducted during the study period. However, three schools conducted only 3 practicals in form three while one conducted maximum practicals (26). The average practical done in Lugari Sub County was 38.35% which is way far below expected number of practical during the four years.

Extent of Leaner Exposure to Biology Practicals per Topic

The study sought to establish extent of exposure to each topic, (17 topics). The results are as shown in Table 2

Table 2: Extent of Leaner Exposure to Biology Practicals per Topic

	N	Minimum	Maximum	Mean	Std. Deviation
Introduction To Biology	13	0.000	1.000	0.423	0.277
Classification I	13	0.667	1.000	0.449	0.125
The cell	13	0.250	1.000	0.423	0.214
Cell physiology	13	0.600	1.000	0.423	0.130
Nutrition in plant and animal	13	0.538	1.000	0.446	0.166
Transport in plant and animal	13	0.000	1.000	0.386	0.299
Gaseous exchange	13	0.000	1.000	0.403	0.298
Respiratory	13	0.000	1.000	0.318	0.405
Excretion and homeostasis	13	0.000	1.000	0.404	0.280
Classification II	13	0.273	1.000	0.604	0.189
Ecology	13	0.000	1.000	0.531	0.316
Reproduction	13	0.091	1.000	0.402	0.250
Growth and development	13	0.115	1.000	0.407	0.247
Genetics	13	0.000	1.000	0.392	0.323
Evolution	13	0.000	1.000	0.296	0.347
Reception, response & Coordination	13	0.000	1.000	0.204	0.351
Support and movement	13	0.300	1.000	0.485	0.227

There are five topics in Form one. The results indicated 42.3% of the sampled schools conducted practical session in regard to introduction to Biology. In the second topic, Classification One, the practicals were conducted at 44.9%. The third topic which the cell was averagely conducted at 42.3%. One school conducted it at 25.0%, another at 75.0% while others at 100%. The fourth topic in form one was cell physiology which was conducted at 42.3%. One of the schools conducted it at 60.0% while two of the schools at 80.0%. The rest was conducted at 100%. The last topic in form one was nutrition of plants and animals which was conducted 44.6%. Two of the schools conducted at 54.8% and five of the schools conducted at 100.0%. Other schools conducted it between 76.95 and 92.3%

Form two has four topics in Biology. The first topic, transport in plants and animals was conducted at 38.6%. The second topic in form two us gaseous exchange which was conducted at 40.3%. The third topic in form two is respiration and it was conducted at averagely 31.8%. The last topic in form two is excretion and homeostasis which was conducted at 40.4%.

Similarly, form three has four topics. The first topic, classification II was conducted at 60.4% with one of the schools conducted it at 27.7% and three of schools conducting practicals at 100.0%. The second topic is ecology and practicals were conducted at 53.1%. One of the schools did not conduct any practicals in ecology while five of the schools conducted whole practicals. The remaining school conducted between 33.3% and 83.3% of the practicals. The third topic in form three is reproduction and practicals were conducted at 40.2%. One the schools conducted 9.1% practicals while nine of them conducted all the practicals. The last topic in form three is growth and development and practicals were conducted at 40.7%. One the schools conducted the practicals at 11.5% and one of the schools conducted all the practicals. Two of the schools conducted 96.0% of the practical sessions. The rest conducted practicals between 54.0% and 95.8%

There are four topic in form four. The first topic is genetics and it was conducted at 39.2%. One of the schools did not conduct any topic at all while five of the schools conducted it at 100.0%. The rest of the schools conducted between 20% and 50% of the practicals. The second topic was evolution and it was conducted at 29.6%. Four of the schools did not conduct any topic at all while 2 of the schools conducted all practicals in this topic. Perception, response, and coordination was third topic and it was conducted 20.4%. Six of the schools did not conduct any practicals in this topic while one of the schools conducted all the practicals. The remaining schools conducted between 18.6% and 55.7%. The last topic in form four is support and movement. The practical conducted in this topic were at 48.5% with six of the schools conducting 30% of the practices and nine of the conducting all the practicals. The rest of the schools conducted between 40% and 60% of the practicals under this topic.

Extent of Leaner Exposure to Biology Practicals per Practical activities

The study sought to establish extent of exposure to each 113 practical activities. The presentation is per topic. The results are as shown in Table below

Table 3: Introduction to Biology

INTRODUCTION TO BIOLOGY	Yes	No	Mean	Chi-Square
To observe living and non-living things	12	1	.42	X2(1)=9.308, P=0.002

From Table 3, only one school out of 13 schools did not observe living and non-living things. Chi-square test showed that there was highly significant (P<0.05) variation in regard to observe living and non-living things

Table 4: Classification One

CLASSIFICATION ONE	Yes	No	Chi-Square
To collect and observe animal specimens	3	10	X2(1)= 6.231, P=0.013
To collect and observe plants specimens	3	13	X2(1)= 6.231, P=0.013
Naming of organisms	13	0	N/A

Results indicated that ten schools did not collect and observe animal specimens as well as collect and observe plants specimens. Chi-square test showed that there was highly significant (P<0.05) variation in regard to collection and observe animal specimens. On the other hand, all schools conducted naming of organisms.

Table 5: The Cell

THE CELL	Yes	No	Chi-Square
Observing the light microscope	8	5	$X^2(1)$= 12.008, P=0.002
Observing permanent slides of plants and animals	5	8	$X^2(1)$= 6.231, P=0.013
To prepare and observe temporary slides of onion cells under the light microscope	5	8	$X^2(1)$= 9.308, P=0.002
Estimation of the size of onion cell	4	9	$X^2(1)$= 9.308, P=0.002

Eight of the school observed the light microscope. However, eight of the schools did not observed permanent slides of plants and animals. There was significant variation among the schools that observed and those that did not. Further, eight schools did not prepare and observe temporary slides of onion cells under the light microscope and at the same estimate of the size of onion cell. The results established that there was significant variation among the schools that observed and those that did not undertake these activities.

Table 6: Cell Physiology

CELL PHYSIOLOGY	Yes	No	Chi-Square
To demonstrate diffusion OF potassium permanganate	8	5	$X^2(1)$= 6.231, P=0.013
To demonstrate diffusion using a visking tubing	3	10	$X^2(1)$= 9.308, P=0.002
To demonstrate osmosis using visking tubing	3	10	$X^2(1)$= 3.769, P=0.052
To demonstrate living osmosis in living tissue	10	3	$X^2(1)$= 3.769, P=0.052
To examine the effects of osmosis on living cells	3	10	$X^2(1)$= 6.231, P=0.013

Eight schools demonstrated diffusion of potassium permanganate, diffusion using a visking tubing and osmosis using visking tubing. However, ten of the schools did not demonstrate living osmosis in living tissue. There was no significant variation among the schools that demonstrated living osmosis in living tissue and those that did not. Further, tens schools did not examine the effects of osmosis on living cells. The results established that there was significant variation among the schools that observed and those that did not examine the effects of osmosis on living cells.

Table 7 (a): Nutrition of Plants and Animals

Nutrition of Plants and Animals	Yes	No	Chi-Square
To test for proteins	5	8	$X^2(1)= 0.692, P=0.405$
To study the definition of sheep	1	12	$X^2(1)= 0.692, P=0.405$
To observe distribution of stomata	1	12	$X^2(1)= 1.923, P=0.166$
To investigate the presence of starch in a leafs	2	10	$X^2(1)= 0.692, P=0.405$
To investigate the gas used during photosynthesis	2	11	$X^2(1)= 6.231, P=0.013$
To investigate the factors which are necessary during photosynthesis	5	8	$X^2(1)= 9.308, P=0.002$
To investigate the factors of catalase in living tissues	3	10	$X^2(1)= 3.769, P=0.052$
To investigate the factors affecting enzyme activities	3	10	$X^2(1)= 6.231, P=0.013$
To examine the external features of a dicotyledonous and monocotyledonous leaf	8	5	$X^2(1)= 0.692, P=0.405$
To demonstrate emulsification of fats	5	8	$X^2(1)= 0.692, P=0.405$
Testing for the presence of lipids	5	8	$X^2(1)= 0.692, P=0.405$
Test for ascorbic acid	5	8	$X^2(1)= 0.692, P=0.405$
Dissecting a mammal to display the digestive system and associated organs	5	8	$X^2(1)= 0.692, P=0.405$

Five schools examined the external features of a dicotyledonous and monocotyledonous leaf. However, 12 of the schools did not observe distribution of stomata. There was no significant variation among the schools that observe distribution of stomata and those that did not. Two schools investigated the presence of starch in a leaf. However, 11 schools did not investigate the gas used during photosynthesis. The results established that there was significant variation among the schools that investigated the gas used during photosynthesis and those that did not. Eight of the schools did not investigate the factors which are necessary during photosynthesis. There was significant variation in regard to investigating the factors which are necessary during photosynthesis. Eight schools tested presence of lipids, proteins and ascorbic acid. Ten schools did not investigate the factors affecting enzyme activities and the variation was significant. The results also revealed that eight schools did not demonstrate emulsification of fats and the variation among the schools was significant. Three of the schools did not investigate the factors of catalase in living tissues and the variation was not significant. Similarly, twelve schools did not study the definition of sheep and the variation was not significant. Lastly, majority of the schools (8) did not dissect a mammal to display the digestive system and associated organs and the variation was not significant.

Table 7 (b): Transport Plants and Animals

Transport Plants and Animals	Yes	No	Chi-Square
To observe the external structure of the root	6	7	$X^2(1)= 9.308, P=0.002$
To observe the internal structure of the root	5	8	$X^2(1)= 6.231, P=0.013$
To observe internal structure of the stem	5	8	$X^2(1)= 6.231, P=0.013$
To investigate the ate of transpiration from the leafs surface	6	7	$X^2(1)= 9.308, P=0.002$
To investigate the rate of transpiration of a leafy shoot using a photometer	3	10	$X^2(1)= 0.077, P=0.782$
To display the circulatory system in a mammal (demonstrating)	4	9	$X^2(1)= 0.692, P=0.405$
To investigate the external and internal structures of a mammalian heart	5	8	$X^2(1)= 6.231, P=0.013$
To investigate the pulse rate at the wrist	4	9	$X^2(1)= 1.923, P=0.166$
To investigate the directions of blood flow in the superficial veins of the arms	5	8	$X^2(1)= 6.231, P=0.013$

Seven of the schools did not observe the external structure of the root and investigate the rate of transpiration from the leafs surface. There was no significant variation among the schools that observe the external structure of the root and those that did not. Eight of the sampled schools did not observe the internal structure of the root as well as internal structure of the stem, the external and internal structures of a mammalian heart and directions of blood flow in the superficial veins of the arms. There was no significant variation among the schools. Seven of schools did not investigate the rate of transpiration of a leafy shoot using a photometer and the variation was not significant among the schools. Further, nine schools did not investigate the pulse rate at the wrist and the variation was not significant. Lastly, eight schools did not display the circulatory system in a mammal (demonstrating). The variation was not significant.

Table 8: Gaseous Exchange

Gaseous Exchange	Yes	No	Chi-Square
To examine the structure of a gill of a bony fish	6	7	$X^2(1)= 9.308$, P=0.002
To investigate the movement of the lungs and diaphragm in a model thoracic cavity	6	7	$X^2(1)= 9.308$, P=0.002
Effects of exercise on the rate of breathing	6	7	$X^2(1)= 9.308$, P=0.002
To investigate the release of oxygen by plants	5	8	$X^2(1)= 6.231$, P=0.013
To observe transverse section of leaves and stems	5	8	$X^2(1)= 6.231$, P=0.013
To compare the amount of carbon dioxide in the inhaled and exhaled air	5	8	$X^2(1)= 6.231$, P=0.013
To investigate the release of carbon iv)oxide by plants	4	9	$X^2(1)= 3.769$, P=0.052
Observation of breathing movements in an insect	4	9	$X^2(1)= 3.769$, P=0.052
To investigate the rib action during breathing using a model	2	11	$X^2(1)= 0.692$, P=0.405

Six of the schools did not examine the structure of a gill of a bony fish, investigate the movement of the lungs and diaphragm in a model thoracic cavity and examine the effects of exercise on the rate of breathing. There was significant variation in regard to these practical activities. Eight schools did not investigate the release of oxygen by plants, observe transverse section of leaves and stems and compare the amount of carbon dioxide in the inhaled and exhaled air. There was significant variation among the schools in respect to these practicals. Nine of the schools did not investigate the release of carbon (iv) oxide by plants and observe of breathing movements in an insect and the variation was not significant. Lastly, majority of the schools (11) did not investigate the rib action during breathing using a model and the variation was not significant.

Table 9: Respiratory Practical Activities

Respiratory	Yes	No	Chi-Square
To investigate production of heat by germinating seed	5	8	$X^2(1)= 3.769$, P=0.052
To investigate the gas produce during fermentation	5	8	$X^2(1)= 3.769$, P=0.052
To investigate what gas is given off when food is burnt	4	9	$X^2(1)= 0.692$, P=0.405

Eight of the schools did not investigate production of heat by germinating seed and gas produce during fermentation and the variation was not significant. Lastly, nine schools did not investigate what gas is given off when food is burnt and the variation was not significant.

Table 10: Excretion and Homeostasis Practical Activities

Excretion and Homeostasis	Yes	No	Chi-Square
To examine plants of economic importance from around the school compound	6	7	$X^2(1)= 9.308$, P=0.002
To investigate the structure of mammalian skin	6	7	$X^2(1)= 9.308$, P=0.002
To observe the structure of the mammalian kidney	6	7	$X^2(1)= 9.308$, P=0.002
To investigate the enzyme catalase on hydrogen peroxide	5	8	$X^2(1)= 6.231$, P=0.013

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Seven of the schools did not examine plants of economic importance from around the school compound, investigate the structure of mammalian skin and observe the structure of the mammalian kidney. There was significant variation in regard to these practical activities. Lastly, eight schools did not investigate the enzyme catalase on hydrogen peroxide and there was was significant variation among the schools in respect to this practical.

Table 11: Classification Practical Activities

Classification	Yes	No	Chi-Square
To examine the external features of members of phylum chordata	13.0	0.0	N/A
To demonstration the construction of a dichotomous key	13.0	0.0	N/A
To construct a dichotomous key	13.0	0.0	N/A
To examine the external structure of a pteridophyta	12	1	$X^2(1)= 9.308$, P=0.002
To examine common features of spermatophyta	12	1	$X^2(1)= 9.308$, P=0.002
To observe the external features of members of phylum. arthropoda	12	1	$X^2(1)= 9.308$, P=0.002
To classify members of phylum	12	1	$X^2(1)= 9.308$, P=0.002
To examine bread mould	10	3	$X^2(1)= 3.769$, P=0.052
To examine the external structure of a bryophyta	10	3	$X^2(1)= 3.769$, P=0.052
To observe organism in pond water using a microscope	4	9	$X^2(1)= 1.923$, P=0.166
To examine spirogyra	4	9	$X^2(1)= 1.923$, P=0.166

All schools in Lugari Sub County examined the external features of members of phylum chordate, demonstrated the construction of a dichotomous key and constructed a dichotomous key. One of the schools did not examine the external structure of a pteridophyta, examine common features of spermatophyte, and observe the external features of members of phylum. Arthropoda and to classify members of phylum. There was significant difference among the schools. Three of the schools did not examine bread mould and he external structure of a bryophyte. The difference was not significant among the schools. Majority of the schools (9) did not observe organism in pond water using a microscope and spirogyra. The difference was not significant.

Table 12: Ecology Practical Activities

Ecology	Yes	No	Chi-Square
To estimate population of organism using a line transect	6	7	$X^2(1)= 9.308$, P=0.002
To examine the adaptive features of various plants	6	7	$X^2(1)= 9.308$, P=0.002
To study feeding insectivorous plant	5	8	$X^2(1)= 6.231$, P=0.013
To measure some biotic factors of a habitat	5	8	$X^2(1)= 1.923$, P=0.166
To compare number of root nodules of legumes from different fertility	4	9	$X^2(1)= 0.077$, P=0.782
To estimate the population size using quatrat method	3	10	$X^2(1)= 0.077$, P=0.782

From Table above, seven of the schools did not estimate population of organism using a line transect and examine the adaptive features of various plants. There was significant variation in regard to these two practical activities. Eight of the schools did not study feeding insectivorous plant. There was significant variation in regard to study feeding insectivorous plant. Eightr schools did not measure some biotic factors of a habitat. There was no significant variation in regard to this practical activity. Nine schools did not compare number of root nodules of legumes from different fertility and majority of schools 10) did not estimate the population size using quatrat method. There was no significant variation in regard to these two activities.

Table 13: Production Practical Activities

Reproduction	Yes	No	Chi-Square
To observe meiosis in plant cells	7	6	$X^2(1)= 9.308$, P=0.002
To observe budding in yeast	6	7	$X^2(1)= 9.308$, P=0.002
To observe structure of a flower	6	7	$X^2(1)= 9.308$, P=0.002
To study the structure of insect pollinate flower	6	7	$X^2(1)= 9.308$, P=0.002
To study the structure of wind pollinated flower	6	7	$X^2(1)= 9.308$, P=0.002

To classify fruits	6	7	$X^2(1)= 9.308$, P=0.002
Adoptive of seeds and fruits to dispersal methods	6	7	$X^2(1)= 9.308$, P=0.002
To investigate the reproductive system of a female mammal	6	7	$X^2(1)= 9.308$, P=0.002
To observe stage of mitosis	5	8	$X^2(1)= 6.231$, P=0.013
To investigate the reproductive system of a male mammal	5	8	$X^2(1)= 6.231$, P=0.013
To observe the structure of rhizopus	5	8	$X^2(1)= 3.769$, P=0.052

Seven schools observed meiosis in plant cells. Seven of the schools did not observe budding in yeast, structure of a flower, study the structure of insect pollinate flower, study the structure of wind pollinated flower, classify fruits, Adoptive of seeds and fruits to dispersal methods and investigate the reproductive system of a female mammal. There was significant variation among schools in regard to these activities. Eight of the schools did not observe stage of mitosis and investigate the reproductive system of a male mammal. There was significant variation in regard to these practical activities. Lastly, eight of the schools did not observe the structure of rhizopus. There was no significant variation in regard to observing the structure of rhizopus.

Table 14: Growth and Development Practical Activities

Growth and Development	Yes	No	Chi-Square
To investigate the conditions necessary for germination.	7	6	N/A
To investigate epigeal and hypogeal germination	7	6	N/A
To investigate structural differences between monocotyledonous and dicotyledonous seed	6	7	$X^2(1)= 9.308$, P=0.002
To determine the region of growth in roots	6	7	$X^2(1)= 9.308$, P=0.002
To investigate apical dominance in plants	5	8	$X^2(1)= 3.769$, P=0.052
To investigate the changes that take place during growth of the housefly	5	8	$X^2(1)= 3.769$, P=0.052
To measure the growth of a plants	4	9	$X^2(1)= 0.692$, P=0.405

Six of the schools investigated the conditions necessary for germination and epigeal and hypogeal germination. Six schools did not investigate structural differences between monocotyledonous and dicotyledonous seed and determine the region of growth in roots. There was significant variation among schools in regard to these two activities. Eight schools did not investigate apical dominance in plants and the changes that take place during growth of the housefly. There was no significant among schools in regard to these two activities. Lastly, nine schools did not measure the growth of plants and there was no significant variation among schools in regard to this activity.

Table 15: Genetics Practical Activities

Genetics	Yes	No	Chi-Square
To observe some variations in human beings	6	7	$X^2(1)= 9.308$, P=0.002
To demonstrate chromosome behaviour during cell division	5	8	$X^2(1)= 6.231$, P=0.013
To demonstrate probability by tossing a single coin	4	9	$X^2(1)= 1.923$, P=0.166
Breeding fruits flies (drosophila melangaster) to study inheritance	3	10	$X^2(1)= 0.077$, P=0.782
To demonstrate random fusion of genes in a monohybrid inheritance	3	10	$X^2(1)= 0.077$, P=0.782

Seven of the schools did observe some variations in human beings. There was significant variation in regard to these two activities. Eight of the schools did not demonstrate chromosome behaviour during cell division. There was significant variation among schools. Nine of the schools did not demonstrate probability by tossing a single coin. There was no significant variation in regard to this activity. Ten schools did not breeding fruits flies (drosophila melangaster) to study inheritance. There was no significant variation among schools. Lastly, majority of the schools (10) did not demonstrate random fusion of genes in a monohybrid inheritance. There was no significant variation among schools.

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Table 16: Evolution Practical Activities

Evolution	Yes	No	Chi-Square
To compare vertebrate forelimbs	6	7	X2(1)= 6.231, P=0.013
To compare wings of birds and insects	6	7	X2(1)= 6.231, P=0.013
To prepare of cryptic coloration	3	10	X^2(1)= 0.692, P=0.405
Education tour to museum	2	11	X^2(1)= 1.923, P=0.166

Seven of schools did not compare vertebrate forelimbs and compare wings of birds and insects. There was significant variation among schools in regard to these two activities. Majority of the schools (10) did not prepare of cryptic coloration and there was no significant variation in regard to this activity. Lastly, majority of the schools did undertake education tour to museum. The variation was not significant.

Table 17: Reception Response and Co-Ordination Practical Activities

Reception Response and Co-Ordination	Yes	No	Chi-Square
To investigate response to light by animals	6	7	X2(1)= 6.231, P=0.013
To investigate response of plants to uni-directional light	6	7	X2(1)= 6.231, P=0.013
To investigate the response of seedling to gravity	5	8	X^2(1)= 3.769, P=0.052
To illustrate plant etiolation	4	9	X^2(1)= 0.692, P=0.405
To determine the presence and distance of the blind spot	3	10	X^2(1)= 0.077, P=0.782
To demonstrate the knee jerk reflex	3	10	X^2(1)= 0.692, P=0.405
To investigate chemotaxis on termites	2	11	X^2(1)= 1.923, P=0.166

Seven of the schools did not investigate response to light by animals and response of plants to uni-directional light. There was significant variation in regard to these two activities. Eight of the schools did not investigate the response of seedling to gravity. Further, nine schools did not illustrate plant etiolation. Majority of the schools 10) did not determine the presence and distance of the blind spot and further majority of the schools (10) did not demonstrate the knee jerk reflex. Lastly, majority of the schools did not investigate chemotaxis on termites. There was significant variation in regard to these activities.

Table 18: Support and Movement Practical Activities

Support and Movement	Yes	No	Chi-Square
To examine the bones of a forelimb	7	6	N/A
To examine the bones of hid limb	7	6	N/A
To demonstrate movement in the fore arm	7	6	N/A
To calculate the tail power of a fish	6	7	X^2(1)= 9.308, P=0.002
To examine the bones of the axial skeleton	6	7	X^2(1)= 9.308, P=0.002
To examine the exoskeleton in an arthropod	6	7	X2(1)= 6.231, P=0.013
To examine external features of a finned fish	6	7	X2(1)= 6.231, P=0.013
To examine transverse section (TS) of monocotyledonous and dicotyledonous plants	5	8	X^2(1)= 3.769, P=0.052
To observe permanent slides of transverse section (TS) of the stems	5	8	X^2(1)= 3.769, P=0.052
To observe wilting plants	5	8	X^2(1)= 3.769, P=0.052

All schools examined bones of a forelimb, bones of hid limb and demonstrated movement in the fore arm. Seven of the schools did not calculate the tail power of a fish and examine the bones of the axial skeleton. There was significant variation in regard to these two activities. Seven of the schools did not examine the exoskeleton in an arthropod and external features of a finned fish. There was significant variation in regard to these two activities. Eight schools did not examine transverse section (TS)of monocotyledonous and dicotyledonous plants, observe permanent slides of transverse section (TS)of the stems and observe wilting plants. There was no significant variation in regard to these three practical activities.

5. CONCLUSIONS AND RECOMMENDATION

The study established that there 113 practical activities from form one to four with majority of practical activities (35) concentrated in form three. Form one, two and four had each 26 practicals. The study concluded that in Lugari Sub County, the extent of practical activities conducted is 38.3% (45 practical activities out of 113). Majority of the practical activities were conducted in form three and four while few practical activities were conducted in form two and one. There was significant difference in the number of practical activities carried in the four year course. Within classes, there was significant variation in number of practical activities with one school managing half of the activities while four schools conducting maximum practical activities (26). In form two, two schools conducted less than half of the practical activities and none of the schools conducted all practical activities. In Form three, one school conducted six out of 35 practical activities while one of the schools conducted all practical activities. In form four, five schools conducted less than 13 practical activities while two schools conducted maximum practical activities (26).

Therefore, the study concluded that the extent to which learners are exposed to biology practicals in Lugar sub County is at low extent. In this regard, the study recommended that there is need to increase number of functional laboratories in the said school, acquisition of reagents and laboratory equipment. Further, the schools need to have at least one laboratory assistant to aid in preparation of laboratory session. Lastly, the study recommended that there is need for policy formulation which will ensure students are adequately exposed to biology practicals in Kenya.

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