IMPACT OF SCHOOL BASED PRACTICAL ASSESSMENT ON LEARNER ACHIEVEMENT IN BIOLOGY IN SECONDARY SCHOOLS IN KAKAMEGA COUNTY, KENYA

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A research project submitted to university of Nairobi in partial fulfillment of the requirements for the award of the degree of master of education in measurement and evaluation in department of psychology.

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DECLARATION

This research project is my original work and has not been submitted for any academic award at any other university

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……………………………………………… Date………………………………..

This research project is being submitted for examination with my approval as university supervisor.

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DEDICATION

This work is dedicated to my mother Kayaro and late father Galinga Malongo may his soul rest in peace for taking me to school despite their humble background. I also dedicate it to my wife Dorcas, my son Kelvin and my daughters Abigael, Getrude for their patience.

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ACRONYMS AND ABBREVIATIONS

DEO	-	District education officer
KIE	-	Kenya institute of education
KLB	-	Kenya literature bureau
KNEC	-	Kenya national examination council
KCSE	-	Kenya certificate of secondary education
KICD	-	Kenya Institute of curriculum development
SBA	-	School based assessment including classroom tests set by Teacher.
MOE	-	Ministry of education
MOCK	-	Trial examinations administered at school level for the finalists.
SPS	-	Science process skills.
AAAS	-	America Association for Advancement of Science.
SAPA	-	Science A process Approach.
ICT	-	Information Communication Technology
SMASSE	-	Strengthening Mathematics and Science in Secondary Schools Education

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ABSTRACT.

Performance in Biology at certificate of secondary Examinations (KCSE) has been poor in the recent years. This has been attributed to many factors among them teaching and learning styles. This research investigated the impact of practical process skills observation, experimenting, drawing and measurement on learner achievement in Biology at secondary schools level in Likuyani sub-county. The design for the research was quasi-experimental and involved pre-test, post-test with control and experimental groups. A sample of 400 participants from form 1,3 and 4 purposively drawn from 8 secondary schools were used in the study. A total of 8 teachers took part in the research on basis of willingness. Four research questions guided the research. Achievement test in biology and a teachers questionnaire were used for data collection .Data collected were analyzed using SPSS based on mean, standard deviation and t-test. The results revealed that practical process skills pedagogy was more effective mode of teaching and learning because students in experimental class where practical process skills observation, experimenting, drawing and measurement were integrated performed better. They had superior mean scores with t values for t-test less than p values. Practical approach to teaching from research showed had significant positive impact on performance in Biology in secondary schools. Experimental group that integrated practical approach to instruction performed better because better teaching strategy .Findings would be useful to education ministry to guide curriculum review. This may influence teacher training especially area of pedagogy and ministry to strengthen quality assurance unit to oversee schools undertake holistic science teaching and assessment through acquisition of practical process skills.

CHAPTER ONE

INTRODUCTION

The chapter was organized into the following sub-headings: background of the study, problem statement, purpose of the study, objectives of the study, research questions, significance of study, rationale, limitations, delimitations of study, basic assumptions, definitions of significant terms and organization of study.

1.1 Background to the study

The goal of education in Kenya is to promote economic, technological and industrial development for national good (Gacheri 2014). There is no much research conducted to show whether the youth are prepared scientifically to play effective and productive role in development of the nation. Industrial and technological developments in Kenya will depend on skills, knowledge and expertise in science hence appropriate training in sciences is necessary (K I E 2006) as envisaged in vision 2030.

Science is a great enterprise which nations depend on, in-order to advance technologically. Biology in senior secondary school can equip students with useful concepts, principles and theories .Science therefore, should receive much emphasis in education because of its significance and relevance to life and society (Chinwe, Chukele, 2008). Biology as a branch of science and the prerequisite subject for many fields of learning contributes immensely to the technological growth of the nation. This includes medicine, forestry, agriculture, biotechnology and nursing. The study enable them face the challenges before and after graduation.

In any curriculum, science education is acknowledged as means of providing knowledge and skills for developing various spheres of life. Biology is one of the key sciences that play great role in developing technological skills.

The process for effective learning in Biology is generally the case in other sciences which require a practical input. But the use of practical approach to teaching and learning in schools is on decline in the belief that it is time consuming as teachers rush to complete the syllabus.

Development of practical process skills requires well equipped laboratories in schools and trained manpower. In Likuyani where research was conducted most schools lack laboratory facilities and trained lab technicians necessary in teaching science to develop process skills.

Development of practical process skills are important in acquisition of twenty first century skills which include technological development. In Likuyani where research was carried no single candidate qualified to join school of medicine and pharmacy in the year 2013 and 2014 which require biology component suggesting poor performance in biology in the sub-county.

It is on this background that this study attempted to establish the effect of practical learning and assessment on learner achievement in Biology in Kenyan schools.

Performance of students in summative KSCE examinations in Kenya has been of great concern to parents and other stake holders. The chief method to judge school staff success is through students' performance on standardized tests (Kinyua 2014).

Biology is a natural science dealing with study of life Kenya literature bureau (KLB BK1). Biology knowledge is important to equip the learner with knowledge to apply, improve and maintain the health of the individual family and community.

Biology syllabus recommends teaching through discussion on practical activities, field trips, demonstration and project (KIE Teachers guide 2006). This encompasses theory and practical work. Shiundu , Omulando (1992) notes teaching methods or strategies currently recommended process-based approach of teaching to help students learn science process skills. These include laboratory work, field and project work. The curriculum developers in Kenya advocate for learner-centered approaches in teaching of science in secondary schools (Kenya Institute of Education 2006). But most teachers in schools still use traditional written approaches, whereas practical and projects are rarely used. This raises questions on pedagogy and assessment impressed by teachers to enhance performance. The subject curriculum examines students in three papers:

Two theory papers and one practical paper three (KNEC, 2010). Biology is one of the sciences which is compulsory in first two years of secondary education but most schools offer biology throughout the four years of the course. 90% of students in schools take biology to the final KCSE hence the most popular science subject at secondary level. In Likuyani sub-county, 97% of form four students studied biology to the final KCSE (KNEC records DEOs office).

This study considered practical approach in learning when it was used to support and enhance the attainment of curriculum objectives and to engage students in meaningful learning in Biology. The assumption of this study was that if practical process skills were to be used in learning Biology, performance would vary from that of traditional teacher –led chalk and board method. The problem addressed in this study therefore was that enhancing learning through hands on practical approach to improve performance.

To achieve the vision 2030 in education, a number of initiatives have been started to enhance practical teaching in schools as a pedagogy .This included SMASSE insets for teachers, equipping school laboratories through government funding. This study sought to establish the gap that could be filled through the practical integration in Biology.

Assessment is defined as a direct measure of what has been learned as a result of instruction on specific objectives (Gagne, Briggs, Wagner,1988). It is a process of collecting data by measuring /testing which helps to give value judgment.

Assessment comprise of two components: measurement and evaluation. Measurement is a systematic process of developing a quantitative and qualitative description of student performance (Erickson, Wentling, 1978). Evaluation is concerned with the worth of particular performance.

Suggested assessment methods in biology are: Practical Work, Project work, Field trips, Oral questions,. Quizzes, Written tests and examinations (KICD 2010).

Practical work should be essential constituent of school science. This is important as practical work encourages science process skills.

Practical assessment mostly deals with acquisition of practical science process skills. The biology practical skills are science process skills. They are taught as part of the biology curriculum. These skills can be acquired and developed through activities involved in the biology practical sessions. According to Maundu, Sambili and Muthwii (2005), one of the ways of assessing the objectives of teaching biology is through practical work. In practical work, an opportunity is provided for testing application of scientific procedures, manipulative abilities as well as scientific skills.

The Kenya National Examinations Council (KNEC) makes use of practical examinations to test students' acquisition of various biology practical skills which in essence are science process skills. In these examinations, students are required to carry out biology practical activities following some given instructions.

The basic science process skills in biology include measuring, drawing, observation, classifying, manipulating, inferring/conclusion. Integrated skills include experimenting and interpreting (Owino,Indoshi , 2013).

These practical process skills are also examined in the two theory papers of biology hence biology practical component contribute immensely on final biology grade. Most teachers do not adequately teach and assess students in practical and if they do so the quality of assessment is suspect , assessment of basic science practical process skills is not adequate especially drawing, observation , measuring, experimenting (KNEC 2008).

Examiners who mark K.C.S.E. note that students failed to demonstrate mastery of science process skills. Most wait until students are in form four to commence practical learning and assessment.

According to KNEC report 2009 biology paper three, most candidates had wrong procedures, incorrect colour observation on food test. Most questions testing on experimental design were performed poorly by candidates; many candidates were unable to measure and calculate magnification.

Performance of candidates in biology in Kenya national examination was far below average. In 2010 for example, KCSE biology had a mean score of 4.2, physics 3.7 and chemistry 3.36. These were among five poorly performed subjects. The table below indicated how the students performed from 2007 to 2014.

Table 1.1 K.C.S.E Biology mean performance 2007- 2014.

Year	Paper	Maximum score	Mean score	Standard deviation.
2007	1	80	27.10	13.68
	2	80	35.01	14.63
	3	40	21.81	8.73
2008	1	80	22.24	13.42
	2	80	21.09	11.55
	3	40	17.30	6.76
2009	1	80	20.14	12.31
	2	80	18.41	10.30
	3	40	15.86	8.43
2010	1	80	20.14	13.76
	2	80	18.41	10.82
	3	40	15.86	8.31
2011	1	80	22.74	12.41
	2	80	23.31	13.04
	3	40	18.84	8.10
2012	1	80	19.77	12.84
	2	80	20.70	12.09
	3	40	11.97	6.59
2013	1	80	28.03	14.49
	2	80	22.36	12.70
	3	40	12.88	7.64
2014	1	80	23.91	14.49
	2	80	18.92	11.83
	3	40	19.51	8.39

Source: The year 2008, 2014 KCSE KNEC report.

From the table, was observed that the performance in all the biology papers was below average over the years.2014 Sub-county biology mock results in Likuyani indicated that students posted poor performance in biology mean of 3.1436D (Kakamega County 2014 mock results analysis).

National results indicated that students posted worst performance in paper 3 that tested practical skills and yet the paper contributes 40% of the total candidate score in biology. Practical skill questions are also tested in theory papers especially the number 6 compulsory question in biology paper 2 worth 20 marks.

Consider the following statistics:

Table 1.2 K.C.S.E biology paper 3 mean performance 2006- 2010.

Year	2006	2007	2008	2009	2010
Mean score	11.63	21.81	17.3	15.86	18.42

Source: KNEC, year 2008 K.C.S.E Report, (Gacheri, Ndege international journal of social sciences 2014).

Mock results in biology paper 3 Likuyani, Lugari and Matete sub-county was far below average:

Table 1.3 mock biology papers 3 mean 2009-2013

2009	2010	2011	2012
13.45	15.44	14.78	17.58

Source; Western province academic report 2012

Examiners who marked KCSE noted that students failed to demonstrate mastery of practical skills e.g. drawing, measuring, observation, experimentation. Teachers were hence advised to ensure teaching and assessment of these areas.

Although such results were helpful to explain how schools performed, they hardly gave any reasons to link results with the way students are taught and assessed at school level. According to Afolabi, Akinbobola (2010), the practical assessment score of a student is a reflection of the teaching approach that a teacher employed during learning situation.

1.2 Statement of the problem

Science is recognized for economic development and for citizens to acquire scientific literacy In African countries there is comparative dismal performance in science due to poor teaching styles and assessment. Vision 2030 aims at creating human base who are adaptive .This can be achieved through development of skilled man power in the field of medicine, pharmacy, agriculture and biotechnology

Africa has huge potential in the field of agriculture but still suffers from hunger and diseases due underutilization of her landmass. The main problem is that Africa , Kenya included has not developed specialized human resources to address this problem.

Development of these skills requires biology background to pursue an advanced degree in these fields. In Likuyani where research was carried out performance in biology and other sciences are poor. For the last ten years Likuyani sub-county produced only 8 candidates scoring grade A in biology at KCSE to qualify for direct entry in school of medicine and pharmacy. There is need to improve performance in biology as perquisite to produce qualified personnel in the sub-county to address cited problems.

One of the measures to mitigate this problem is integration of practical process skills observation, experimenting, drawing and measurement during teaching and learning process. Hence the purpose of study was to find the impact of practical process skills observation, experimenting, drawing and measurement on learner achievement in biology.

1.3 Purpose of study

The purpose of study was to determine impact of practical process skills in biology on learner achievement in biology in comparison with teacher-led traditional method of instruction in public secondary schools in Kakamega County, Kenya.

1.4 Objectives of the study

The study strived to achieve the following objectives:

1. To establish the impact of observation on the learning classification of animals.

2. To determine the impact of experimentation on the learning of chemicals of life.

3. To establish the impact of drawing on learning of cell biology.

4. Establish the impact of measurement on the learning of support and movement in animals.

To achieve the stated objectives, the study used the following questions as a research guide to be tested using the collected data.

1.5 Research questions.

1. What is the impact of observation on learning classification in animals?

2. What is the impact of experimentation on learning chemicals of life?

3. What is the impact of drawing on learning cell biology?

4. What is the impact of measurement on learning support and movement in animals?

1.6 Rationale of the study

The study is likely to influence schools to enhance learning biology through practical activities, student centered approach to learning .Student participation may enhance freedom and autonomy as salient ideas of modern educational practice. The overall effect is likely to improve performance in biology.

1.7 Significance of study.

Solving problem of poor performance in public secondary schools particularly in biology in Likuyani and in Kenya as whole would be of great benefit to the subject and science in general. Country like Kenya where science and technology is considered an integral part to achieving the millennium Development Goals (MDG) as indicated in the vision 2030 objectives.

Policy makers who may find the findings of this study of relevancy include the MOE. This may influence teacher training especially area of pedagogy and ministry to strengthen quality assurance unit to oversee schools undertake practical teaching and assessment.

Another beneficiary of this report may be the Kenya Institute of curriculum Development (KICD) which is the national curriculum development and research Centre who may find the findings of this study an important feedback and fundamental basis for curriculum revision.

The teachers service commission(TSC) whose mandate is to ensure effective service for quality teaching standards, could also find this report useful as it may serve as a source of information from schools about the use of practical learning in public secondary schools.

This may put TSC at a better position not only to recognize its resources in terms of teaching personnel but also be able to advice training institutions on what to train .

The public secondary schools may also stand to benefit because these institutions are the key players in the implementation of government policies in education system

1.8 Limitations of study

Use of tests as a research instrument may have had some limitations. For instance the learners have different cognitive levels and school environment is different across schools. Validity and reliability of the tests may have affected the results but was mitigated through peer reviews in form of test moderation.

The researcher is a full time teacher, time and financial constraints likely arose. Remedial lessons were utilized to compensate for time spent on research.

1.9 Delimitations of study

Area of study was delimited to secondary schools in Kakamega county specifically Likuyani sub-county as shown in map (appendix). Likuyani su-county boarders Uasingishu county along Eldoret - Kitale road Bungoma county along river Nzoia. It involved biology students and teachers.

1.10 Assumptions

It is hoped that instruments chosen for data collection were adequate to gather relevant information required for this study and that all respondents were co-operative and reliable. Teachers were assumed to be well trained and therefore aware of practical teaching and assessment techniques.

1.11 Definition of operational terms

School based assessment –	is an assessment carried out by schools with students being assessed by their own subject teachers. It includes trial examinations administered at school.
Learner achievement-	the amount of academic content a student learns in a determined time, it includes the test score and grade the learner attains in a given subject.
Practical process skills-	are basically problem solving tools used to gather information and test inferences. Science process skills have been described as mental and physical abilities which serve as tools needed effective study of science
Laboratory resources-	facilities, personnel and materials required at school necessary for learning and assessing practical in science subjects.
Practical assessment-	practical task that involves an experimental test of prediction provided by the teacher.
Classification-	topic in biology that deals with naming, identification and grouping of living organisms.
Nutrition-	topic in biology dealing with how organisms obtain nutrients
Cell biology-	topic in biology dealing with units of life.
Support-	deals with how organisms bear their own weight and maintain shape
Academic Performance-	achievement of superior test scores in an achievement test.
Pedagogy-	methodology used in teaching a particular skill by teacher.
Practical work-	learning experiences in which students interact with materials or with secondary sources of data to observe and understand the natural world.
Learning :	process of gaining knowledge or skills by studying, experience or from being taught.
Experimenting	Is testing by following procedures to produce verifiable results.

Measurement Is a process which involves comparison of an entity with standard Unit of measurement.

Observation Identifying similarities and differences; noticing details and sequence.

Drawing make accurate well labeled biological diagrams.

1.12 Organization of the study.

Report comprises of five chapters , chapter one contains background information to the study, statement of the problem, purpose of study, objectives, research questions, rationale of study, significance of study, limitations, delimitations, assumptions, definitions of operational terms and organization of the study.

Chapter two comprises of review of related literature, theoretical framework, conceptual frame work. Chapter three contains research design, target population, sampling procedure, research instruments, validity and reliability of instruments, ethical consideration data processing and analysis. Chapter four comprises of results and discussions.

Chapter five comprises summary, conclusions and recommendations.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction.

The literature was reviewed in order to have better understanding of the study problem. The review was conducted topically as guided by stated problem, the objectives and questions,

This resulted into subsections starting from the general literature on assessment, learner achievement, and practical process skills: observation, measurement, drawing and experimentation. The review was concluded by a summary of the key findings in conceptualization of the study.

2.2. The concept of assessment

Assessment begins with learning and is the process of gathering and discussing information from multiple and diverse sources in order to develop a deep understanding of what students know, understand, and can do with their knowledge as a result of their educational experiences; the process culminates when assessment results are used to improve subsequent learning (Huba , Freed, 2000)

Assessment is the systematic basis for making inferences about the learning and development of students. It is the process of defining, selecting, designing, collecting, analyzing, interpreting, and using information to increase students' learning and development.(Erwin, 1991)

Assessment is the systematic collection, review, and use of information about educational programs undertaken for the purpose of improving student learning and development (Palomba, Banta 1999). All of us who teach know that assessment practices drive learning. The first thing that students do when they are introduced to a syllabus or course outline is look to see how they will be assessed, how they will earn credit or grades in the course. In addition, research tells us that feedback has a powerful influence on learning. As curriculum developers it is important that the assessment processes that we put into place support the learning process (Sally, Phil race, 1996). Biology practical tests are some of the assessment tools used to assess biology paper three in Kenya.

School based assessment (SBA) is an assessment which is embedded in teaching and learning process. It has a number of important characteristics which distinguish it from other forms of assessment,(http://www.hkeaa.edu.hk/en/sba.hkdse).It involves the teacher from beginning to the end .It can adapted and modified by the teacher to match teaching and learning goals of particular class.

2.3 Practical assessment.

Practical work is learning experiences in which students interact with materials or with secondary sources of data to observe and understand the natural world. Importance of practical work in science has been recognized and greatly emphasized in national policy of education. Most of studies on performance in biology in the country concentrated on aspect of theory delivery in classroom situation. Some of the research done in the country dealt with aspects of practical work such as Wekesa (2003), Kibos (1998) concentrated on the issue of innovation content delivery in terms of current technology.

Science curricula around the world emphasize the philosophy of inquiry in science teaching. In the context of science, inquiry refers to the abilities students should develop to be able to design and conduct scientific investigations. In the context of instruction, inquiry refers to the teaching and learning strategies that enable concepts to be mastered through practical work and investigation (National research, 2000) by R.O. Ongowo. According to Maundu, Sambili (2005), in the inquiry approach, learning is by discovery and is characterized by the development of science process skills.

In Kenya, Kenya institute of education (KIE) recognized and rationalized the current biology curriculum with strong recommendation for inquiry approach to teach and asses’ biology and development of process skills. Practical work inculcates attitudes and conceptual perspectives which are necessary for scientific inquiry. This study delved into analytical insight on the impact on teaching style of biology impressing practical skills and related with performance in the subject.

2.4 Science practical process skills

Practical work is learning experiences in which students interact with materials or with secondary sources of data to observe and understand the natural world, for example students observing chart of digestive system in a lesson nutrition in animals (Luneta et al, 2007) .

According to Fraser (1988) by Grace Gacheri (2014) achieving the objectives of science practical work depend a lot on the mode of learning and assessment of laboratory work adopted by teachers and examination bodies. KNEC use practical examinations to assess student's acquisition of various biology practical skills. Scores of students obtained through marking of their practical work indicate indirectly the levels of biology practical process skills they could demonstrate during the practical examination.

Science process skills are basically problem solving tools used to gather information and test inferences Science process skills are described as mental and physical abilities which serve as tools needed for effective study of science (Gacheri, Ndege 2014).

The commission on science education of the American Association for Advancement of science (AAAS) launched a programme named Science A process Approach (SAPA), which emphasized the laboratory method of instruction and learning of scientific process by children. SAPA grouped skills into two types basic and integrated.

According to Rambuda , Fraser (2004) ,the basic science process skills apply to foundational cognitive functioning at elementary grade and integrated skills represent the foundation of scientific reasoning.

Basic process skills include measuring, manipulating, recording drawing, observing, classifying, inferring and the integrated process skills interpreting data, experimenting (KIE hand book, 2006). Biology learning to emphasize practical process skills.

From nature to the test tube and to experiments in the laboratory, observation must be used.

A useful characterization of scientific observation is given by Harlen (1987) taking information during practical activity learners are allowed to manipulate apparatus, handle specimens such as cutting instruments, magnifying lens, microscope and test tubes.

Furthermore, Okoli (2006) indicated that many science teachers prefer the traditional expository/lecture method of teaching that is, a teaching technique in which one person, the teacher, presents a spoken discourse on a particular subject and shy away from activity-oriented teaching methods which are student centered (such as inquiry method, discovery method, investigative laboratory approach). Nwagbo (2006) observed that such teacher-centered approach which places the teacher as the sole possessor of knowledge and the students as passive recipients of knowledge may not enhance achievement or promote positive attitude to biology.

2.4.1 Observation.

Almost every activity of science begins with observation about all things around, using the senses as appropriate and safe; identifying similarities and differences; noticing details and sequence; ordering observations. One of the national goals of education in Kenya is to enable the learners play a more effective role in the economic, technological and industrial development of the nation (Kenya Institute of Education, 2002). Among the many skills required to achieve this goal is observation skill, a skill which is developed by making drawings and diagrams. Allan et al. (1994) say that drawing has an important place in biological teaching because of its role in developing observation skills. Making of drawings of specimens is very fundamental in developing observational skills .Alkaslassy, O'Day (2002) noted that observing is a fundamental science process skill. We observe objects and events using all our five senses and this is how we learn about the world around us. According to Hayward (2000), observing is not simply a question looking, but it involves the use of all the senses, that is, sight, sound, touch, smell and even taste. One has to look at a specimen very carefully to be able to draw it accurately, and labeling of a drawing forces one to think about the component structures and their positions (Allan et al., 1994).This means that making and labeling of drawings in Biology sharpens a student’s observation and thinking skills making him able to relate

Observation alone is not necessarily an accurate and reliable activity for gathering data. Observers often “miss seemingly obvious things” and “invent quite false observations.” Nevertheless, the skill is valuable for and crucial to both the process of conducting scientific inquiry and to the process of teaching and studying the ways of science Angowo(2002).Observational skills expected in science are to read the instrument correctly, notice colour change, notice relevant details in given specimen, locate desired parts in specimen accurately, and take observations carefully in a systematic manner. Without studies to explain how this skill influence learning and performance in biology. Alego (1987) studies in junior secondary school pupils’ competence in some selected science process skill of observation, prediction, generalization and controlling variables found out that the nature of Kenya secondary schools is not process oriented as skills are not emphasized in syllabus although pupils are expected to acquire them informally through laboratory experiences. Junior secondary school pupils demonstrated low competency skill of observation, prediction, generalization and controlling variables. Performance in boys was better than those of girls in same skills. Despite the importance of this study, it felt short of explaining whether these skills are incorporated in teaching and examination and the impact on learning and performance.

2.4.2 Measurement.

Measuring involves evaluation; it is a process which involves comparison of an entity with a standard unit of measurement. In measuring learners are expected to compare and order objects by length, area, weight and volume.

Akinbobola (2010) analyzed science process skills in West Africa senior school certificate physics practical examination in Nigeria for a period of 10 years (1998-2007). Ex-post facto design was adapted for the study. The 5 prominent science process skills identified out of 15 used in the study were: manipulating (17%), calculating (14%), recording (14%), observing (12%), communicating (11%). The results also showed high percentage rate of basic lower order science process skills 63%) as compared to integrated higher order skills (37%). The results also indicated that the number of basic process skills were significantly higher than the integrated process skills. It recommended examination bodies to impress integrated skills to enable students to be prone to creativity, problem solving, thinking, originality and invention. There was need to study integrated skill experimentation on enhancing teaching and learning biology.

2.4.3 Drawing

Drawing skill subsumes other skills like observation; the learner is expected to make accurate well labeled biological diagrams. The role of drawing skills in the teaching and learning of Biology has often been underestimated. Schonborn, Anderson (as cited in Lerner, 2007) argue that the pedagogical importance of visual literacy and visualization in Biology and especially in the education of biochemistry has been ignored for a long time. Mei-Ying (1992) noted that very little research has been done on understanding the function of drawing in children’s writing and learning processes. The use of visual representations to learn can be traced to Louis Agassiz. In his approach, students were to study nature through carefully observing, drawing and making inferences (Lerner, 2007). In Biology, the study of life requires careful observation and description. One excellent way to describe an object is to draw it. The goal of the observer is normally to move beyond simple mental images of what he/she believes a particular plant or animal looks like, and instead concentrate on the unique identity of that specimen (Dempsey et al., 2001). Such approaches to learning in Biology will help students relate structure to function to a great extent .Aggarwal (2001) says that the making of drawings in botany and zoology is an accepted technique. He noted that drawing in Biology had the following functions:

Ensure that the pupil looks at and examines the details of the specimen with proper attention. This ensures meaningful learning which will be translated into good performance in Biology.

To provide avenues for learning through visual and kinesthetic experience in addition to the auditory experience of listening to the teacher. This breaks monotony during the learning process, resulting in increased attention span. To provide a record of the work done by the pupil. It also provides the pupil with material useful for revision. As it will be noted later, drawings can be used to summarize a large content of information. This makes it an excellent tool in preparing for examinations.

In addition to the above it acts as a medium for analysis and synthesis, that is to be a stimulus to think. This will help in solving the problem of candidates being unable to relate structure to function as indicated in the KNEC report of 2005.Ogunniyi (1996) defined science as an organized body of knowledge and processes by which that knowledge is gathered, analyzed, synthesized and disseminated. One way the scientific knowledge is disseminated is by use of drawings and diagrams.

Temba (2013) surveyed mastery of practical process skill drawing as a factor affecting performance in biology in Bungoma west district, Bungoma County. Schools and students were sampled through simple random sampling and balloting respectively responded to sets of questionnaire and tests. 85.51% of the students sampled lacked drawing skills. Most students could not draw specimen well and almost all could not make accurate observations of the specimen. It was necessary to investigate effect of learning incorporating process skill drawing and assessment of some of these basic process skills which also feature in theory papers.

2.4.4 Experimenting

Experimenting is testing by following procedures to produce verifiable results. It is process by which one carries a scientific test in order to study unfolding results and gain knowledge. It also involves, analyzing and presenting. For Gagne (1963), expertise in scientific inquiry is the ultimate objective of science education.

Further Toili (1985 by Gacheri,) investigated the relationship between acquisition of science process skill and achievement in science among class 7 pupils and found out that, there is positive correlation between performance in science process skill and science achievements, but similar studies was necessary at secondary level. The work is also general but focuses theory and practical without specifying which science process skills. There was need to extent research to secondary schools.

The conception of teaching and conducting guided study of science and scientific inquiry and the nature of science are rooted deeply in the activities and experiments which students under guidance undertake.

Stone (1972) suggested following steps in experimenting; identifying the problem, hypothesizing to guide investigation, propose ways of gathering data from controlled experiment, observation, reading, and other pertinent sources, carrying an investigation to gather the data, summarizing the data to conclude about the adequacy of hypothesis. Learners are expected to; design an investigation to test a hypothesis. Conduct simple experiments. Recognize limitations of methods and tools used in experiments, i.e. experimental error. Utilize safe procedures while conducting investigations.

Interpreting is a very important skill with respect to data from an investigation. The learners should be able to relate the data from an investigation to content and give out clear explanations (K.I.E hand book, 2006). Interpreting and inferring are critical determinant of science activities. Information gathered from scientific investigation usually is not readily useful and meaningful; data have to analyzed and interpreted. The question of assessment tools that are necessary in sciences has been a central issue in many scientific debates.

Although assessment schemes are designed to provide students with opportunities to present what they know to identify aspects of science, in a study by Owino, Indoshi (2013) in Kenya analyzed KNEC biology practical past papers for the last 10 years to determine process skills tested using Ex-post facto design. Findings showed that the most common process skills were observation (32.24%), inferring with frequency of (13.13%), experimenting with (12.2%) and interpreting data with frequency of (11.94%). According to 2009 KNEC report, questions testing on experimental design were poorly performed by candidates. There was need to establish impact of practical learning on performance in biology in Kenyan schools.

2.5 Practical Aspect in Science Education

Science practical skills have been emphasized in many learning education systems in the world (Lynch 1978, Weiss (1978), Woolnough , Betty 1982) but without an absolute agreement on assessment strategies. Hodson (1990) study on Assessment of practical Work, argued that "since1960s, numerous curriculum development projects have emphasized on hands- laboratory based practical work" as effective learning methods. The study however, raised critical concerns that increasing emphasis on skill-based approach, increases workload of teachers and reduced their scope of making judgment and tend to trivialize learning. Bennet (2001) argued that, written examinations" "cannot adequately assess the range of practical abilities." The study however, made a much generalized claim that, "school science curricula of many countries have "a clear commitment" to practical assessment, which is not substantiated as true for every country. Bryce and Robertson (1985), have for instance, stated that the fundamental problem is that "the poor implementations of practical work in schools" is what considerably undermined effective learning.

Practical science skills assessment have featured significantly, for example in Britain, since 1970s underscoring its importance, but lack of a clear agreement on what is to be taught and assessed in scientific inquiry has been seen as ambivalent. The methodological issues related to the way science should be studied and assessed, particularly whether the Ministry of Education guidelines are adhered to in secondary schools in Kenya remain understudied. The general dismal performance in sciences compared to art-related subjects is frequently highlighted by the media issues KNEC (2009, 2015), and is urgent for empirical investigations. The questions that beg answers are; do Kenya secondary schools apply important aspects of practical science like demonstration, laboratory activities, field and project activities, and do they know the impact on the learner? In Likuyani sub-county where the study was focused, showed consistent trend, where biology performances ranks below average. Although such results are helpful to explain how schools are performing, they hardly give any reasons to link results with the way students are instructed and assessed, particularly fundamental to students of science. This research was therefore, pertinent as it questioned whether biology is taught assessed within the proven science process skills and the impact on performance.

2.6 Learner achievement

Learner achievement measures the amount of academic content a student learns in a determined amount of time. Each grade level has learning goals or instructional standards that educators are required to teach. Standards are similar to a 'to-do' list that you can use to guide your instruction. Student achievement will increase when quality instruction is used to teach instructional standards. Learner’s achievement in biology is determined by scores at grade level and the final grade attained by students in final KCSE biology subject.

Biology syllabus in Kenya comprises of 16 topics from form one to four (4 in form 1,4 in form 2,4 in form 3 and 4 in form 4) to be taught within four years(KIE, 2002). Four topics were used for the research namely support and movement in animals, classification in animals, cell biology and chemicals of life because there is consistent poor performance in these topics. KNEC report (2014) indicated that questions testing aspect of cell were performed poorly especially drawing and labeling cellular diagrams, chemicals of life are organic in nature found in living things .KNEC (2014) report indicated that most students had incorrect procedures, wrong colour observations, support in animals is a challenging topic due to difficulties to comprehend the terms, relate bone parts with function.

The performance of the subject in national exam in Kenya has not been satisfactory as exemplified by the table below showing performance in biology both papers for the last 8 years.

Table 2.1: KCSE performance in Biology

Year	2007	2008	2009	2010	2011	2012	2013	2014
P1 mean	27.10	22.24	23.21	20.14	22.74	19.77	28.03	23.91
P2	35.01	21.09	18.41	18.43	23.31	20.70	22.36	18.92
P3	21.81	17.30	15.86	18.42	18.84	11.97	12.88	19.51

Source: KNEC: 2008, 2014 report.

Although there exists a rich literature on possible causes of this performance for example congested syllabus, heavy work load, lack of laboratory facilities, Wekesa (2003), study sought to investigate the effect practical learning and assessment on performance of biology.

Some learners have exhibited lost interest along the way in biology as they move from junior to senior classes in secondary schools partly attributed to low motivation among students, overloaded curriculum and poor management of the subject by schools. Following these findings this study delved into analytical insight on the effect of teaching styles and assessment of the subject teacher in Biology classrooms on academic performance.

Bennet (2001) supported the claim that the use of written examination to assess practical abilities is likely to permit very little range of skills assessed. Ango (2002) argued that in Africa science teaching was weak compared to developed countries and they tended to emphasize rote learning without any expertise in science process skills. Tsai, (2012) emphasized on students involvement or heuristic learning and termed this teacher-facilitated student centered pedagogy as most productive, a finding this study investigated through practical incorporation. KNEC (2009) report indicated questions testing on adaptations performed poorly because candidates failed to relate structure to function.

This study sought to investigate link to these work done by Bennet and Wekesa in the sense that Biology teaching ought to emphasize practical aspect in its approach.

Another major challenge in teaching of Biology identified in this literature was lack of adequate laboratory resources. To this end the government sponsored in-service course; Strengthening of Mathematics and Sciences in Secondary Schools Education (SMASSE) program advocated for the teachers to improvise teaching and learning materials from the environment in what was called Activity, Student, Experiment and Improvisation (ASEI) lesson, which was an endeavor to demystify the concepts thought difficult to conceptualize such as use of process practical skills to teach problematic topics to bridge the existing gap.

From various research it indicates that most examination bodies assess lower cadre basic process skills Akinbola (2010) without much attention on higher integrated process skills. This study investigated integrated process skill experimenting to fill the gap.

Most research on acquisition of process skills were focused at junior primary schools Toil (1985) similar studies are necessary at secondary schools.

2.7 Summary of literature review.

This literature revealed that there were several factors that would determine how much practical approach in teaching and assessment could be done in a class of biology to enhance performance .There existed massive empirical data on benefits of the progressive thought that practical approach as a teaching pedagogy would impact on performance that education stakeholders, teachers and learners would reap if fully utilized. The literature revealed that the use of practical activities could help make learning concrete and less abstract. This study sought to address gaps existing in the use of practical approach to change teaching pedagogies.

Although there were lots of data showing how integration could solve the challenges of teaching and assessment, there was little empirical data that showed how deep practical approach had been done in Biology classes in Likuyani sub-county public secondary schools and in the entire country. Little had been mentioned on what extent learning Biology had been made less abstract by practical approach. The study sought to bridge this gap by using examples in Likuyani sub-county and whose results could be used to generalize in the entire country.

2.8 Theoretical framework.

This study adopted the theory of discovery learning by Jean Piaget (1973), constructivism by Vygotsky and Brunner.

In his book to understand is to invent. Piaget argued that understanding comes from discovery. Furthermore, without understanding production and creativity are lost. Hence, the individual is caught in repetition. Discovery learning encompasses an instructional model and strategies that focus on active, hands-on learning opportunities for students. Piaget described three main attributes of discovery learning as:

Exploring and problem solving to create, integrate and generate knowledge.

Student driven, interest-based activities in which the student determines the sequence and frequency.

Activities to encourage integration of new knowledge into the learner's existing knowledge base.

The first attribute of discovery learning is a very important one. Through exploring and problem solving, students take on an active role to create, integrate, and generalize knowledge. Instead of engaging in passively accepting information through lecture or drill and practice, students establish broader applications of skills through activities that encourage risk-taking, problem solving, and an examination of unique experiences (Bicknell- holmes and hoffmans, 2000). This study considered learning by discovery while integrating the science process skills together and gradually developing abilities to design fair tests .

Vygotsky's main work was in developmental psychology, and he proposed a theory of the development of higher cognitive functions in children that saw reasoning as emerging through practical activity in a social environment. During the earlier period of his career he argued that the development of reasoning was mediated by signs and symbols, and therefore contingent on cultural practices and language as well as on universal cognitive processes.

From his theory learning is through practical enhancing student centered approach as teaching and learning style.

Vygotsky also posited a concept of the Zone of Proximal Development, often understood to refer to the way in which the acquisition of new knowledge is dependent on previous learning, as well as the availability of instruction.
This study was based on Bruner's (1966) constructivist theory of learning. Constructivist theory states that learning is an active process where the learner creates meaning from different experiences. The facets of the process include selection and transformation of information, decision making, generating hypothesis and making meaning from information and experiences while relying on cognitive structure to do so. Cognitive structure (i.e., schema or mental models) provides meaning and organization to experiences and allows the individual to "to go beyond the information given". According to Bruner, learners construct new ideas based upon their current and past knowledge. This as Brooks and Brooks (1993) notes means that a teacher cannot "pour" information into a student's brain and expect them to process it and apply it correctly later. The teacher facilitates moderates and suggests while allowing the students to experiment asks questions or perform activities that require the student's full participation. The study integrated practical process skills in teaching and learning as envisaged by Brunner.

Dewey (1997) by Gacheri believed that children were naturally motivated to actively learn and that education only served to make more learning. Dewey saw children as participants in their learning rather than receivers of their learning. The teacher role is to present students with materials, situations and occasions that allow them to discover new learning. In active learning, the teacher confidence in the child's ability to learn on its own is important. Science process focuses on the acquisition and the use of process skills. It also emphasize the process being taught. It draws attention to the following process skills applying, interpreting, classifying, investigating, observing, experimenting, drawing, hypothesizing, raising question and inferring. The modern trend in science instructions is of stressing the acquisition of the process of learning the subject rather than mere acquisition of the content of the subject. According to Rezba (1999) in the earliest grades students spend a larger amount of time using skills Such as observation and communication. As the students get older they spend more time using the skills of inference and prediction. Classification and measurement tend to be used across the grade levels more evenly, partly because there are different ways to do classifying, in increasingly complex ways, and because methods and systems of measuring must also be introduced to children gradually over time. This study consider learning by discovery while integrating the science process skills together and gradually developing abilities to design fair tests as essential in successive grade levels.

2.9 Conceptual framework.

The conceptual framework had independent variable and dependent variables. The independent variables were : science practical process skills, drawing, observation ,experimenting and measurement. The researcher manipulated independent variables in order to determine how they affected the dependent variable which is learner achievement in biology. Other confounding variables which might have affected the research included: teachers workload, teacher training, students entry behavior and absenteeism .It is illustrated as shown in the diagram below:

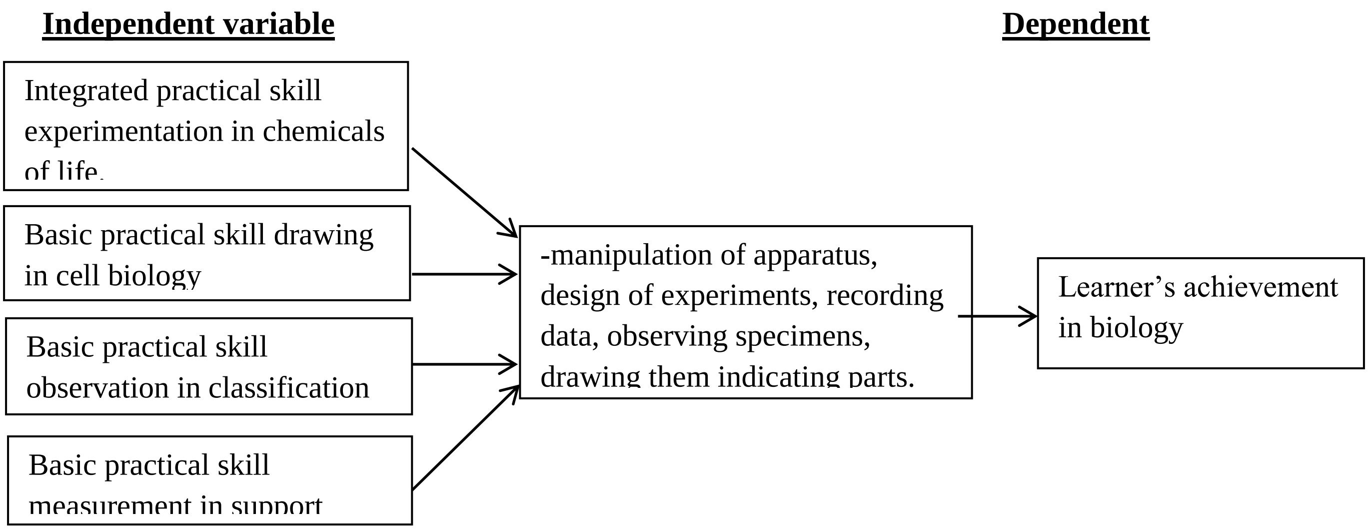


Fig 2.1 Conceptual framework

Discovery learning encompasses an instructional model and strategies that focus on active, hands-on learning opportunities for students. Understanding comes from discovery. The major inputs in discovery learning in sciences involves; new findings, verification through experiments and other procedures, its output involves knowledge content, acquiring skills, solution of problems, explanation of nature, creative application and innovation. On the other hand, science process focuses on the acquisition and the use of process skills. It draws attention to the following process skills applying, interpreting, classifying, investigating, observing, experimenting, measuring drawing, predicting, hypothesizing, and inferring. The theoretical framework tried to address acquisition of the skills thorough active learning in general but it fell short of describing how it is taught and assessed to attain competency. The conceptual framework aided by addressing the shortfalls of the theoretical framework.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter presented a description of the procedures and methods that the researcher used in order to obtain the required data needed for the study. It comprised the research design, target population, sampling strategy, the sample size, data collection tools, instruments and data analysis.

3.2 Research design

The research project used Quasi- experimental design. Mugenda and Mugenda (1999) define experimental research as an experiment that involves manipulation of independent variables to determine their effect on a dependent variable. The independent variables were the treatments. Pre-test exam was administered to establish learner's background on the topics of research (Appendix V). The design consisted of one experimental group and one control group. A small number of participants were chosen to obtain more refined information. For efficient management and control of experiment conditions, it was necessary to use a small number of schools in teaching experiment. Four schools were used to provide experimental group based on availability of school laboratory providing 200 participants distributed over cluster region The researcher trained biology teachers who taught experimental group on application of instructional approach. This group was exposed to the practical activities during teaching and learning process. One class was taught classes of food through real experimental design in the laboratory, students wrote procedures, did the experiment, observed, recorded and inferred. Another group was taught classification by observing real plants and animal specimens. Support in plants and animals was taught by observing real types of bones, measured length and related to their function, then measured fish size. Cell biology was taught by observing cells by aid of microscope, Students were required to make well labelled diagrams of these cells. Another four schools provided control group (200) where Learners were exposed to traditional teacher –led conventional method of teaching.

Immediately after the stipulated time of three weeks of learning, the two groups then sat for a similar written standard achievement test (post-test) based on specific instructional objectives. The scripts were marked by biology teachers and scores recorded. The learners were given back the marked scripts and respective teachers given a brief report on the outcome on various group performances.

3.3 Target population

According to Mugenda and Mugenda (2003), population refers to the entire group of individuals, events or objects having common observable characteristics. The study targeted biology teachers and biology students in public schools in Likuyani sub-county, Kakamega County. Public schools were targeted because they benefit from government subsidies for procurement of laboratory materials and text books unlike private schools. Form one; four and three students were targeted because the topics are covered in those classes according to the syllabus. Biology teachers were targeted since they are experts in the subject. There was total number of 23 public schools in Likuyani sub-county in the year 2015 with total population of 9440 students. From this 8 schools were used comprising of 30% which constituted target group based on being in form1,3 and 4 in public secondary schools.

3.4 Sampling procedures and sample size.

Eight schools were sampled purposively in Likuyani sub-county. This formed 30% of schools in the sub-county. Stratification by gender- Mixed, Boys and girls day schools. This was because their entry behavior marks of standard eight was homogenous. Each stratum was allocated a share of the sample through proportional allocation technique (Kothari, 2008). From target population a sample of 400 students was drawn purposively of which 200 formed experimental group and 200 control groups. Experimental group was arrived at on basis of availability of laboratory resources and control group on basis of class size.

A total of 8 trained experienced biology teachers from the selected schools were involved in the experiment of which half for experimental and control group. Teachers were selected on basis of willingness to participate in the research, who taught form 1,3 and 4 classes in that particular school.

3.5 Research Instruments.

The teacher was the sole instructor for the teacher led class of the control group which comprised of 200 students distributed in 4 schools. The teacher used traditional conventional method of teaching. Each lesson lasted 40 minutes, two lessons per week for total of 3 weeks.

For each group a common achievement pretest and post- test was administered (Appendix I) and (Appendix V) respectively, whose duration was 1 hour, the average duration for schools continuous assessment tests. The test given was a representative of the syllabus content in the topics with focus on Blooms taxonomy; remembering, understanding, interpreting, application, analysis. It was marked out 50 marks and converted to percentage to evaluate learners 'performance on the topics which were rated using similar marking scheme (Appendix II) for fair comparison. The results scores from both experimental and control groups were recorded in excel spreadsheets for preparation of analysis. Questionaire (Appendix iv) was also used to determine demographic factors. The research instruments were pre-tested in one public mixed school outside the sample.

3.6 Pilot study.

Piloting was done to refine the instruments before they were applied in actual research. Mugenda and Mugenda (1999) observe that piloting ensures that research instruments are clearly stated and have the same meaning to all respondents. Since the actual study was in 8 schools, piloting on one school in Uasingishu county constituted 12% coverage of the total sample population. Piloting ensured that the instruments are of acceptable reliability and validity.

3.6.1 Validity of instruments.

Validity of test is defined by Henning stout(1994) as the extent to which the test procedure measures what it is intended to measure. A test is appropriate if its performance in fact accurately reflect the objectives**.** A group of peer review test moderators who are the biology teachers analyzed the items to gauge suitability of the tests in terms of the content and objectives. Moderation was a means of adjusting to ensure consistency of assessment standards across schools due to concerns raised by Mwanyumba (2009).

3.6.2 Reliability of instruments

Reliability refers to how consistent scores for an individual are .It is a measure of how stable; trustworthy a test is in measuring the same thing each time.

Test-Retest method was used to determine reliability of the achievement test (Appendix III), how much error is in the test score. To determine it the test was administered to the same participants on two different occasions. Correlated test scores of the two administrations of the same test was determined .Spearman Brown formula was used to determine reliability (Appendix III). Pilot students from Uasin gishu County were used to sit for the test twice. The reliability p= 0.8, was high (Appendix III).

3.6.3 Ethical consideration

It is the view of the respondent's security and respect that the information the respondent gave in this study was treated confidentially and was not disclosed to anybody.

Mc Namara (2004) highlights ethical concerns that were adhered to before embarking on research. The same principle was adhered to by researcher. The principles are : identity of people from whom information will be obtained in the course of the study be kept strictly confidential. The nature and purpose of the research be explained to the respondents by the researcher so as to allay any fears of other ulterior motives other than academic research. The participants were assured of anonymity; and their ability to withdraw from the study at will also assured. On consent; first, a request letter to the selected school's administration seeking permission to involve and students and teachers was done.

Permission from Nairobi University was sought after which application for a research permit was made from ministry of education. Data documents after analysis and final presentation were properly disposed.

3.7 Data processing and analysis.

3.7.1 Data processing.

Each school was coded for students in each category either in experimental group 1 learning by practical activities or in control group 2 traditional conventional methodology of teaching and learning for easier recording and processing of results. Marking of the scripts was done by teachers who participated in the research of various groups using similar marking scheme for uniformity.

The results were recorded in a score sheet and the marked scripts returned to students.

Data file was created where raw marks were entered in excel spreadsheet. Scores were converted to percentage to give a better form for statistical analysis. Data was analyzed using descriptive statistics. Descriptive statistics included frequencies of occurrence, mean and standard deviation. The descriptive technique was chosen because it enabled the researcher to meaningfully describe the scores or measurement using a few indices. A paired two sample t-test was used to test the significant of the mean.

Statistical package for social sciences (SPSS) was used to define variables, create tables and generate graphs from data.

CHAPTER FOUR

ANALYSIS, RESULTS AND DISCUSSION

4.1 Introduction.

This chapter dealt with data analysis results, interpretation and discussion of the findings. This chapter was divided into the following sections; General characteristics of the respondents; data analysis results and discussion per objective.

4.2 General characteristics of respondents.

The study was informed by trained experienced Biology teachers, form one, three and four biology students in public day secondary schools in Likuyani sub-county. There were 408 respondents comprising 200,100 and 100 form one, three and four students respectively. 8 biology teachers were involved.

The data collected from pre-test and post-test were analyzed to obtain mean, standard deviation and t-test to answer research questions

4.2.1 Gender and Age Distribution of Respondents

The respondents were asked to give their gender and age distribution. The response is as shown in table 4.1.

Table 4.1 Crosstabulation for Gender and age of Respondents

			Age of Respondents					Total
			18-25 years	26-35 years	36-45 years	46-55 years	Over 55 Years	
Gender of Respondents	Male	Count	26	83	96	34	22	261
		% within Age of Respondents	66.7%	68.6%	65.3%	68.0%	81.5%	68.0%
		% of Total	6.8%	21.6%	25.0%	8.9%	5.7%	68.0%
	Female	Count	13	38	51	16	5	123
		% within Age of Respondents	33.3%	31.4%	34.7%	32.0%	18.5%	32.0%
		% of Total	3.4%	9.9%	13.3%	4.2%	1.3%	32.0%
Total		Count	39	121	147	50	27	384
		% within Age of Respondents	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	10.2%	31.5%	38.3%	13.0%	7.0%	100.0%

Source: Survey Data (2015)

From Table 4.1 it is evident that majority at 68.0% were male while only 32.0% were female. This indicates that the overall teaching profession at Lukuyani was male dominated. Eshiwani (2003) observes that the culture of male teaching and particularly headship in schools is still rampant with many education stakeholders in rural schools preferring a male leader at the detriment of their female counterparts. This is supported by Nwagbo (2008) who argued that the teachers of sciences like most social sciences is still male dominated.

On age, majority at 38.3% were aged between 36-45 years, followed by 31.5% between 26-35 years, 12.0% between 46-55 years, 10.2% between 18-25 years and only 7.0% were aged above 55 years.

4.2.2 Level of Education and Work Experience

Education is important for the acquisition of necessary skills and competencies for proper work (Opwora, 2005). Further, the respondents had served for varied number of years as teachers . The result is as shown in Table 4.2.

Table 4.2 Cross tabulation of Level of Education and years served

			Number of Years Worked				Total
			Below 5 years	5-10 years	10-15 years	Above 15 years	
Highest Level of Education Attained	Diploma	Count	8	15	25	17	65
		% within Number of Years Worked	17.0%	23.1%	22.7%	10.5%	16.9%
		% of Total	2.1%	3.9%	6.5%	4.4%	16.9%
	First Degree	Count	23	31	47	114	215
		% within Number of Years Worked	48.9%	47.7%	42.7%	66.7%	56.0%
		% of Total	6.0%	8.1%	12.2%	29.7%	56.0%
	Post Graduate Diploma	Count	10	12	22	16	60
		% within Number of Years Worked	21.3%	18.5%	20.0%	9.9%	15.6%
		% of Total	2.6%	3.1%	5.7%	4.2%	15.6%
	Masters	Count	6	7	16	15	44
		% within Number of Years Worked	12.8%	10.8%	14.5%	9.3%	11.5%
		% of Total	1.6%	1.8%	4.2%	3.9%	11.5%
Total		Count	47	65	110	162	384
		% within Number of Years Worked	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	12.2%	16.9%	28.6%	42.2%	100.0%

Source: Survey Data (2015)

From table 4.2 it is evident that majority at 56.0% were first degree holders, 16.9% had diplomas, 15.6% were post graduate diploma holders and 11.5% were Master's Degree holders. This is an indication that the teaching workforce was well educated. It further implies that there had been efforts by the respondents to further their studies. As a result the respondents who had first degree education and above were more knowledgeable compared to the others. Moreover, the fact that majority of the respondents had degree qualification and above implies that they were qualified to reliably teach well.

On their experience, majority at 42.2% had worked for more than 15 years, 28.6% had worked for between 10-15 years, 16.9% had worked for between 5-10 years and only 12.2% had worked for less than 5 years. This implies that majority of respondents were fairly experienced. The level of experience indicated above is significant because the credibility of the information gathered in any study is informed by the many years of the respondents' service to the organization (Osborne, 2005). The experience proves the validity and reliability of the information obtained. Their skills, knowledge and expertise had been tested for a long period hence their perception on the matter under study had been influenced by their experience. From the table you would notice that the respondents seeking higher education was proportionate with the number of years worked, basically, implying a need to improve on education as years go by.

4.3 Findings on performance in pre-test schools.

The study was to investigate effect of school based practical assessment on learner achievement in biology. During the study, schools were administered with the same test. Tests were administered and marked out of 100%. The results of analysed data are shown in

Table 4.3

Process Skill		Experimental	Control	Mean		Standard Deviation	
				Exp	Ctrl	Exp	Ctrl
Observation	Valid	35	39	41.97	40.72	14.362	14.294
	Missing	4	0				
Experimenting	Valid	35	33	40.86	36.18	17.411	15.735
	Missing	0	2				
Drawing	Valid	30	36	38.47	39.44	17.778	16.266
	Missing	6	0				
Measurement	Valid	39	36	34.77	37.44	14.346	14.090
	Missing	0	3				

The tables shows that both experimental and control classes had pre-test mean scores below population mean. Means were as follows 41.97 and 40.72, 40.86 and 36.18, 38.47 and 39.47,34.77 and 37.44 in comparison to population mean of 50% with standard deviation of 14.36,14.29,17.41,15.73,17.77,16.26,14.36 and14.09 respectively. The high standard deviation means scores were widely spread not concentrated around the mean. Low mean score meant that students' performance in these topics is poor .

4.4 Practical process skill of Observation.

The first objective sought to establish the effect of observation on learning classification in animals .The results are as shown in tables 4.4 and graph 4.1

Table 4.4: practical skill observation

a. Group=practical process skill observation integrated class (experimental).

Score[a]

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	44.00	1	2.0	2.0	2.0
	46.00	2	4.0	4.0	6.0
	48.00	1	2.0	2.0	8.0
	50.00	2	4.0	4.0	12.0
	54.00	3	6.0	6.0	18.0
	56.00	2	4.0	4.0	22.0
	58.00	4	8.0	8.0	30.0
	60.00	3	6.0	6.0	36.0
	62.00	2	4.0	4.0	40.0
	64.00	4	8.0	8.0	48.0
	68.00	3	6.0	6.0	54.0
	70.00	4	8.0	8.0	62.0
	72.00	5	10.0	10.0	72.0
	74.00	4	8.0	8.0	80.0
	76.00	4	8.0	8.0	88.0
	78.00	2	4.0	4.0	92.0
	80.00	1	2.0	2.0	94.0
	84.00	2	4.0	4.0	98.0
	88.00	1	2.0	2.0	100.0
	Total	50	100.0	100.0	

Statistics[a]

Score

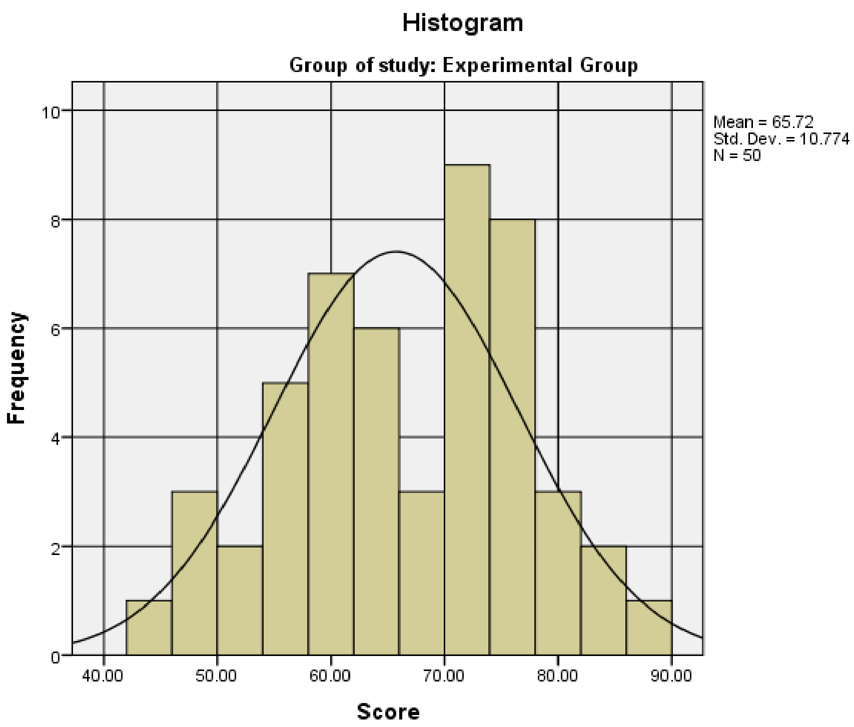
N	Valid	50
	Missing	0
Mean		65.7200
Median		68.0000
Mode		72.00
Std. Deviation		10.77419
Variance		116.083

a. Group of study = Experimental Group

The table 4.4 above presents a summary of the test scores from the data file created for the process skill observation. The analysis was then used to compute the mean and standard deviation to generate histogram. It showed that the class had high mean score 65.72% and lower standard deviation 10.771.High mean score confirms that methodology used by the teacher in teaching was more effective. Low standard deviation meant that scores were more consistent majority of students scored above 50%. The practical process observation as practical approach to instruction improved learning process in students. From the results, observation clearly affects learning classification in animals. Literature attests to this. Alkaslassy and O'Day (2002) noted that observing is a fundamental science process skill. We observe objects and events using all our five senses and this is how we learn about the world around us. According to Hayward (2000), observing is not simply a question looking, but it involves the use of all the senses, that is, sight, sound, touch, smell and even taste. One has to look at a specimen very carefully to be able to draw it accurately, and labeling of a drawing forces one to think about the component structures and their positions

Integration of this practical process skill observation contributed to better performance in the experimental class.

The results were then used to obtain histogram as shown in graph 4.1.



Graph 4.1, Source :Research Data(2015)

The above graph indicated that the distribution tended to assume normal curve shape but slightly negatively skewed with majority of students obtaining high marks which suggested a good performance.

The above results was compared with control group taught by traditional teacher- led conventional method.

Table 4.5 Group of study=control

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	20.00	1	2.0	2.0	2.0
	26.00	2	4.0	4.0	6.0
	28.00	2	4.0	4.0	10.0
	30.00	6	12.0	12.0	22.0
	32.00	5	10.0	10.0	32.0
	34.00	4	8.0	8.0	40.0
	38.00	3	6.0	6.0	46.0
	40.00	2	4.0	4.0	50.0
	42.00	1	2.0	2.0	52.0
	46.00	2	4.0	4.0	56.0
	48.00	2	4.0	4.0	60.0
	50.00	3	6.0	6.0	66.0
	52.00	4	8.0	8.0	74.0
	56.00	3	6.0	6.0	80.0
	58.00	1	2.0	2.0	82.0
	60.00	2	4.0	4.0	86.0
	62.00	2	4.0	4.0	90.0
	64.00	1	2.0	2.0	92.0
	66.00	2	4.0	4.0	96.0
	68.00	1	2.0	2.0	98.0
	80.00	1	2.0	2.0	100.0
	Total	50	100.0	100.0	

Source: Research Data(2015)

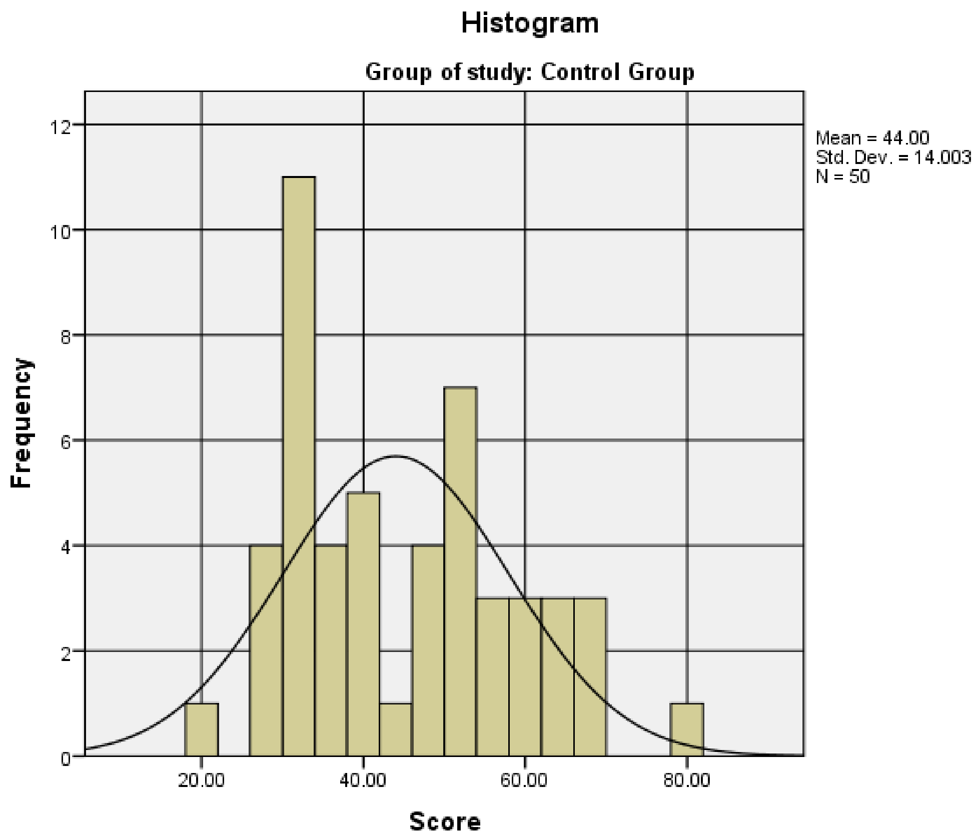
Group of study = Control Group

Statistics[a]

Score

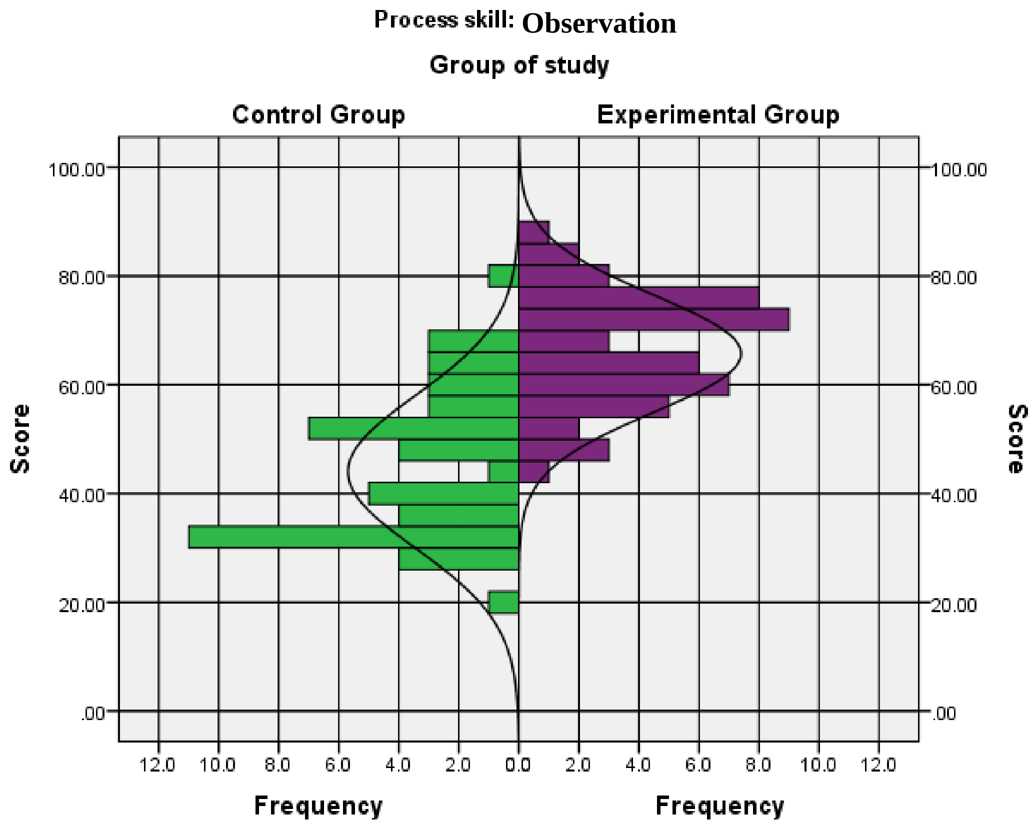
N	Valid	50
	Missing	0
Mean		44.0000
Median		41.0000
Mode		30.00
Std. Deviation		14.00292
Variance		196.082

The above table indicated that the control group had a lower mean score 44% and higher standard deviation 14.002. Poor performance of the control class could be attributed to traditional teacher-led method of instruction without involving much the learners. High standard deviation means that scores were widely spread because students scored much lower marks below 50%. The results were then used to obtain histogram as shown in graph 4.2 below.



Graph 4.2

From the histogram above it indicated that the distribution tended to assume normal curve shape but slightly positively skewed suggesting that only few students scored higher marks in the test. The experimental and control group results were summarized in the graph below.



Graph 4.3 comparing control and experimental group.

Whether observation affects learning classification in animals, experimental class had high post-test mean score of 65.720% , control class 44% with mean difference of 21.720%. From the drawn histogram it showed normal distribution curve shape but slightly negatively skewed but control class slightly positively skewed, majority of students scored high marks in the experimental class and many students in the control class scored low marks.

The pre-test mean scores for experimental class was 41.97% and standard deviation score of 14.36% while control class 40.% and14.29% .The mean achievement gain for this experimental class was 25.75% and mean gain for control class was 3.28% indicating superiority of treatment group over control group.

Integration of this practical process skill observation might have contributed to better performance in the experimental class. Observational skills in science are to read instrument correctly, notice colour change, notice relevant details in given specimen, locate desired parts in specimen. The skill is valuable for conducting scientific inquiry and to the process of teaching and studying the ways of science (Ango,2002).

4.5 Practical process skill of Experimenting

The second objective sought to determine the effect of experimenting on learning chemicals of life. The results are seen in tables and graphs below.

Group of study = Experimental Group

Statistics[a]
Score

N	**Valid**	**50**
	Missing	**0**
Mean		**60.5200**
Std. Deviation		**14.21589**

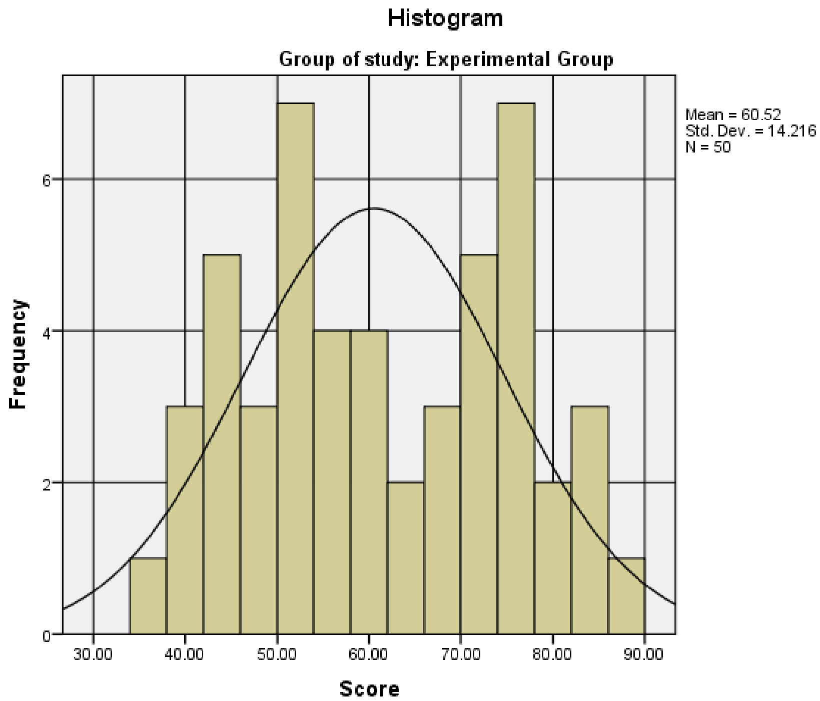
Table 4.6 Practical skill experimenting.
Score[a]

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	36.00	1	2.0	2.0	2.0
	38.00	2	4.0	4.0	6.0
	40.00	1	2.0	2.0	8.0
	42.00	2	4.0	4.0	12.0
	44.00	3	6.0	6.0	18.0
	46.00	1	2.0	2.0	20.0
	48.00	2	4.0	4.0	24.0
	50.00	4	8.0	8.0	32.0
	52.00	3	6.0	6.0	38.0
	54.00	1	2.0	2.0	40.0
	56.00	3	6.0	6.0	46.0
	58.00	3	6.0	6.0	52.0
	60.00	1	2.0	2.0	54.0
	64.00	2	4.0	4.0	58.0
	68.00	3	6.0	6.0	64.0
	70.00	2	4.0	4.0	68.0
	72.00	3	6.0	6.0	74.0
	74.00	4	8.0	8.0	82.0
	76.00	3	6.0	6.0	88.0
	78.00	2	4.0	4.0	92.0
	82.00	2	4.0	4.0	96.0
	84.00	1	2.0	2.0	98.0
	88.00	1	2.0	2.0	100.0
	Total	50	100.0	100.0	

a. Group of study = Experimental Group

Source: Research Data (2015)

From the table it is clear that the group had higher mean score 60.52% and lowers standard deviation 14.315.High mean score for the experimental group is attributed to teaching methodology used by the teacher through hands on learner centered approach through experimental design. This agrees with literature, as it argues that this difference in performance could be attributed to teaching the topic chemicals of life through experiment design. Experimenting is an inquiry teaching pedagogy as opposed deductive approach. Inquiry approach provides means to increased interest in science by students. Experimenting is an integrated process skill where learners are expected to design an investigation to test hypothesis .This affirms that integrated practical process skill is increasingly important in learning science Akinbobola (2010).The results obtained were then used to obtain histogram.



Graph 4.4: practical process skill experimenting integrated group.

From the above graph it indicated that the distribution tended to assume a normal curve shape but negatively skewed .This suggested that majority of students scored high marks indicating a good performance.

The results from this group in comparison with control group as shown below.

.

Frequencies

Group of study = Control Group

Score[a]

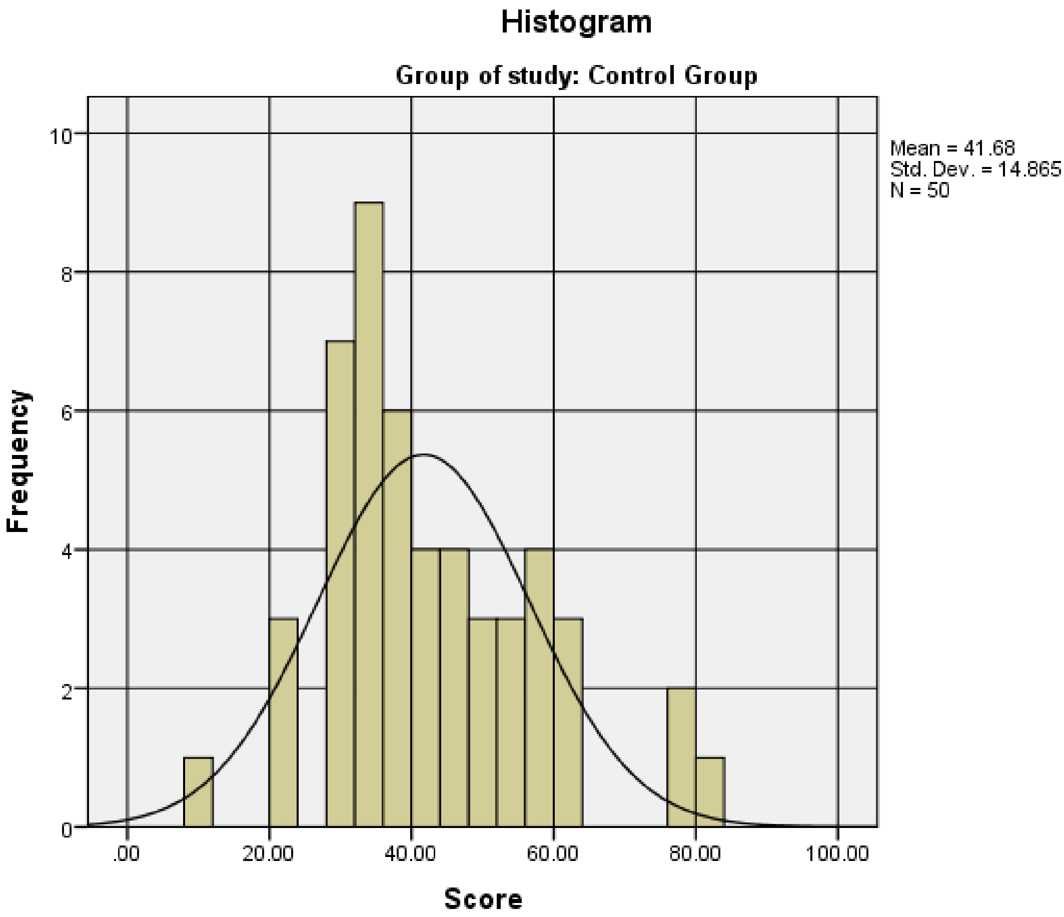
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	10.00	1	2.0	2.0	2.0
	20.00	2	4.0	4.0	6.0
	22.00	1	2.0	2.0	8.0
	28.00	3	6.0	6.0	14.0
	30.00	4	8.0	8.0	22.0
	32.00	5	10.0	10.0	32.0
	34.00	4	8.0	8.0	40.0
	36.00	3	6.0	6.0	46.0
	38.00	3	6.0	6.0	52.0
	40.00	2	4.0	4.0	56.0
	42.00	2	4.0	4.0	60.0
	44.00	3	6.0	6.0	66.0
	46.00	1	2.0	2.0	68.0
	48.00	2	4.0	4.0	72.0
	50.00	1	2.0	2.0	74.0
	52.00	1	2.0	2.0	76.0
	54.00	2	4.0	4.0	80.0
	56.00	3	6.0	6.0	86.0
	58.00	1	2.0	2.0	88.0
	60.00	2	4.0	4.0	92.0
	62.00	1	2.0	2.0	94.0
	76.00	2	4.0	4.0	98.0
	82.00	1	2.0	2.0	100.0
	Total	50	100.0	100.0	

Table 4.7, Source Research Data (2015)

N	Valid	50
	Missing	0
Mean		41.6800
Median		38.0000
Mode		32.00
Std. Deviation		14.86461
Variance		220.957

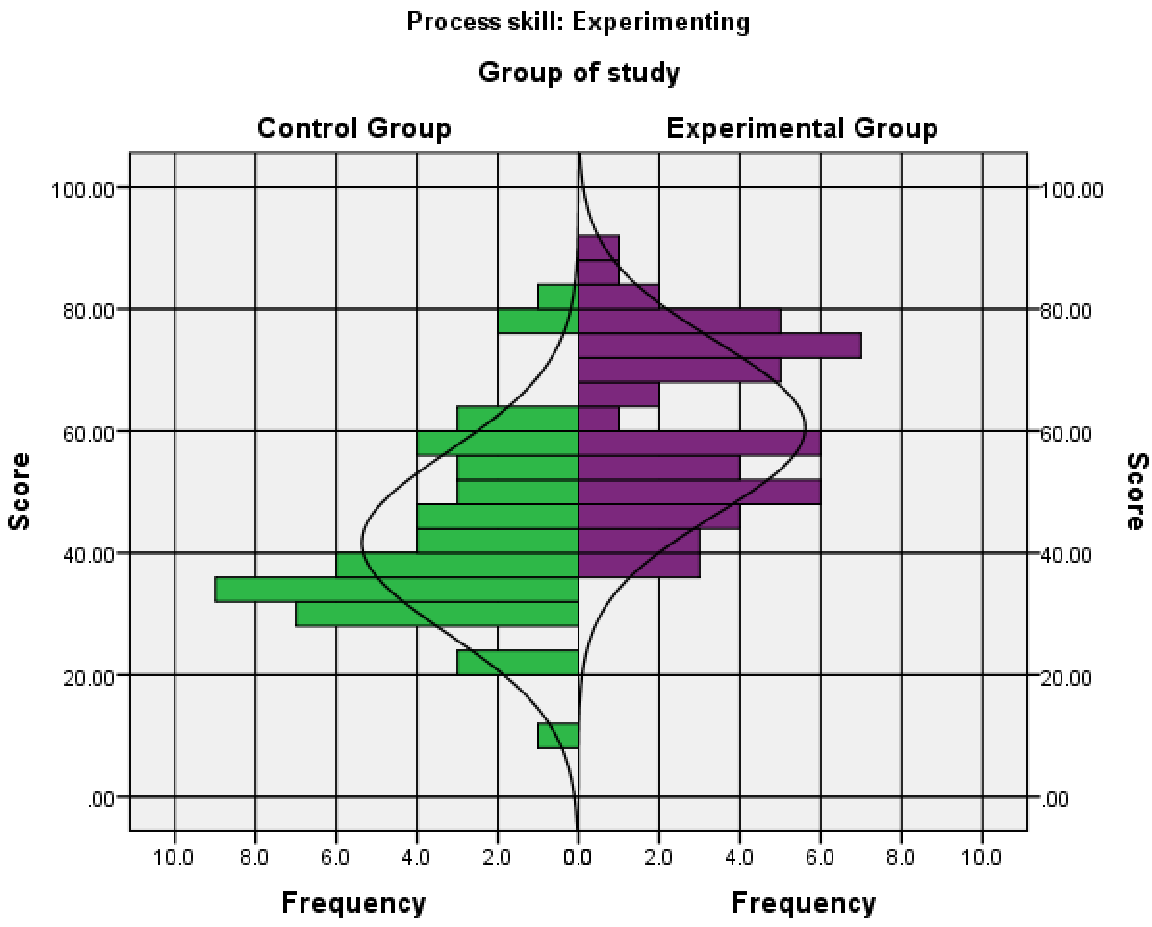
From the above results the class has lower mean score 41.68% and higher standard deviation 14.864. Most student performed below average and scores were widely spread , this could be attributed to teacher centered method of teaching as opposed student centered.

Graph 4.5.



Graph 4.5 indicated that the distribution tended to assume normal curve but slightly positively skewed suggesting that majority of students scored lower marks and few scored higher marks in the test.

The two groups were compared and summarized as shown in the graph below.



Graph 4.6, comparison between experimental and control group

Experimental class had mean score of 60.520%, control class mean 41.680% with mean difference of 18.840% between the groups. Histograms obtained indicated normal distribution curve but negatively skewed and control class slightly positively skewed, many students scored high marks in the experimental class than in control class.

Pre-test mean scores for experimental group was 40.86% and control group 36.18%.

Mean achievement gain for experimental group was 19.66% and control group 0.96% indicating superiority of experimental group.

This difference in performance could be attributed to teaching the topic chemicals of life through experiment design. Experimenting is an inquiry teaching pedagogy as opposed deductive approach. Inquiry approach provides means to increased interest in science by students. Experimenting is an integrated process skill where learners are expected to design an investigation to test hypothesis .

4.6 Practical process skill of Drawing.

The third objective sought to establish the effect of drawing on learning cell biology. The results are as shown in table 4.8

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	40.00	2	4.0	4.0	4.0
	44.00	2	4.0	4.0	8.0
	46.00	1	2.0	2.0	10.0
	48.00	2	4.0	4.0	14.0
	50.00	1	2.0	2.0	16.0
	54.00	4	8.0	8.0	24.0
	56.00	3	6.0	6.0	30.0
	58.00	4	8.0	8.0	38.0
	60.00	3	6.0	6.0	44.0
	62.00	4	8.0	8.0	52.0
	64.00	3	6.0	6.0	58.0
	66.00	4	8.0	8.0	66.0
	70.00	2	4.0	4.0	70.0
	72.00	3	6.0	6.0	76.0
	74.00	5	10.0	10.0	86.0
	76.00	3	6.0	6.0	92.0
	78.00	2	4.0	4.0	96.0
	80.00	1	2.0	2.0	98.0
	82.00	1	2.0	2.0	100.0
	Total	50	100.0	100.0	

Table 4.8 practical process skill drawing,(experimental group).
Source: Research Data (2015).

Group of study = Experimental Group

Statistics[a]

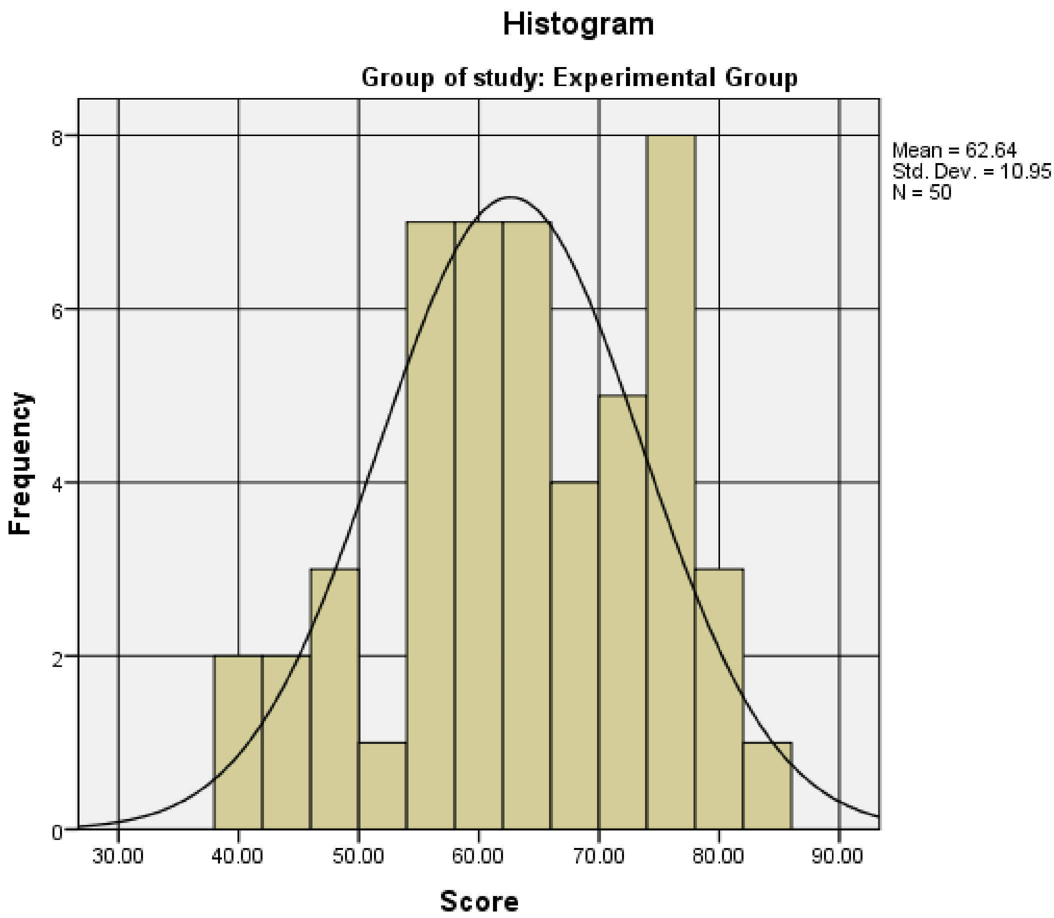
Score

N	Valid	50
	Missing	0
Mean		62.6400
Median		62.0000
Mode		74.00
Std. Deviation		10.95028
Variance		119.909

a. Group of study = Experimental

From the table it was clear that the class has high mean score 62.64% and lower standard deviation 10.950. Majority of students scored above average 50% and majority had more consistent scores about the mean. Good performance could be attributed to teaching and learning style used by teacher and students. Integration of process skill drawing could have contributed to this performance. This is also agreed to in literature, Schonborn and Anderson (as cited in Lerner, 2007) argued that the pedagogical importance of visual literacy and visualization in Biology and especially in the education of biochemistry has been ignored for a long time. Mei-Ying (1992) noted that very little research has been done on understanding the function of drawing in children's writing and learning processes. The use of visual representations to learn can be traced to Louis Agassiz, Harvard Professor of Zoology. In his approach, students were to study nature through carefully observing, drawing and making inferences (Lerner, 2007).

The results were then used to obtain histogram as shown in graph 4.9.



Graph 4.7

From the graph it was clear many students obtained high scores and fewer students scored low marks. This suggested a good performance in the test.

The table 4.9 below presents the summary of test scores from the data file created for the control group, the percentage conversion of the marks. The analysis was then used to compute mean and standard deviation to generate histogram.

Score

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	28.00	1	2.0	2.0	2.0
	30.00	2	4.0	4.0	6.0
	32.00	2	4.0	4.0	10.0
	34.00	1	2.0	2.0	12.0
	36.00	5	10.0	10.0	22.0
	38.00	6	12.0	12.0	34.0
	40.00	4	8.0	8.0	42.0
	42.00	4	8.0	8.0	50.0
	46.00	2	4.0	4.0	54.0
	48.00	1	2.0	2.0	56.0
	50.00	4	8.0	8.0	64.0
	52.00	3	6.0	6.0	70.0
	54.00	1	2.0	2.0	72.0
	56.00	2	4.0	4.0	76.0
	58.00	2	4.0	4.0	80.0
	60.00	2	4.0	4.0	84.0
	64.00	3	6.0	6.0	90.0
	66.00	1	2.0	2.0	92.0
	70.00	3	6.0	6.0	98.0
	72.00	1	2.0	2.0	100.0
	Total	50	100.0	100.0	

Table 4.9: Group of study = Control Group

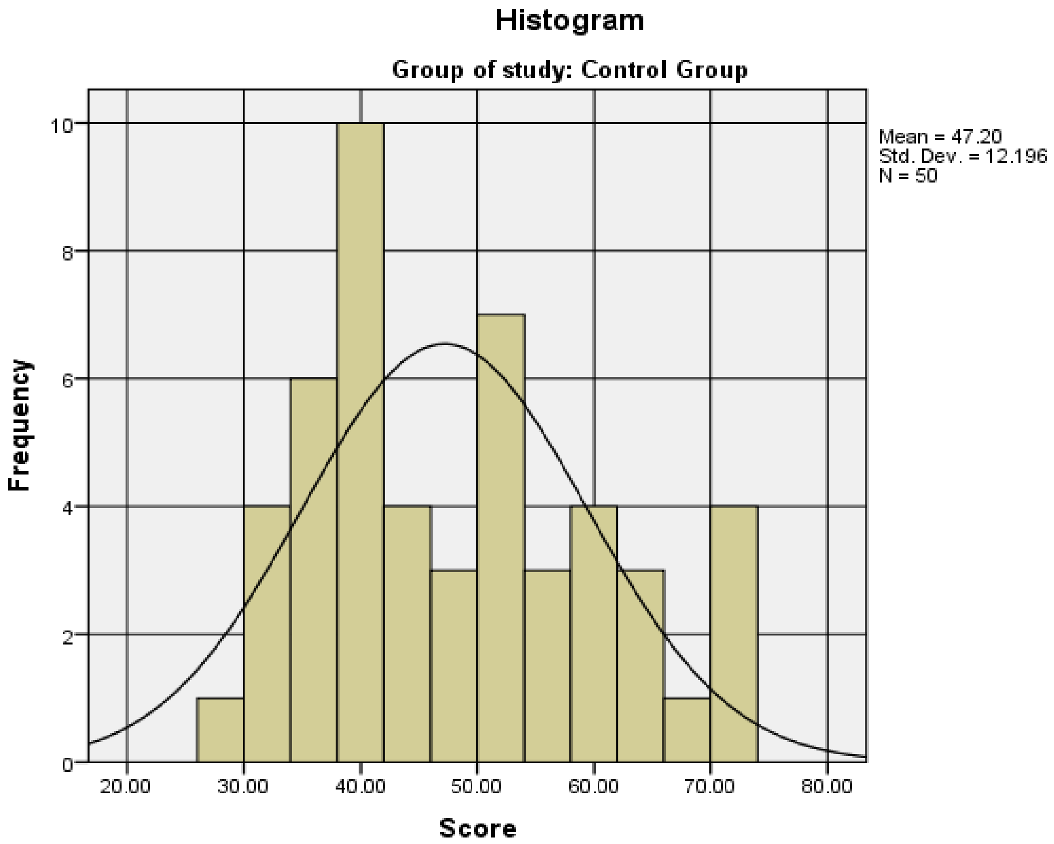
Statistics[a]

Score

N	Valid	50
	Missing	0
Mean		47.2000
Median		44.0000
Mode		38.00
Std. Deviation		12.19568
Variance		148.735

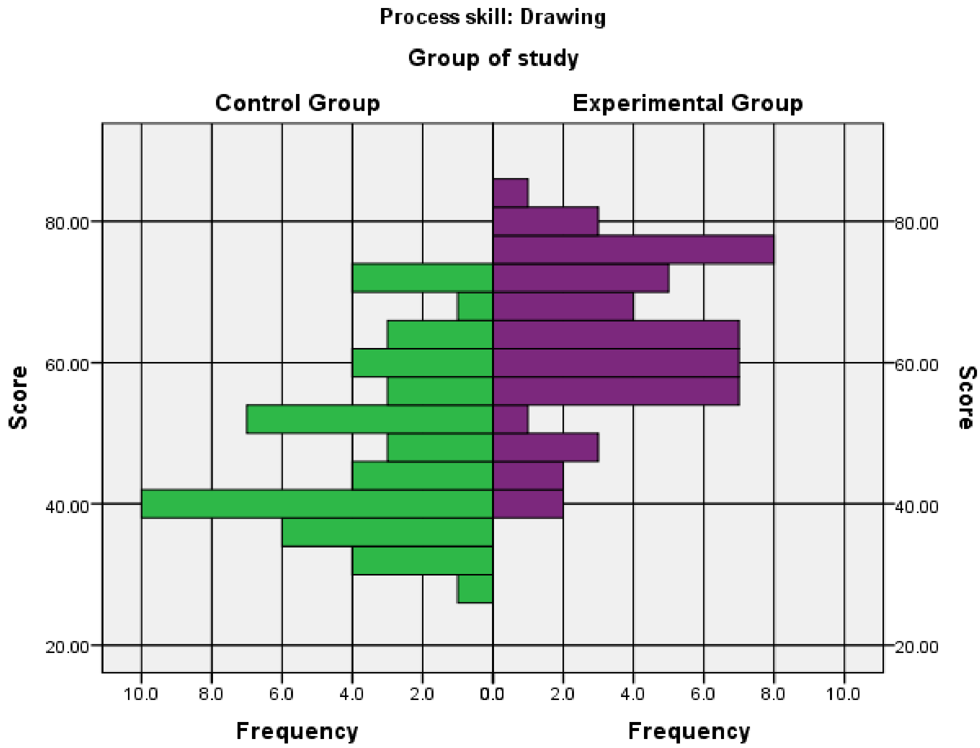
a. Group of study = Control

From the results the class had lower mean score 47.200 % and higher standard deviation 12.195 than experimental class. Majority of students scored below 50% and scores were not consistent , widely spread. Poor performnce could be attributed to teaching and learning style used by the teacher and students.



Graph 4.8

The above graph 4.8 indicated that the distribution tended to assume normal curve but fewer students scored higher marks .The two class performances was summarized in graph below.



Graph 4.9

Whether drawing affects learning cell Biology; from analysis of the results experimental class had high mean score of 62.640%, control class low mean score 47.200%. Mean difference between the two groups was 15.440% which indicated significant difference in performance. Histograms obtained showed normal distribution curve shape but slightly negatively skewed for experimental class and slightly positively skewed in control class .Experimental class majority of students scored higher marks than control class and control class fewer students scored high marks.

Pre-test mean for experimental and control groups were 38.47% and 39.47% respectively. Achievement gain for experimental group was 24.17% and control 7.73% indicating experimental class superiority.

4.7 Practical process skill of Measurement.

The fourth objective sought to establish effect of measurement on learning support in animals.

The raw scores were obtained and converted to percentages to enable obtain mean and standard deviation as indicated in table 4.10 below.

Group of study = Experimental (Practical process skill measurement)

Score

N	Valid	50
	Missing	0
Mean		52.6000
Median		49.0000
Mode		48.00
Std. Deviation		14.38395
Variance		206.898

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	30.00	2	4.0	4.0	4.0
	34.00	3	6.0	6.0	10.0
	36.00	4	8.0	8.0	18.0
	38.00	3	6.0	6.0	24.0
	40.00	2	4.0	4.0	28.0
	44.00	1	2.0	2.0	30.0
	46.00	4	8.0	8.0	38.0
	48.00	6	12.0	12.0	50.0
	50.00	1	2.0	2.0	52.0
	52.00	1	2.0	2.0	54.0
	54.00	2	4.0	4.0	58.0
	56.00	3	6.0	6.0	64.0
	58.00	1	2.0	2.0	66.0
	60.00	1	2.0	2.0	68.0
	62.00	3	6.0	6.0	74.0
	64.00	2	4.0	4.0	78.0
	66.00	1	2.0	2.0	80.0
	68.00	3	6.0	6.0	86.0
	70.00	2	4.0	4.0	90.0
	76.00	3	6.0	6.0	96.0
	82.00	1	2.0	2.0	98.0
	84.00	1	2.0	2.0	100.0
	Total	50	100.0	100.0	

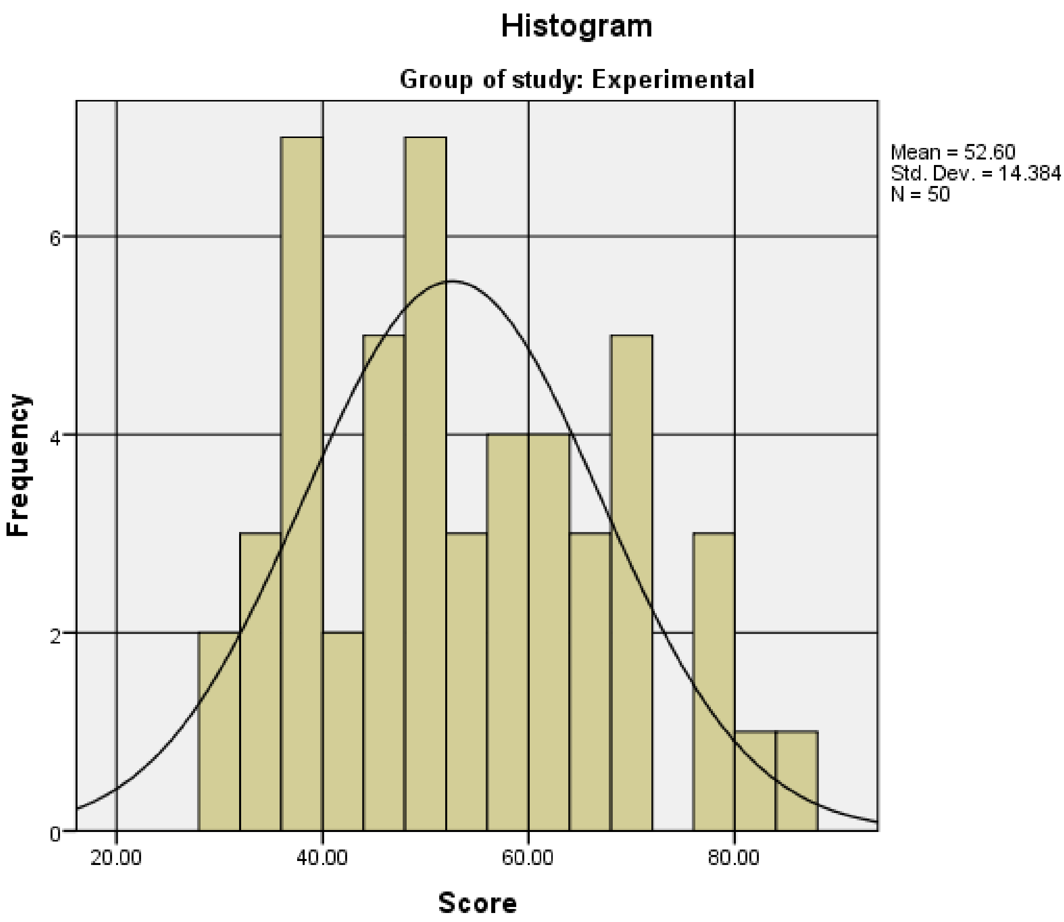
Table 4.10, Source: Research Data (2015).

The analyzed data indicated that the class had high standard deviation14.383 mean score of 52.60%. Integration of practical process skill measurement in teaching and learning of Biology could be a positive force in classrooms enhancing deeper understanding of principles and concepts of Biology. This study affirmed earlier finding by (Maundu, Sambili 2005) that in the inquiry approach, learning is by discovery characterized by development of practical process skills and this influenced the performance in the topic support in animals

The active involvement of students in practical activities may have given rise to efficient learning, which accounted to the reported significant effect in performance. The results of this study were in line with the views of previous researchers (Nwosu,1991, SMASSE 2004) who indicated that active participation of students gave meaningful and effective learning.

Further**, a**ctivity-focused-teaching should involve activities aimed at helping students arrive at the learning outcome. Activities must be well and carefully selected when formulating the kind of instructional techniques and procedures best suited for achieving the objectives of a particular lesson. These activities according to SMASSE (2004) can be hands-on (manipulation) minds-on (intellectual, thinking, and reasoning). Teacher centered teaching methodology also tends to motivate learners.

The results were then used to obtain histogram as shown in graph 4.10 below.



Graph 4.10

The above graph 4.10 indicated that the distribution tended to assume a normal curve shape, most students having obtained marks around population mean.

Table 4.11 Group= Control class.

Group of study = Control

Statistics[a]

Score

N	Valid	50
	Missing	0
Mean		41.8400
Median		40.0000
Mode		30.00[b]
Std. Deviation		15.14469
Variance		229.362

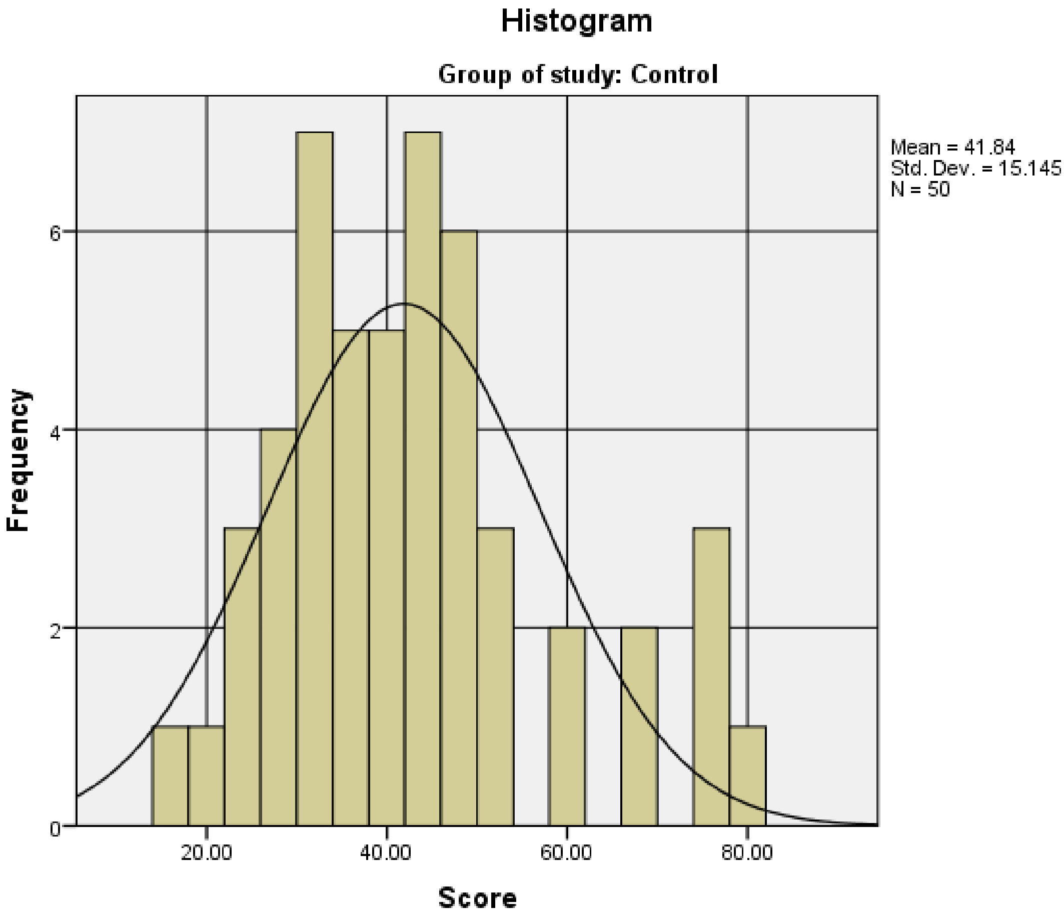
Score[a]

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	16.00	1	2.0	2.0	2.0
	20.00	1	2.0	2.0	4.0
	22.00	2	4.0	4.0	8.0
	24.00	1	2.0	2.0	10.0
	26.00	1	2.0	2.0	12.0
	28.00	3	6.0	6.0	18.0
	30.00	4	8.0	8.0	26.0
	32.00	3	6.0	6.0	32.0
	34.00	2	4.0	4.0	36.0
	36.00	3	6.0	6.0	42.0
	38.00	2	4.0	4.0	46.0
	40.00	3	6.0	6.0	52.0
	42.00	4	8.0	8.0	60.0
	44.00	3	6.0	6.0	66.0
	46.00	4	8.0	8.0	74.0
	48.00	2	4.0	4.0	78.0
	50.00	2	4.0	4.0	82.0
	52.00	1	2.0	2.0	84.0
	60.00	2	4.0	4.0	88.0
	66.00	2	4.0	4.0	92.0
	74.00	1	2.0	2.0	94.0
	76.00	2	4.0	4.0	98.0
	80.00	1	2.0	2.0	100.0
	Total	50	100.0	100.0	

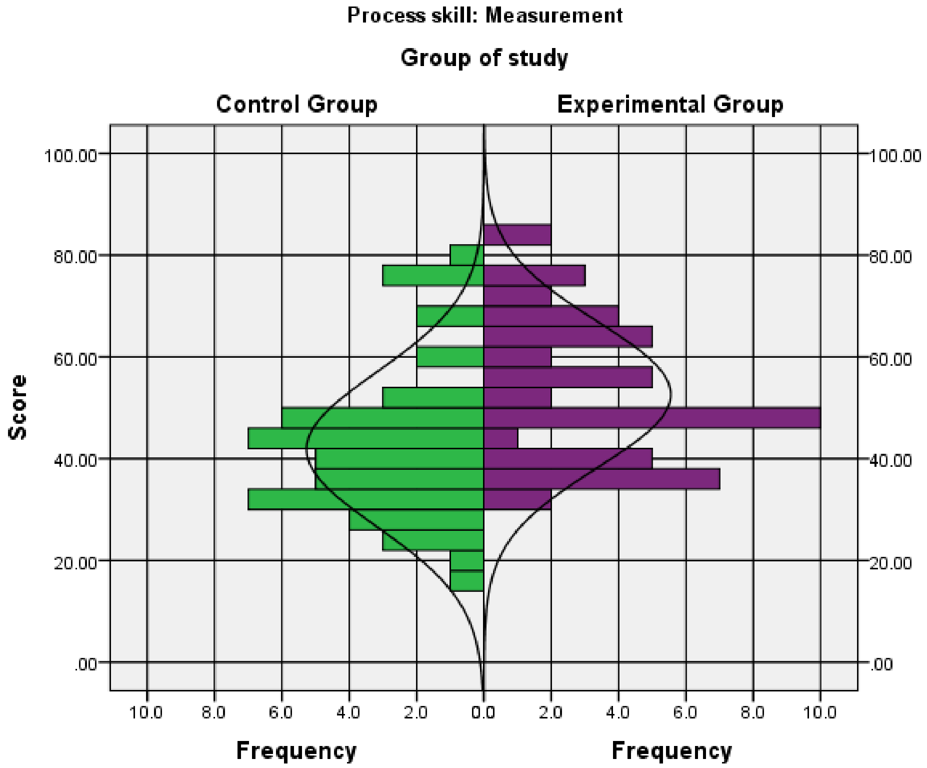
a. Group of study = Control

Table 4.11, Source Research Data (2015).

The above table 4.11 indicated that the control class had a lower mean score 41.84% and higher standard deviation 15.144.



Graph 4.11
The above graph 4.11 indicate that the distribution tended to assume the normal curve shape although slightly positively skewed which suggests only few students scored higher marks in the test. The two group of classes were compared and illustrated in graph 4.12.



Graph 4.12

On whether measurement affects learning support in animals, experimental class computed mean score of 52.600%, control class 41.840%. Mean difference between the groups was 10.760. Histogram obtained indicated majority of students' marks about the population mean.

Pre-test mean score for experimental and control groups was 34.77% and 37.44% respectively. The mean achievement gain for the treatment group was 17.83% while control was 4.4% indicating superiority of treatment group over control group.

Difference in performance was significant enough , experimental class performed better. The difference in performance could be attributed integration of practical skill measurement in teaching support in animals.

The students in the experimental group had higher mean scores in the post- test and lower standard deviations than control group respectively. Lower standard deviation meant that the scores tended to cluster around the population mean hence more consistent in terms of performance than the control group.

The active involvement of students in practical activities may have given rise to efficient learning, which accounted to the reported significant effect in performance. The results of this study were in line with the views of previous researchers (Nwosu,1991, SMASSE 2004) who indicated that active participation of students gave meaningful and effective learning.

4.8 T-Test

A paired two sample t-test was used to test the significance of the means of independent sample test.

Table 4.12 T-test group statistics

Group Statistics[a]					
	Group of study	N	Mean	Std. Deviation	Std. Error Mean
Score	Control Group	50	41.680	14.86461	2.10217
	Experimental Group	50	60.520	14.21589	2.01043
a. Process skill = Experimenting					

From Table 4.12 it is clear that on experimenting, the experimental group had a more significant result (M=60.520; SD=14.21589) thus indicating a marked high performance as compared to the control group (M=41.680; SD=14.86461)

Table 4.13 Independent samples test.

	t-test for Equality of Means						
	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
Score Equal variances assumed	-6.477	98	.000	-18.840	2.908	-24.612	-13.067
Equal variances not assumed	-6.477	97.806	.000	-18.840	2.908	-24.612	-13.067

Based on the results, with a P-Value of .000, it is clear that experimenting was a statistically significant result and shows that there is a positive influence and relationship between experimenting and learner achievement**.**

Table 4.14 T-test group statistics.

Group Statistics[a]					
	Group of study	N	Mean	Std. Deviation	Std. Error Mean
Score	Control Group	50	41.840	15.14469	2.14178
	Experimental Group	50	52.600	14.38395	2.03420
a. Process skill = Measurement					

From Table 4.17 it is clear that on measurement, the experimental group had a more significant result (M=52.600; SD=14.38395) thus indicating a marked high performance as compared to the control group (M=41.840; SD=15.14469).

Table 4.15 Independent samples test

	t-test for Equality of Means						
	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
Score Equal variances assumed	-3.643	98	.000	-10.760	2.953	-16.621	-4.898
Equal variances not assumed	-3.643	97.741	.000	-10.760	2.953	16.621	-4.898

Based on the results from table 4.18, with a P-Value of .000, it is clear that measurement was a statistically significant result and shows that there is a positive influence and relationship between experimenting and learner achievement.

Table 4.16 group statistics.

Group Statistics[a]					
	Group of study	N	Mean	Std. Deviation	Std. Error Mean
Score	Control Group	50	47.200	12.19568	1.72473
	Experimental Group	50	62.640	10.95028	1.54860
a. Process skill = Drawing					

From Table 4.18 it is clear that on drawing, the experimental group had a more significant result (M=62.640; SD=10.95028) thus indicating a marked high performance as compared to the control group (M=47.200; SD=12.19568).

Table 4.17 Independent samples test.

	t-test for Equality of Means						
	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
Score Equal variances assumed	-8.693	98	.000	-21.7200	2.4986	-26.6785	-16.7614
Equal variances not assumed	-8.693	91.961	.000	-21.7200	2.49866	-26.6825	-16.7574

Based on the results from table 4.19, with a P-Value of .000, it is clear that drawing was a statistically significant result and shows that there is a positive influence and relationship between experimenting and learner achievement**.**

Table 4.18 Group statistics

Group Statistics[a]					
	Group of study	N	Mean	Std. Deviation	Std. Error Mean
Score	Control Group	50	44.000	14.00292	1.98031
	Experimental Group	50	65.720	10.77419	1.52370
a. Process skill = Observation					

From Table 4.21 it is clear that on observation, the experimental group had a more significant result (M=65.720; SD=10.77419) thus indicating a marked high performance as compared to the control group (M=44.000; SD=14.00292).

Table 4.19 Independent samples test.

	t-test for Equality of Means						
	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
Score Equal variances assumed	-8.693	98	.000	-21.7200	2.4986	-26.6785	-16.7614
Equal variances not assumed	-8.693	91.961	.000	-21.7200	2.49866	-26.6825	-16.7574

From the independent samples t-test tables above,(df=N1+N2-2=98) and 0.05 level of significance the computed values of t is less than p value (t= -8.693,-6.477,-3.643, -6.661 and p=0.000 two tailed) hence the difference in means of samples is statistically significant.

This suggests that students who are taught biology through practical process skills perform better than those who are taught through traditional teacher led method. The difference in performance is due to interventions (treatment) done to the experimental group of schools. This finding suggests students should be taught by use of practical based approach.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter contains a summary of findings, the conclusions drawn and the recommendations made thereof. It finally offers the suggestions for further research.

5.2 Summary.

The purpose of this study was to investigate the effect of practical approach to teaching Biology on learner achievement in the subject in public schools in Likuyani sub-county. Research design was quasi experimental with four experimental schools and four control schools. Four practical process skills observation, experimenting, drawing and measurement were used in teaching experimental classes. Post-test exam was administered after three weeks of teaching the results were analyzed

Key findings of the study were that experimental group performed better than control group in achievement test due to the practical activities involved in teaching and learning Biology.

Based on first objective experimental class which integrated practical skill observation in learning classification in animals had mean score of 65.720 % suggesting better performance than control class with mean score 44%. Standard deviation of this experimental class was lower 10.774 suggesting a more consistent class in performance than control class 14.002.

Based on second objective teaching chemicals of life through experimenting improved performance in experimental class with a mean score 60.520% and lower standard deviation 14.215 than control class with mean score 41.680%.

Based on third objective practical process skill drawing class in learning cell Biology scored high mean score 62.520% than control class 47.200% .

This suggests also that this class performed better than the control group. Experimental class was also more consistent in performance with a lower standard deviation10.950 and control class 12.195.

Based on fourth objective teaching support in animals by incorporating practical process skill measurement improved performance but it was not as high as the other three practical process skills (52.600%). The control class still scored mean below population mean (41.840%).

Practical activity method fosters active participation of students in the class, aids retention and makes the lesson more meaningful. This is because students manipulate apparatus/materials, they apply their five senses and other skills to their lessons more than when they would have learned in abstraction or non-interactive.

5.3 Conclusions.

From the summary, the study made the following conclusions;

Based on the objective on observation, the experimental classes and control classes showed significant differences in Biology performance from the analysis computed and represented in form of frequencies, histograms and t-test. From the results, observation clearly affects learning classification in animals. Integration of this practical activity observation might have contributed to better performance in the experimental class.

Based on second objective, students in experimenting class performed far better among all the three process skills. This difference in performance could be attributed to teaching the topic chemicals of life through experiment design. Experimenting is an inquiry teaching pedagogy as opposed deductive approach. Inquiry approach provides means to increased interest in science by students. Experimenting is an integrated process skill where learners are expected to design an investigation to test hypothesis.

Based on third objective experimental class which integrated practical process skill drawing in teaching cell biology performed better. Drawing is a manipulative skill which actively involves learners in learning process.

Based on fourth objective, it was found that learner centered approach through practical process skill measurement was more productive in teaching the topic support in animals than traditional conventional methodology. This was evident from superior mean scores of experimental group. On measurement, difference in performance was not significant enough although still experimental class performed better. The difference in performance could be attributed integration of practical skill measurement in teaching support in animals

5.4 Recommendations

Biology concepts should be taught with practical activity so that the students will do science instead of learning about science.

Teachers need to be in-serviced on new and various innovations in science that can ease teaching through practical approach by integrating ICT to be able to use simulations where real laboratory materials are not available Seminars and workshops would provide a forum for science teachers to freely exchange professional skills.

An evaluation of current teacher training program is required to determine its efficiency and effectiveness. Actual school practice should shift from drill and rote learning to interactive learning dominated by learner activity.

Further on, the students should be encouraged to perform and carry out experiments outside normal class work under supervision. School laboratories should be made available to students

Biology teachers should seek ways of encouraging and motivating students during the Biology experiment lessons, for example, in volunteering to perform a task, in suggesting possible outcomes to the experiments, and in improvising materials to perform experiments. School administrators should endeavour to create a work strategy that will ease teacher workload to give them time for lesson preparation for practical activities. Experienced teachers should be used as resource for training other teachers. Finally, the Government, through the Ministry of Education, should ensure all training policies are well articulated and reviewed through quality assurance unit.

5.5 Suggestions for further research

Research is needed to:

To investigate the effect of practical activities on acquisition of science process skills.

Establish effect of practical activities on science process skills of male and female students.

Situational analysis of laboratory facilities in schools.

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APPENDICES

Appendix I

Achievement tests for the four topics.

TEST 1.

THE CELL

1.Which organelle would be abundant in?

Skeletal muscle cell ___________________

Palisade cell ___________________

2.State the functions of the following organelles.

Lysosomes ___________________

Golgi apparatus ___________________

3.State the functions of the following organelles;

Goigi apparatus ________________

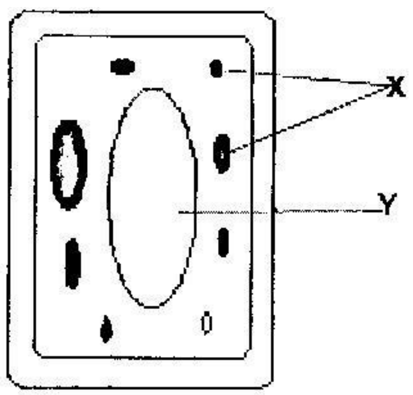
Ribosomes cell ________________

4.Name the organelles that perform each of the following functions in a cell.

Protein synthesis ___________________

Transport cell secretions ___________________

5.The diagram below represents a cell.



a)Name the parts labeled x and y

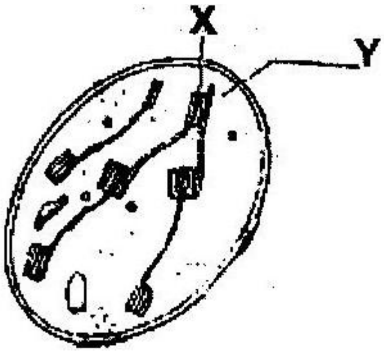
X ________________

Y ________________

b)Suggest why the structures labeled x would be more on one side than the other side.

6.a)State the function of cristae in mitochondria (1mk)

b)The diagram below represents a cell organelle



(i)Name the part labeled Y (1mk)

(ii)State the function of the part labeled X (2 mks)

7. a)What is the formula for calculating linear magnification of a specimen when using a hand lens? (1mk)

b)Give a reason why staining is necessary when preparing specimens for observation under the microscope. (1mk)

8.State three functions of Golgi apparatus. (3mks)

9.Name two structures found in plant cell but are absent in animals cell.

10.State the role of the following parts of a microscope

i)Eye piece

ii)Mirror

iii)condenser

iv)Diaphragm

11.The diameter field of view of a light microscopic is 3.5mm. Plant cells lying of the diameter are 10. Determine the size of one cell microns (1mm = 1000µm)

12.Define the following terms:(3mks)

i. tissue…………………………………………………………………………………

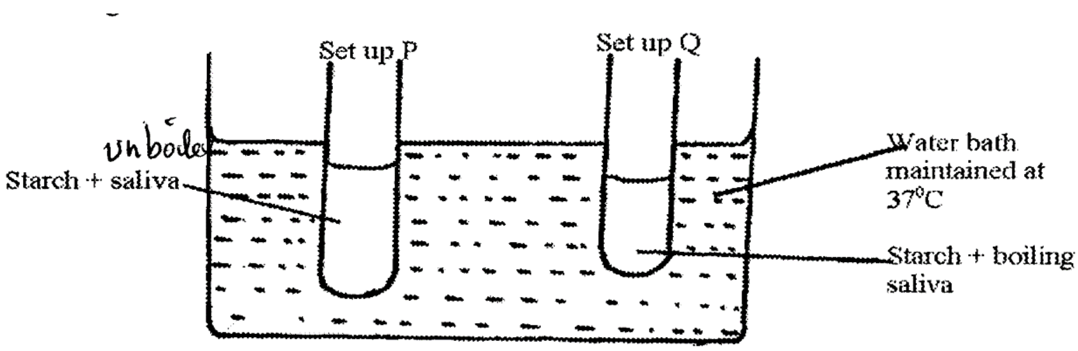
ii Organ………………………………………………………………………………

13.State three differences between plant and animal cell 3mks

14.a).Explain how mitochondrion is adapted to its function 3mks b).State two differences between chloroplast and mitochondrion. 2mks.

ACHIEVEMENT TEST ON CHEMICALS OF LIFE(sample).

1.In an experiment to investigate an aspect of digestion, two test tubes P and Q were set up as show in the diagram below.



The test tubes were left in the bath for 30 minutes. The content of each test tube was then tested for starch using iodine solution.

(a) What was the aim of experiment?1mk

………………………………………………………………………………………………

(b) What results were expected in test tube P and Q (2mks)

P………………………………………………………………………………………

Q………………………………………………………………………………………

(c) Account for the results you have given in b above in test tube P and Q (2mks)

P………………………………………………………………………………………

Q………………………………………………………………………………………….

(d) Why was the set up left at 37°C

………………………………………………………………………………………………

………………………………………………………………………………………………

(e) Name the carbohydrate stored in 2mks

i. Mammalian liver……………………………………………………..

Potato tuber…………………………………………………………

You are provided with specimen H, which is food substance in attest tube.

(a)(i)Use the reagents provided to test for the food substances present in the contents of the specimen H. Record the food substances tested, procedures, observations and conclusions in the table below. (6mks)

Food substance	**Procedure**	**Observation**	**Conclusion**

(ii)Account for the results obtained in (a) (i) above. (3mks)

....

....

b).Distinguish between essential and non-essential amino acids.(1mk).

c)Name the chemical process involved when two amino acids are joined together.(1mk)

3.a) List three main types of carbohydrates .(3mks)

………………………………………………………………………………………………..

………………………………………………………………………………………………..

b)State the chemical substance or reagents that are used to test for each of the above mentioned carbohydrates(. 3mks)

…………………………………………………………………………………………………
…………………………………………………………………………………………………
c). What are reducing sugars?

Give two examples of reducing sugars.(3mks)

…………………………………………………………………………………………………
…………………………………………………………………………………………………
……………………………………………………………………………….

d). State two properties of non- reducing sugars (2mks).

…………………………………………………………………………………………………
………………………………………………………………………………………………..

4 a) What is the main difference between fats and oils(2mks).

…………………………………………………………………………………………………..

b)State three important functions of lipids in mammals (2mks).

………………………………………………………………………………………………….

5.a)Define the term enzyme.(1mk).

…………………………………………………………………………………………………..

b). The figure below shows the effect of temperature on an enzyme catalyzed reaction.

i Explain what happens between points R and S(.2mks).

………………………………………………………………………………………..

ii)What is X? (1mk)

iii).Explain what happens beyond T.

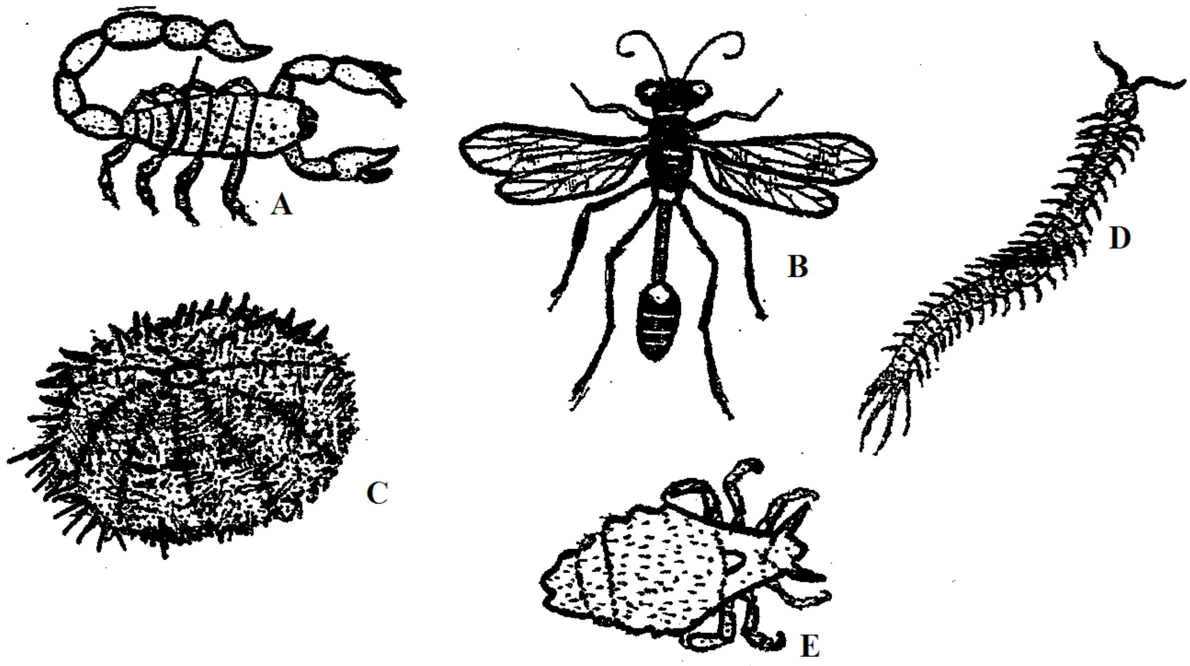
6. When testing presence of non-reducing sugars the following substances are added to food sample: Dilute hydrochloric acid and sodium hydrogen carbonate solution. Give a reason for each.

a)Dilute hydrochloric acid………………………………………………………………………

b). Sodium hydrogen carbonate…………………………………………………………..

ACHIEVEMENT TEST ON CLASSIFICATION IN ANIMALS.

Below are drawings of various organisms. Examine them.



(a)(i)Name the phyllum to which B belongs. (1mk)

....

(ii)Give three reasons for your answer in (a) (i) above. (3mks)

....

....

....

(b)Name the class to which specimen B and E belong.2MKS

B...

E...

(c)Give three observable differences between specimen B and E. (3mks)

....

....

....

(d)Use the dichotomous key provided to identify the organism.

1.(a)Jointed legs present.. go to 2

(b)Jointed legs absent.. go to 7

2.a)Have 3 pairs of legs... go to 3

(b)Have more than 3 pairs of legs.. go to 5

3.(a)With wings.. go to 4

(b)Withoutwings...Anoplura

4.(a)Have one pair of wings...Diptera

(b)Have two pairs of wings...Hymenoptera

5.(a)Have 4 pairs of legs... Arachnida

(b)Have more than 10 pairs of legs.. go to 6

6.(a)With one pair of legssegment...Chilopoda

(b)With two pairs of legs per body pesegment..................................Diplopoda

7.(a)With body enclosed in a shell...Mollusca

(b)Body surface with spiny projections......................................Echnodermata

Identify steps followed to identify organism A, B, C, D, and E

(5mks)

Specimen	Steps followed	Identity
A		
B		
C		
D		
E		

2.Which taxonomic grouping contains;

a) The largest number of individuals?1mk……………………………………………….

b the least number of individuals 1mk………………………………………………..

c). individuals with most similarities 1mk

3. Insects are found in almost all parts of the world. List four features that make them very successful. 4mks.

……………………………………………………………………………………………

….……………………………………………………………………………………

4. Name two external features that jou would use to distinguish a millipede and members of the phylum annelida. 2mks

…………………………………………………………………………………………………..

5.List two features that distinguish;

a) molluscs from other organisms. 1mk

b). annelid from nematode 1mk.

6. State two characteristics mammals share with birds 2mks.

……………………………………………………………………………………………….

b). Give two major characteristics that are unique to mammals, 2mks

………………………………………………………………………………………………..

7.State four features used for identification in animals 4mks.

………………………………………………………………………………………………

……………………………………………………………………………………………….

8.Consider the characteristics of the following organisms:

Bee, tick, lobster, cockroach, millipede, moth, mosquito

a). Give the name of the phylum to which all these organisms belong. 1mk.

b)State the four classes represented by animals named above and place each animal into the class. 4mks.

………………………………………………………………………………………………

…………………………………………………………………………………………..

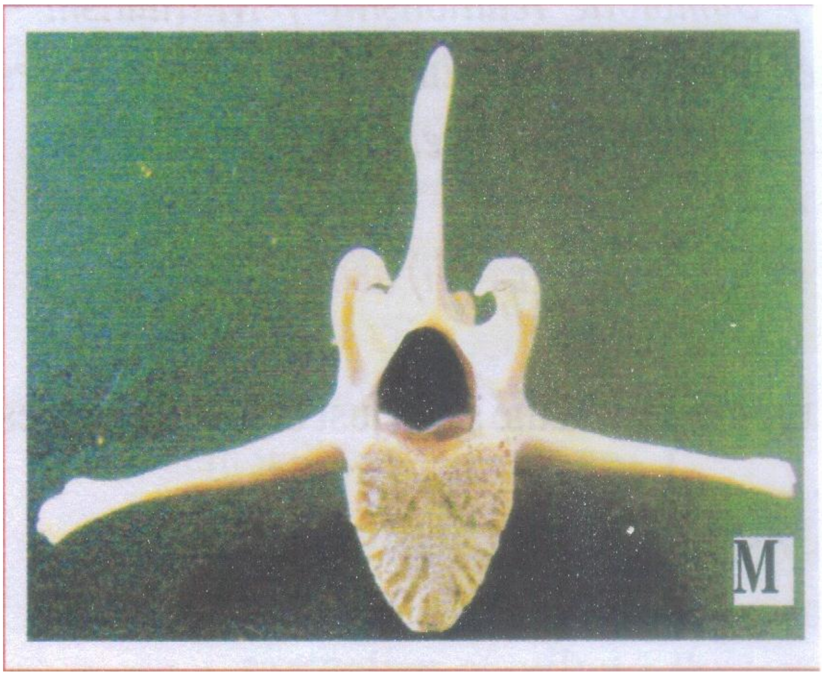
11. Afrog and human being both belong to the phylum chordate. State two characteristics in a frog that are absent in human. 2mks.

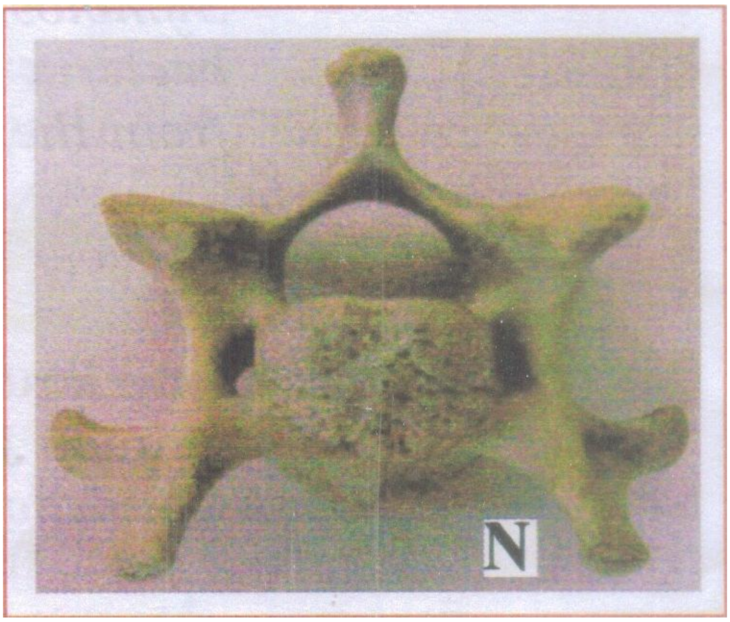
………………………………………………………………………………………………

………………………………………………………………………………..

2. ACHIEVEMENT TEST ON SUPPORT IN ANIMALS.(sample)

You are provided with photographs of specimen labelled M and N obtained from the same animal. Examine them carefully.





a) Identify the specimens and in each case name the region of the body from which it was obtained. {4mks}

Specimen M:

....

Region:

....

Specimen N:

....

Region:

....

bi) Measure the length of both specimen using a ruler from the proximal to the distal end.

Length of M

Length N

Explain the differences in length above

……………………………………………………………………………………………………

………………………………………………………………………………..2mks

bii) State two features of specimen N which adapt it to its functions. {2mks}

i)...

ii)..

c) State **three** differences between specimens M and N. {3mks}

M	**N**
i)	
ii)	
iii)	

d) On the photograph labeled M, name any **three** parts.

2.a) Outline procedure of how to determine tail power in fish.4mks

……………………………………………………………………………………………
……………………………………………………………………………………………
…………………………………………………………………………………………….
b) Explain the significance of tail power in fish
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………3mks.
c.Femur is bone with broad shaft and rounded head explain the significance of this features.
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………3mks
3a).Explain how pelvic girdle is adapted to its functions. 3mks
b) State three differences between smooth and skeletal muscles.3mks
c)Which type of joint is found at the proximal end of femur 1mk

APPENDIX II

MARKING SCHEME:

Chemicals of life.

1a)To investigate the effect of temperature on an enzyme- catalyzed reaction 1mk.

b) P- Enzyme salivary amylase present in saliva digests starch to maltose

Q- starch is not digested 1mk

c).P- conditions were favourable for salivary amylase enzyme. 1mk

Q- boiling of saliva denatured the amylase enzyme in saliva hence no effect on starch. 1mk.

d).Optimum temperature for salivary amylase enzyme 1mk

e)i) Glycogen. 1mk

ii) Starch 1mk.

2.Food substance: starch,reducing sugar, proteins 1mk

Starch:

Procedure-Put 2ml of food substance in testtube, add 2 drops of iodine solution.1mk

Observation- no colour change.1mk

Conclusion –Starch absent.1mk

Reducing sugar:

Procedure- put 2ml of substance in tt, add equal amount of Benedicts solution and heat.1mk

Observation- colour changes to brown 1mk

Conclusion- reducing sugar present 1mk

Proteins.

Procedure- put 2ml of food substance in tt, add equal amount of sodium hydroxide then copper sulphate. 1mk

Conclusion- proteins present. 1mk

b) Essential amino acids are those which cannot be synthesized in the body of an organism and must therefore be provided in the diet. 1mk

Non- essential amino acids are those which the body can synthesise and therefore need not be available in the diet. 1mk

c) Condensation 1mk.

3.a) monosaccharide 1mk

Disaccharide 1mk

Polysaccharide 1mk

b) Monosaccharide-Benedicts solution 1mk

Disaccharide- Benedicts solution+Sodium hydrogen carbonate solution 1mk

Polysaccharide- Iodine solution 1mk.

c) Reducing sugars are those that reduce copper(II)sulphate present in Benedicts solution to form copper(I) oxide that form an orange precipitate.1mk

d) Have sweet taste , soluble in water, can be crstalised.1mk

4.a) Fats are solid at room temperature.1mk

Oils are liquids at room temperature 1mk

b).- As structural materials of cell membrane

-source of energy and water

5.a)Enzymes are biological catalysts that are protein in nature whose function is to speed up rate of chemical reactions.

b)i) As the temperature increases the rate of reactions also increases because increase in temperature increases molecular movement increasing chances of collision btwn enzyme and substrate. 2mks

ii) X is optimum temperature.

iii) Beyond point T the rate of reaction falls as the temperature increases. This happens because at high temperatures, enzyme become denatured.

6.a) Dilute hydrochloric acid breaks down non-reducing sugars to reducing sugars. 1mk

b) Sodium hydrogen carbonate solution neutralizes the acid. 1mk.

THE CELL

1. mitochondrion, chloroplast

2.Breaks down worn out cells

3. protein synthesis

4.a) chloroplast, vacuole/cell sap.

To trap maximum light for photosynyhesis

6.a) increases surface area for respiration.

i) Y-stroma

ii)- produce chlorophyll

7.a)Mg=image/object size

b).To make distinct parts clear.

9. Chloroplast, tonoplast, vacuole, cell wall.

10. i) magnifies object

ii) Reflects light

ii) concentrates light.

iv) Regulate amount of light entering .

11. 3.5x1000/10=3500/10=35 um

CLASSIFICATION IN ANIMALS.

1.a)i) arthropoda

ii). Segmented body

-presence of hard exoskeleton

-jointed appendages.

b) B- insecta

D-chilopoda

c)

B	D
Body has three parts, head, thorax and abdomen.	Body has two parts, head and trunk.
Has wings	Wings absent
Elongated body	Body not elongated
Has three pairs of legs	Has many legs.

d). A - 1a,2b,5a arachnida

B- 1a,2a,3a,4b Hymenoptera

C- 1b,7b Echinodermata

D- 1a,2b,5b,6a Chilopoda

E - 1a,2a,3b Anoplura.

2.a) Kingdom

b)Species

c)Species

3-.A hard exoskeleton which supports the insect above the ground.

-A waterproof waxy layer over the exoskeleton which reduces evaporation to conserve water.

-Excretion of uric acid which reduces water loss.

-internal fertilization which eliminates the need for water to achieve successful reproduction.

4.a) A millipede has a large number of jointed walking legs but absent in annelids.

b) Amillipede has antennae but absent in annelids.

5.a) molluscs have a soft unsegmented body which in most cases is partially enclosed in ashell.

- they have single muscular foot used for locomotion.

b) Annelids have a segmented body, nematodes smooth body.

6.a) Fertilisation is internal

-Have four chambered heart.

-Gaseous exchange is through lungs.

- Homoiothermic.

b) Have mammary glands

Bodies covered with fur or hair.

Have heterodont dentition

Have sweat glands.

7a) chordate

b) carnivours.

8.a) Whale

b) The whale is a mammal while the other two are fishes.

9.locomotory structures, legs wings,fins.

Antennae presence and numbers

Number of body parts.

Body segmented

10a) Arthropoda

b) Insecta

SUPPORT IN ANIMALS

1.a)M- Lumber vertebra, thorax

N- Cervical vertebra, neck

M- 12cm

N-7cm

M is longer than N to create large surface area for attachment of thorax muscles.

b) N – Wide neural canal to accommodate thick spinal cord.

-two vertebraterial canals for passage of blood vessels.

c).

M	N
Long neural spine	Short neural spine
Long transverse process	Short transverse process
Large centrum	Small centrum.

-neural spine, centrum, transverse process, neural canal

2.Measure fish lengthwise from tail to mouth tip X, measure length of fish from mouth to anus Y. Tail power=X/Yx100.

b) Large tail power increases propulsion in fish in water.

c). Broad shaft inceases surface area for attachment of thigh muscles.

Rounded head to fit in acetabulum forming ball and socket joint.

Appendix III

Reliability

Column1	X	y	X-X	y-y	$\dot{x}^2$	Y^2	XY
1	78	85	13.69444	19.11111	187.5378	365.2346	261.716
2	80	76	16.08571	10.65714	258.7502	113.5747	171.4278
3	79	76	15.55882	10.97059	242.077	120.3538	170.6894
4	82	80	19.0303	15.30303	362.1524	234.1827	291.2213
5	75	81	12.625	16.78125	159.3906	281.6104	211.8633
6	76	73	14.03226	9.322581	196.9043	86.91051	130.8169
7	80	41	18.5	-22.3667	342.25	500.2678	-413.783
8	75	82	14.13793	17.86207	199.8811	319.0535	252.5327
9	74	81	13.64286	17.5	186.1276	306.25	238.75
10	63	79	3.148148	16.14815	9.910837	260.7627	50.83676
11	76	77	16.26923	14.76923	264.6879	218.1302	240.284
12	70	78	10.92	16.36	119.2464	267.6496	178.6512
13	60	72	1.375	11.04167	1.890625	121.9184	15.18229
14	73	72	14.43478	11.52174	208.3629	132.7505	166.3138
15	69	71	11.09091	11.04545	123.0083	122.0021	122.5041
16	68	68	10.61905	8.571429	112.7642	73.46939	91.02041
17	71	67	14.15	8	200.2225	64	113.2
18	64	67	7.894737	8.421053	62.32687	70.91413	66.48199
19	63	48	7.333333	-10.1111	53.77778	102.2346	-74.1481
20	59	54	3.764706	-4.70588	14.17301	22.14533	-17.7163
21	63	53	8	-6	64	36	-48
22	66	50	11.53333	-9.4	133.0178	88.36	-108.413
23	58	53	4.357143	-7.07143	18.98469	50.0051	-30.8112
24	60	65	6.692308	4.384615	44.78698	19.22485	29.3432
25	52	65	-0.75	4.75	0.5625	22.5625	-3.5625
26	61	64	8.181818	4.181818	66.94215	17.4876	34.21488
27	59	64	7	4.6	49	21.16	32.2
28	60	63	8.777778	4.111111	77.04938	16.90123	36.08642
29	54	63	3.875	4.625	15.01563	21.39063	17.92188
30	49	60	-0.57143	2.285714	0.326531	5.22449	-1.30612
31	50	59	0.333333	1.666667	0.111111	2.777778	0.555556
32	60	60	10.4	3	108.16	9	31.2
33	55	56	8	-0.25	64	0.0625	-2
34	46	60	1.666667	3.666667	2.777778	13.44444	6.111111
35	49	55	5.5	0.5	30.25	0.25	2.75
36	38	54	0	0	0	0	0
				SUM	**3980.427**	**4107.266**	
				STD DEV	10.664 10.8328	10.8328	2264.134

r=xy/N-1(sdx)(sdy)=0.5593

Reliability(p)=2r/1+r=0.713

Appendix IV-Biology teachers questionnaire.

PART ONE-DEMOGRAPHIC DATA

1. Gender

Male [ ] Female [ ]

2. Age

[ ] 18-25 years [ ] 26-35 years [ ] 36-45 years

[ ] 46-55years [ ] Over 55 Years

3. Highest level of education attained

[ ] Diploma [ ] Degree [ ] Masters [ ] PHD

[ ] Below 5 [ ] 5-10

[ ] 10 -15 [ ] 15, and above

4. How many years have you worked at your work?

Appendix V: Research Authority from University of Nairobi

UNIVERSITY OF NAIROBI
COLLEGE OF HUMANITIES AND SOCIAL SCIENCES
FACULTY OF ARTS
DEPARTMENT OF PSYCHOLOGY

Telegrams: Varsity Nairobi
Telephone: 318262
Fax: 3245566
Telex 22095 varsity Ke Nairobi, Kenya

P.O. BOX 30197, 00100
NAIROBI
KENYA
6th February , 2015

From: Chair Department of Psychology

To: Whoever it may concern

Ref; Request for permission to conduct research

This is to inform you that MALONGO DAVID NDISA of Registration Number E58/67160/2013 is a postgraduate student studying for the degree of Master of Education in Measurement and Evaluation. The student would like to conduct research in your organization.

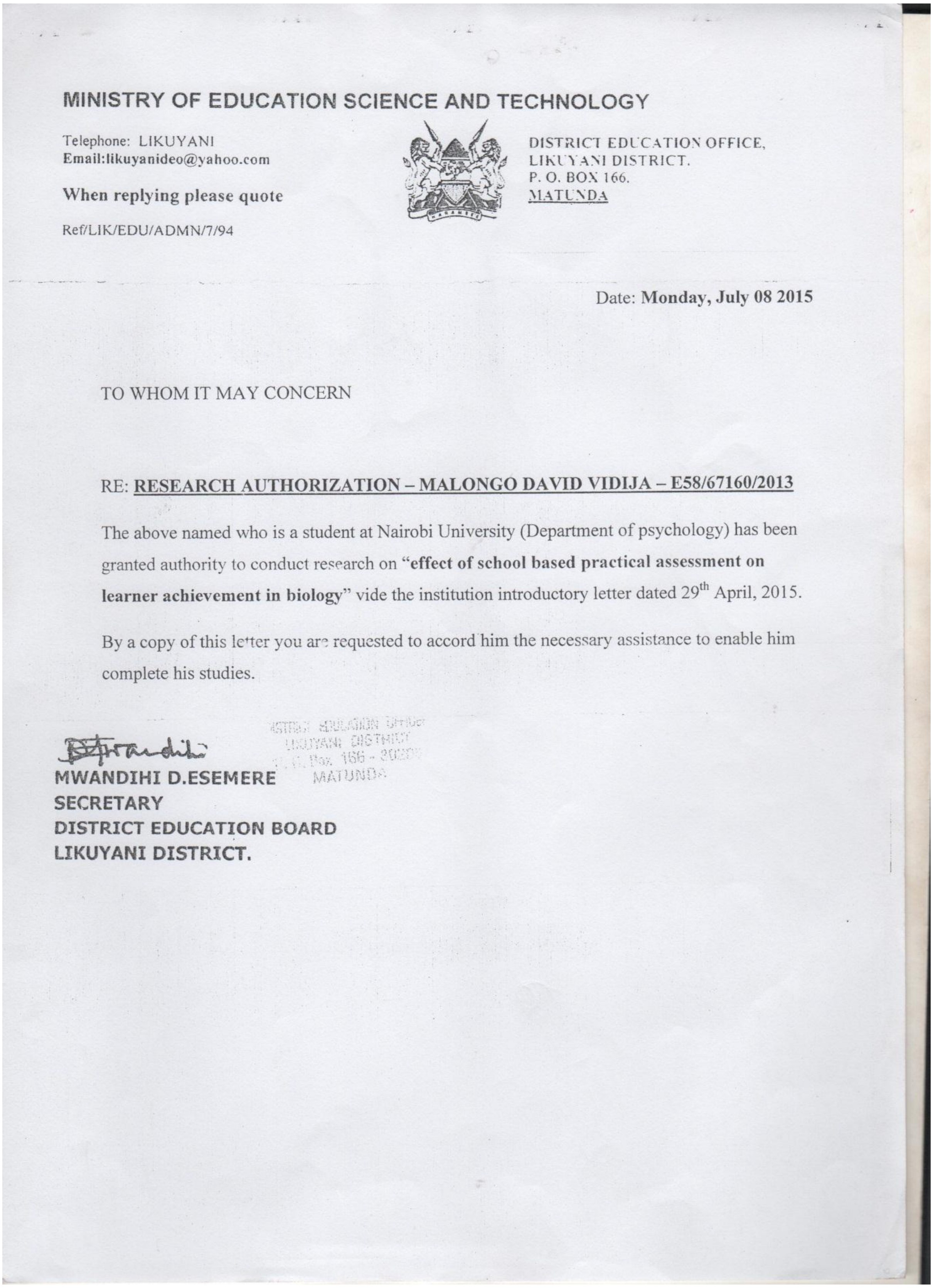
Please be kind to assist him/her if you do not mind.

DEPARTMENT OF PSYCHOLOGY
UNIVERSITY OF NAIROBI

Dr. Luke Odiemo
Chair
Department of Psychology

1

Appendix VI: Research Authority from County Education Office



MINISTRY OF EDUCATION SCIENCE AND TECHNOLOGY

Telephone: LIKUYANI
Email:likuyanideo@yahoo.com

When replying please quote

Ref/LIK/EDU/ADMN/7/94

DISTRICT EDUCATION OFFICE,
LIKUYANI DISTRICT.
P. O. BOX 166.
MATUNDA

Date: **Monday, July 08 2015**

TO WHOM IT MAY CONCERN

RE: **RESEARCH AUTHORIZATION – MALONGO DAVID VIDIJA – E58/67160/2013**

The above named who is a student at Nairobi University (Department of psychology) has been granted authority to conduct research on **"effect of school based practical assessment on learner achievement in biology"** vide the institution introductory letter dated 29th April, 2015.

By a copy of this letter you are requested to accord him the necessary assistance to enable him complete his studies.

MWANDIHI D.ESEMERE
SECRETARY
DISTRICT EDUCATION BOARD
LIKUYANI DISTRICT.