

# **EXTENT OF USE OF BIOLOGY INSTRUCTIONAL RESOURCES AND EFFECT ON STUDENTS ACADEMIC PERFORMANCE IN SECONDARY SCHOOLS IN SIAYA COUNTY – KENYA**

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## **Abstract**

*This study sought to find out the extent of use of biology teaching and learning resources and how it affects students' academic performance. The study was carried out in public secondary schools in Siaya County. The researcher used a sample of twenty-three schools drawn from ninety two public secondary schools selected through stratified random sampling. Teacher respondents were purposively or randomly sampled. Purposive sampling was used to choose the most experienced biology teacher from two or more teachers teaching form two classes. Where there existed more than one long serving and experienced teachers teaching form two classes, random sampling was employed to pick one of them for interview. Student respondents were chosen through random sampling in single sex schools and stratified random sampling in mixed schools. Head teachers from each of the sampled schools were selected for personal interview. The data were collected using questionnaires, checklists, observation schedules and interview guides. Observation schedules were used by the researcher to ascertain use of resources by teachers and learners and the resultant tests used to determine the score differences in achievement between classes frequently taught using resources and those rarely taught using resources. Interviews with head teachers were used to countercheck the information given by teachers and students on utilization of resources. The findings of the study established that audio-visual resources were least used in schools. The resources were mainly bought by the headteachers. The researcher's assessment during live lesson teaching using observation schedules showed that students frequently taught using resources performed better than those rarely taught using the resources. The research also established that frequent use of resources was not the only factor determining high student's academic performance but other factors like teacher's qualification, pedagogy, attitudes and students' entry behaviour also played a role in realizing improved academic performance in students.*

**Key words: Individualized learning, Inductive learning, Teaching resource, Hands on activities**

## **Specific objectives**

The objectives of this research were to:

- i. Investigate the types of resources used for the teaching and learning of Biology in secondary schools in Siaya County.
- ii. Establish the extent to which the resources in the above schools were utilized in the teaching and learning of biology.
- iii. Find out the relationship between frequency of use of teaching and learning resources and students' academic performance in the schools.

## **Background to the study**

The use of instructional resources in education can be traced back to the 17<sup>th</sup> century when Amos Comenius (1592-1670) used pictures to aid in the teaching process. In his book *Orbis Sensualiu* he presented 150 drawings that aided the learning process. Jean Rousseau (1712-1788) and Pestalozzi (1756-1827) likewise advocated for regular use of visuals in realization that in-cooperating resources in the instructional process enhances students interest in the subjects, stimulating self-activity that precedes in-depth learning. There are various types of resources that can be used in teaching and learning of biology grouped differently by various authors:

Bennars and Otiende (1994) have classified resources into three groups according to usage:

- a) Visual aids which are materials that appeals to use of sense of sight
- b) Audio aids that make use of the sense of hearing
- c) Audio visual aids that utilize the senses of hearing and sight

Brown and Wragg (1993) groups' resources into four main categories. In the first category are visual materials which include objects, models, specimens, textbooks, workbooks, programmed instructions, charts, posters, diagrams, photographs, illustrations, slides, filmstrips, overhead projectors, opaque projects, chalkboards, flannel boards and bulletin boards. In the second category are audio aids which include radios, record players and tape recorders. The third category includes audio-visuals made up of motion pictures and televisions. The fourth group is community resources. The community resources incorporates the above three categories in combined or sophisticated forms. They involve use of ICT'S and local resources. ICT'S include computers, DVDS/DVD players, CDS, mobile phones and E-library. Local resources are libraries, fieldtrips and resource persons. The justification for the latter classification is that they include the most recent resources for teaching and learning biology. This study adopts three level classification of resources: visual, audio and audiovisual.

Proponents of Instructional resource learning like Skinner (1968) and Muller (1990) have held the view that instructional resources provide the link between the world of abstraction and real life situations. The last few decades has witnessed changes in education resulting from dynamic and transitional nature of society(Tondon,2009). These changes have, according to Friedl(1986), made education programmes shift attention from content to process. The emphasis on 'process' rather than 'product' is meant to promote development of inquiry and problem solving skills such as manipulation and observation of natural objects and enhance understanding of scientific concepts. According to Mintzes, Joel, Wandoersee and Norak(1998),natural objects and events are the benchmarks of science, the referents and principal arbiters of our knowledge. They argue that you cannot take nature out of natural science and still call it

that. The need for change in the instructional methods in science has been felt throughout Africa. In 1968, the United Nations Educational Scientific and Cultural Organization sponsored a conference on the development of education in Africa at Addis Ababa(UNESCO,2006), in which reform of curriculum to include better methods of teaching sciences was discussed. Observation and experimentation in instructional methods was emphasized at the conference. According to UNESCO International science and technology and environment newsletter Vol XXXI numbers 3 and 4 of 2006: there have been significant efforts in the past few decades to deal with specific educational and communication problem related to the new approach to teaching sciences. These efforts have been predominantly motivated by practical or instrumental innovations related to the use of methods and technologies in school work as well as their implication in constituting a new science teaching and learning culture. The problem of poor performance in sciences in Africa has led to the need for in-servicing and training of Mathematics and Science teachers(INSET) known as strengthening of Mathematics and Science in Secondary School Education(SMASSE) in Western, Eastern, Central and Southern Africa(WECSA).Its headquarter is in Nairobi, Kenya with its membership standing at 23 nations .The centre for Mathematics and Science education in Africa(CEMASTE) based in Nairobi coordinates science and Mathematics teaching in the Continent. Biology is one of the sciences under SMASSE, the others being Chemistry and Physics. The infusion of educational Technology in addition to use of conventional resources in teaching has added a new dimension to the instructional process in biology. Provision and use of resources have been at the center of SMASSE INSET activities at CEMASTE.

Kenya's education system has undergone radical changes since independence in 1963. These changes have been influenced by the needs of the times. The national policy of the Kenyan government after independence was to promote equality and social justice. Policy documents on education Commissions and Committees at the time tended to emphasize on a curriculum for Africans that confined them to attaining inferior education. The purpose of offering a curriculum meant to be subservient to that of Europeans and Asians, was to ensure they serve at the bottom of the social ladder after graduation. The priority of the government after independence was to quickly train Africans to fill high level positions left by former colonial civil servants. Lecture method of instruction and rote memorization of lecture notes by learners were seen as a quick method of training doctors, nurses, environmentalists and other cadres of scientists to fill vacant positions in science oriented careers in medicine, engineering, agriculture, teaching and research work. Biology, like other science subjects that are constantly undergoing change require innovative methods of teaching that encourage problem solving. It has been estimated that the body of knowledge that we call science doubles every 10 years(Howson,1970).Due to the constantly changing nature of science of which biology is a discipline, Makulu(1971) observes that the strategies employed by science teachers in teaching earlier have become irrelevant today as our environment is not static but changing. In an effort to keep abreast with changes in the teaching of science and improve quality of instructions, the Kenyan government set up various Commissions geared towards changing biology curriculum to embrace resource based learning. According to objective number 3 in Mackay report, quality and relevance is key to development of individual talents in learners and this is achieved through acquisition of skills and expertise (GOK ,1981). A student deemed to have excelled in Biology

should demonstrate mastery of practical skills and innovation. An effective school curriculum that takes in to account frequent use of resources render activity of the teacher more efficient in enhancing learners understanding of difficult concept resulting in improved performance in biology.

### **Purpose of study**

The purpose of the study was to determine how academic performance of students is affected by extent of resource use. This is based on the premises that frequent use of various resources in the process of teaching and learning increases interest, comprehension and retention of subject matter (Njoga & Jowi,1981) by students, other factors remaining the same. Extensive use of resources, it is assumed may enhance academic performance to a large extent while infrequent or lack of resource use may only increase performance to a lesser extent.

### **Rationale for the use of resources in teaching and learning of biology**

Meaningful teaching and learning requires instructors and learners to effectively interact with various inputs. These inputs come in the form of learning resources encompassing both print and non-print media. Proponents of instructional resource use have unequivocally stated that resources help teachers deliver information more accurately especially where repetitions are required for concrete learning to take place (Gamble, 1984). Science subjects have some difficult concepts that can best be understood by sequencing instructions. Sequencing provides a logical progression of learning that can be achieved through use of various instructional resources. Inductive method of teaching where reasoning proceeds from specific to general is preferred to deductive methods where reasoning proceeds from general to specific. Inductive method of learning is best exemplified by use of resources.

Psychologists reveal that best learning occurs when the greatest numbers of senses are stimulated. According to Saunders (1994), we learn 11% through hearing and 83% through sight. They further say that we retain 20% of what we hear and 50% of what we see and hear, hence the need to use multi-media approach in teaching. Communication is more efficient when the senses are stimulated directly and simultaneously. Fuller (1986) while carrying out studies in Peru and Uganda found out that there exist a positive relationship between utilization of teaching and learning resources and academic performance. Effective schools have teachers and administrators who plan, design, research, evaluate and prepare teaching materials together while administrators allocate time consistent with priorities. The result, he says is always realization of better academic performance.

### **Related Literature on utilization of resources**

Resources facilitate teaching and learning process and are preferred by students as compared to traditional instructions (Jepkoech,2002). Victor (1975), Suggests that when children learn biology they should use inquiry and discovery approach and not memorize. This he says, is because young people being interested in activity and in concrete objects rather than in ideas, attend more readily where there is

something to see, taste, touch or smell. This view is supported by Anderson (1988) who observes that inadequate supplies of instructional materials in schools limit educational access and result in low quality of education offered in schools. Greater availability of resources raises the quality of learning and interest in the taught subject enhancing performance (Fuller, 1986). Learners are therefore able to follow, understand, respond to, and retain the contents of the lesson. The new found interest makes students assume major responsibility for their learning. Bertalanffy (1995) describes this principle of learning as equifinality since the same final state may be reached from different initial conditions and in different ways. There are many resources for teaching biology in the environment around the learners. According to Orwa & Underwood (1986), resources for use in the classroom need not involve an outlay of expensive scientific equipment. These resources are in fact "aids to teaching" implying that the resources are part and parcel of the teaching process (Romiszowski, 1994). Availability of resource, according to Mwangi (1985) is one of the major variables significantly correlating to learning and achievement. According to Mukwa and Jowi (1988) laboratory and practical techniques are highly suitable for teaching science subjects like biology since in this method the cause, effect and nature of the learning activity are determined by the actual experience or experiment under controlled condition. The review of the selected resources should take into account the changing educational objectives. Kimutai (1991) states that the instructional resources with the highest utility value in the achievement of educational objectives should be given first priority. Wekesa (1993) sees a positive relationship between the length of instructional day when using resources and student performance. Kemp (1985) notes that positive results are obtained when carefully designed instructional resources are used either as an integral part of classroom instructions or as the principal means of direct instructions. This finding resonates well with the result of a study by Shumbo (1993) who found out that secondary school teachers in Harare lacked material teaching resource to use for hands on inquiry that lead to poor understanding of the subject hence the notion that science subjects are difficult. This belief that science subjects are difficult leads to negative attitudes towards sciences in general and biology in particular. According to Brown and Wragg (1993) availability of resources or their frequent use in itself does not guarantee effective communication or effective teaching. It is their careful selection and skillful handling by the teacher that renders them useful in facilitating learning. This view is supported by Winman (1972) who asserts that "having the equipment and material available for use is one thing, knowing how to use them to create relevant learning situation is quite another"

## **Methodology**

The researcher carried out a descriptive study employing survey design. Survey design enabled the researcher to obtain information from a representative selection of the population and from that sample present findings as pointer to population trends. (Bell, 1993). The study involved sampling of 23 secondary schools from a target population of 92 public secondary schools in Siaya County. Stratified sampling was used to put schools into provincial and district categories while random sampling was used to select the sample. Stratified random sampling was used in mixed schools to separate sexes before randomly selecting the sample. Purposive sampling was used to select experienced teachers with more

than 4 years teaching experience in the secondary schools. Research instruments used for data collection were student and teacher questionnaires, checklists, interview guides for headteachers and quality assurance and standards officer and class observation schedule. Data analysis, presentation of findings, conclusions and recommendations were made after research work.

## Findings

*Types of resources that are used for the teaching and learning of biology.*

When asked about the category of resources used by teachers in the teaching of biology in the County, students gave their responses as given in Table 1. Questionnaires were used to obtain raw data that underwent organizing, classification, coding and editing. They were later compiled and processed. Percentages were derived and tabulation done. The table below summarizes the findings from the students.

**Table 1: Categories of resources in schools available for teaching biology**

Category of resource	Frequency	percentage
Audio-visual	0	0
Visual	116	100
Audio	0	0

Resources found in schools according to learners, were those that appeal to the sense of sight and not the sense of hearing. Students who are blind or partially blind can be very much inconvenienced in such resource based learning. It is further observed from table 1 that the type of learning that requires the use of both the senses of hearing and sight was virtually missing. The researcher went further to find out the type of visual resources frequently used for teaching and learning by teachers and students. The learners response are given in Table 2

**Table 2: Types of biology resources mostly used for teaching and learning in secondary schools in Siaya County according to learners.**

Resources	Frequency	Percentage (%)
Video	0	0
Text books	110	95
Real specimen (Realia)	20	17
All of the above	2	1

Schools were lacking adequate and appropriate instructional material and relying mainly on print and real specimens (realia) for instruction. Kimui(1988) and Nyongesa(1990) observe that our schools continue to function as though print are the only instructional media that can be used. Text books were the main type of resource used among visual category. These included other print media as class text, supplementary texts and reference books for teachers and students. Expository rather than heuristic method has been mainly employed in the county for teaching biology. The total percentage response exceeded 100%

since some students mentioned more than one resource. The table also shows that real specimens are also made available to learners but to a small extent (17%).

**Adequacy of biology teaching and learning resources**

When asked whether teaching and learning resources frequently used in biology are adequate, the responses by students were as given as in the table 3 below:

**Table 3: Adequacy level of biology resources frequently used in teaching and learning.**

Responses	Frequency	Percentage (%)
Adequate	10	7
Inadequate	104	90
Undecided	2	3

The inadequacy of resources may be largely due to low level of improvisation by the students and low level of resource acquisition by the schools.

**iii. Improvisation of resources**

Students were asked if they get involved in making resources for teaching and learning. Their responses were captured in the table 4.

**Table 4. Involvement of students in the provision of learning materials**

Responses	Frequency	Percentage
Yes	70	60
No	46	40
Not sure	0	0

Students can indeed make or have access to inexpensive equipment (Orwa & Underwood, 1986). This is the aim of SMASSE that has been carrying out INSET in the district since 2004. This is based on the premises that not all resources can be purchased.

**vi. Individualized learning without teachers’ initiative**

Individualized learning require students to take control of their learning by interacting with resources quite often. Students then become innovative, creating and discovering new knowledge

When asked whether they carry out practical on their own without initiation of the teacher, students responded as given in table 5. Results are given in percentages.

**Table 5: Utilization of resources without teacher’s initiation**

Responses	Frequency	Percentage
Yes	50	40
No	70	60
Not sure	0	0

During classroom observation of teaching using audio-visual resource, the researcher observed that learners were motivated. Beswick (1977) and Hanson (1975) reiterate that with available resources, students can achieve without teacher being available. The data on utilization of resources without teacher's initiation revealed that most students in secondary schools in Siaya County do not carry out practical activities on their own and as Parkinson (1994) observes, this lack of interest and drive is what frequent use of resources should provide.

**Table 6: Frequency of use of biology resources**

Response	Frequency	Percentage (%)
Always	30	26
Sometimes	86	74

Smith and Keith (1975) advice that use of resources must take into account the academic requirements of the learners. Without something to see young people being interested in activity and in concrete objects rather than ideas (Hughes & Hughes, 1966) attend "half heatedly" to the learning process.

#### **Academic tour/trips**

Students are rarely taken for academic tours. These sentiments were expressed through their questionnaires. The processed results are represented in the table 7.

**Table 7: Are you taken out on an academic tour trip?**

Response	Frequency	Percentage
Yes	16	14
No	100	86

Trowbridge, Leslie, Bybee and Powel (2004) observe that the local environment that includes the school, home and community is useful in making ideas clearer to the students and enable observation of the environment to help them demystify biology. Asked where they visit (for the 14% who do take visits outside the classroom) many students (73%) said they just visit the surroundings of their schools while a few (37%) indicated they travel out of their location.

#### **Relating resource utilization with academic performance in biology**

High academic performance is a sum of all factors relating to proper and consistent utilization of resources coupled with sound pedagogy. This includes adequacy of resources, presence of separate equipped biology laboratory and proper student-teacher ratio. The researcher, in collaboration with biology classroom teacher organized for two different biology lessons in classes of equal capability based on teachers' records. In one class an audio-visual lesson was in cooperated in a practical lesson that also involved use of a model of the heart. In the second class teaching was carried out without any resource used. A test was set and marked by the researcher. Result is given in table 8.



**Table 8: Relationship between resource utilization and academic performance**

Measure of practical activity	Measure of academic performance Using standard exam/tests Percentage (%)
<b>1.Effect of resources in teaching biology</b>	<b>Average performance in administered test given by researcher</b>
a, Class(2W) taught using resources. -observed by researcher... <b>First time</b>	52%
b, Class(2E) taught without resources-observed by researcher.. <b>First time</b>	48%

The researcher observed a lesson on the structure of the heart on the two classes-2W and 2E. In 2W a model of the heart and ICT integration was used unlike in form 2E. A test was administered after 2hours to both classes. The table above gives the result of the test. It indicates that with adequate use of biology T/L resources, academic performance is higher (52%) compared to that obtained without using resource (48%).The researcher observed a second round of resource teaching a week later on a related subtopic-The functioning of the heart. Both classes were taught using conventional resources-model of heart and shown simulations of blood flow using the researcher’s laptop and projector. A test was administered after two-hour interval. The result of the test is given in table 9

**Table 9: Relationship between frequency of resource utilization and academic performance**

Measure of practical activity	Measure of academic performance Using standard exam/tests Percentage (%)
<b>1.Effect of resources in teaching biology</b>	<b>Average performance in administered test given by researcher</b>
a, Class(2W) taught using resources. -observed by researcher... <b>Second time</b>	53%
b, Class(2E) taught with resources-observed by researcher.. <b>Second time</b>	51%

Frequent use of teaching and learning resources will, according to the result obtained in table 8 and 9 above make students’ performance even better. Form 2W improved by 5% through continuous use of resources while 2E improved by 3% when exposed to resource use.

The following statements (content analysis) were used to provide indicators of academic performance in the district.

**Table 10: Students opinions on parameters influencing academic performance**

**Key: SA-Strongly agree, A-Agree, UD-Undecided, D-Disagree, SD-Strongly disagree**  
**Response Percentage (%)**

S. No	Items	SA	A	UD	D	SD
1.	Our school has adequate biology resources	0	17	9	34	39
2	We have separate laboratory for biology	9	14	0	17	60
3	We use T/L resources during biology lesson	39	32	03	13	13
4	We utilize biology laboratory adequately	17	09	05	29	22
5	We have less than 50 students in class	14	19	02	23	42
6	I score highly in biology test	17	52	06	18	03
7	I spend free time doing biology practical	05	17	11	34	43
8	I understand when taught biology lessons	34	55	07	03	01
9	School administration buy for us resources	29	40	08	10	13
10	Our class completes biology syllabus on time	35	26	0	21	18

Students' statement analysis from questionnaires.

#### **i. Adequacy of up to-date biology resources**

From the research observation based on administered questionnaire, very few students (17%) agreed that there were adequate biology teaching and learning resources, while minority (9%) were undecided. The majority (73%) said they lacked adequate resources in the school. This translate into low utilization rate of both biology resources and facilities

#### **ii. Availability of separate laboratory for biology practical**

Few students (23%) who were mainly from provincial schools agreed that they had a separate biology laboratory for performing practical while majority (77%) who were mainly from district schools disagreed. All the students who indicated they have separate laboratory for biology (22%) were from provincial schools. This statement indicates that biology laboratories are largely lacking in a cross section of schools in Siaya County.

#### **iii. Use of teaching and learning resources during biology lesson**

Majority of the student respondents (71%) agreed that they use teaching and learning resources while learning biology; while very few (3%) were undecided. Few however (26%) indicated that they do not use teaching and learning resources during biology lessons.

#### **iv. Adequate use of laboratory**

A small number of students (26%) said they use biology laboratory adequately, while minority (5%) were undecided. Majority (69%) disagreed with the proposal.

#### **v. Class with less than fifty students**

When asked whether they had a class with less than fifty students, less than a half (33%) agreed while a small number (26%) were non-committal and about half (51%) refuted.

#### **vi . High score in biology**

The researcher did not indicate what score he considered high but left this statement open to test the level

of student’s satisfaction in their biology performance. Other indicators were used to look at performance in total. Many students (69%) were happy with their biology performance saying they score highly in the subject. Very few, (6%) were non-committal while a quarter (27%) said they performed poorly.

**vii. Spending free time doing biology practical**

Less than a quarter (22%) of the students said they spend their free time doing biology practical. A few (11%) were undecided. The majority (67%) however, denied spending their free time carrying out biology practical.

***Teachers views on extent of resource use and effects on students’ performance***

Teachers view on impact of frequent use of resources on students’ performance was important in moderating the views of the learners on the same subject. The researcher felt that certain teacher factors like sex, activity, competence and interest could influence frequency of resource use in schools and were important in facilitating individualized learning.

**Background Information of Teachers**

The research showed that there were more male teachers (70%) than females (30%) of the County workforce. There was uniform age distribution of teachers in the district considering age bracket 25-60. Age is closely related to activity in the teaching process.

**Table 11: Age distribution of teachers in the district**

Age bracket	Frequency	Percentage (%)
25-34	7	30
35-44	9	40
45 and above	7	30

**a). Teaching experience**

Teachers experience is considered important in knowing available teaching aids, selection of appropriate ones and in guiding learners in their use to obtain correct information (Lawton, 1971:116). Asked about teaching experience it was noted that about half of the teachers (48%) had teaching experience of fifteen years and above. The table below gives the findings.

**Table 12: Teachers teaching experience**

Experience in teaching	Frequency	Percentage (%)
6-9 years	7	30
10-14 years	5	22
15 years and above	11	48

***Source-school records (2011)***

Almost half of the teachers in the district had teaching experience of fifteen years and above and had

attended four cycles SMASSE INSET course. They are able to use and improvise teaching and learning resources. There was no teacher with less than six years teaching experience and were all expected to use teaching and learning resources to the maximum.

#### b). Teachers professional qualifications

The researcher sought to find out whether teachers professional qualifications had effect on utilization of resources and performance. It was discovered that majority of respondents (91%) had either Bachelor of Education or Post-graduate diploma in education. Only a small number (8%) had Diploma in Education. There were no form four school leavers in the staff. Most teachers (48%) had a teaching experience of fifteen years and above and were deemed able to use most of the resources for teaching and learning in secondary schools in the district.

**Table 13: Teachers professional qualification**

Teacher qualification	Frequency	Percentage (%)
Diploma in Education	3	8
Bachelor's degree(BSc /BA)	1	9
BED/PGDE	19	83

It was noted by the researcher that more than three quarters of the teachers were degree holders either having Bachelor of Education or Post graduate diploma in Education.

#### d. Biology classes taught

When asked about the biology classes they teach, the following data were obtained.

**Table 14: Teaching distribution in classes**

Class	Frequency	Percentage (%)
Form 1	22	96
Form 2	18	78
Form 3	19	83
Form 4	15	65

**Source: Deputy Principals in secondary schools in Siaya District (2013)**

It can be noted that the same teachers of form 2 were largely responsible for teaching other forms and had more than fifteen years teaching experience. This is because only twenty three form two teachers were asked about the classes they teach but all classes were mentioned by at least nineteen teachers except for form four that was mentioned by an equally large number of teachers (15) which represents sixty-five per cent. It can be observed from table 13 that most teachers of biology teach the subject in all the forms.

#### e. Class size

Class size influences the use of resources especially if resources are scarce. Asked about the size of classes, they can comfortably teach using resources, many teachers indicated that they can comfortably

teach a class of forty students.

**Type of resources used by teachers**

When asked about the types of resources they normally use in schools, most teachers mentioned print (mainly text books). The table below summarizes the responses. Frequencies and percentages were derived from the raw data obtained from the teachers’ questionnaire.

**Table 15: Resources normally used by teachers in schools**

S. No.	Resources	Frequency	Percentage
1	Video	8	35
2	Print	14	61
3	Realia	5	22

The total number of respondents was higher than 100% since more than three teachers made multiple choice of the media they preferred with sixty-one per cent of the teachers mentioned print as the mostly used resource in teaching and realia the least used resource. Kimui (1988) and Nyongesa (1990) observe that our schools continue to function as though print is the only instructional media that can be used. Davies (1975) calls this information source ‘passive’ and must be activated to facilitate direct use via media.

**Frequency of resource utilization by teachers**

Teachers responded to questions on the frequency of resource utilization by stating that use of resources is limited mostly to practical lessons only.

**Table 16: Frequency of use of available teaching and learning resources in Siaya District secondary schools**

S. No.	Level of resource usage	Frequency	Percentage
1	In every lesson	6	26
2	During practical lessons	15	65
3	Once a fortnight	12	9

Teachers had indicated that the resources normally used in their schools are Audiovisual, print and realia (Table 15). These resources are mostly used during practical lessons (65%) and in taught lessons (26%). Some teachers (9%) use these resources once a fortnight.

**i. Reasons for not using resources frequently**

When asked about the reasons for not using resources quite often, many teachers said the resources were limited and there was difficulty in improvising some essential ones like microscope. They however, appreciated the importance of using resources as can be seen from their responses in the table below.

**Table 17: Reasons for using biology resources in Siaya County secondary schools**

Responses	Frequency	Percentage
For clarity of ideas	6	26
To make learning real	5	22
Expose students to practical experiences	7	30
Arouse students interest	5	22
<b>Total</b>	<b>23</b>	<b>100</b>

**ii. Use of resources outside the school compound by teachers**

Many teachers take students on a learning trip. These activities carried outside school compound by other people help learners to develop curiosity and interest in learning (Hughes & Hughes, 1966).

**Table 18: Taking students outside the school to learn**

Response	Frequency	Percentage
Yes	13	57
No	10	43
Total	23	100

Table 18 shows that more than half of the teachers take their students for academic tours to learn. Such a trip will motivate learners to enable them to view resources in a different setting (Parkinson, 1994) and make ideas clearer (Trowbridge, et al, 2004) resulting in effective learning (Hughes & Hughes, 1966). On the type of resources they are exposed to during trip/ tour the responses were varied with respondents giving more than one resource as seen in the table below.

**Table 19: Types of resources used during trip/ visits/ excursions**

Response	Frequency	Percentage
Resource person	9	39
Activities like plays and shows	6	26
Real specimens	6	26
Sites like factories	2	9
<b>Total</b>	<b>23</b>	<b>100</b>

Table 19 indicates that students interact with an assortment of resources which they are not exposed to at school. Resource persons who are experts in the visited area like factory give students first-hand experience of what takes place in the site complementing their book knowledge with practical aspects at the site. Activities and plays seen in places like showground and real specimens seen in their natural setting crates curiosity and result in effective teaching and learning which in the end results in improved performance of the learners.

**Table 20: Do you use computers for teaching and learning?**

Item	Frequency	Percentage (%)
Yes	6	26
No	17	74

Those who said they used ICT said they used computers for teaching and learning. Asked about the frequency of use about a third (33%) of the respondents said they use them frequently while about two thirds (67%) said they use them infrequently.

**Relationship between resource utilization by teachers’ students and academic performance**

The researcher observed that performance is a sum of many factors relating to utilization of resources. The researcher used a modified Likert scale (Table 20) to gauge the views of teachers to come up with a general performance. Table 20 was used to record information from the teachers based on their responses to questionnaires provided to them. Maritim (1983) found that the quality of teacher pupil interaction correlates positively and significantly with pupil’s performance and that academic achievement depends upon self-concept, facilities and motivations.

**Table 21: Teachers opinion on parameters influencing academic performance**

**Key; SA-Strongly agree; A-Agree; UD-Undecided; D-Disagree; SD-Strongly disagree**

Items	Percentage approval Ratings (%)				
	SA	A	UD	D	SD
Our school has adequate resources in biology	0	26	09	65	0
I use resources whenever I teach biology lesson	0	35	26	35	0
There are more than fifty (50) students in my class	17	35	0	35	13
My biology students are less than fifty (50) in class	0	26	0	57	17
We have separate biology laboratory in our school	04	09	0	09	78
I mostly use lecture and demonstration method in teaching	17	65	0	09	09
Our school administration supports us in acquiring resources	04	61	09	09	17
I have adequate time to plan for biology practical lessons	09	17	0	61	13
My students perform well in biology	0	35	0	52	13

**a) Adequacy of resources in biology**

About a quarter (26%) of teachers said the resources were adequate, while a small number (9%) were non-committal. About two thirds (65%) disagreed that biology teaching and learning resources were adequate.

#### **b) Utilization of resources by teachers during lessons**

A reasonable number (35%) of teachers agreed that they use resources, while about a quarter (26%) was undecided on this while the remaining (35%) refuted the idea.

#### **d) Separate biology laboratory in school**

A small number (13%) of teachers agreed that they have separate laboratory for biology practicals while the majority (87%) said they did not have separate laboratory.

#### **e) Use of lecture method in teaching biology**

Majority (82%) of the teachers acknowledged that they use lecture and demonstration method of teaching biology while the minority (18%) refuted it.

#### **f) Support from school administration in resource acquisition**

A large number (65%) of teachers said school administration support them in resource acquisition, 26% said they were not supported while (9%) were not committal.

#### **g) Adequate time to plan practical lessons**

About a quarter (26%) of teachers said they have adequate time for planning biology practical lessons as opposed to the majority (74%) who said to the contrary.

#### **h) Performance in biology**

More than a third (35%) of teachers said their students performed well in biology while two thirds (65%) said their students 'performance was poor.

**Table 22: Biology teaching resource checklist**

Text books	Title of textbooks	Availability		Number in library	Text books user ratio
		Adequate	Inadequate		
Recommended class text books by ministry (students)	Secondary biology KLB Bk 2	42	58	Adequate	2:1 (provincial) 4:1 (district)
Supplementary books for teachers	Principles of Biology -Longman explorers, Longhorn High Flier Certificate Biology, Comprehensive Secondary Biology	30	70	Scarce	10:1



	(Oxford)				
References books for teachers	Teachers guide KLB Macmillan Sec Biology, Comprehensive Biology, text it fix it KCSE Gate Way Secondary, golden tips, functional approach, modern biology, integrated approach	40	60	Moderate	3:1
Reference books for students	Principles of Biology, top mark, gold medal, discovering secondary, Certificate biology	25	75	Scarce	10:1
Other teaching aids	Name of teaching aids	Adequate	Inadequate	Number in schools	Sign of usage
Commercially manufactured charts	Respiratory system, digestive system, body mechanism, circulatory system, mammalian eye, mammalian ear.	60	40	Abundant	Hanging on wall
Models	Eye, ear, heart, kidney, male reproductive system, female reproductive system	30	70	Scarce	Worn out
Teacher made	Charts, preserve	35	65	Scarce	Hanging

	specimen, sweep nets, bell jar, quadrant				
Pupils made	Charts, sweep nets	20	80	Scarce	Some damaged
Equipment's	Apparatus , microscopes, magnifying lens	30	70	Abundant	Some cracked
Audio visual	Name of teaching aid	Available	Unavailable	Number in school	Sign of usage
Audio	Radio	20	80	Scarce	
Visual	Preserved slides	70	30	Abundant	
Audio visual	Discs , CDs	40	60	Scarce	
Realia	Bottled specimens	30	70	Abundant	

### Results from Observation Checklist

Table 22 reveals that supplementary textbooks, student reference books, models, audio and audio visual teaching and learning resources were scarce in the district. Recommended class textbooks published by Kenya Literature Bureau (KLB) were sufficient with provincial schools having student-book ratio at 2:1 while in District schools the student- book ratio stood at 4:1. The table also shows that commercially manufactured charts, equipment and realia were available in reasonable numbers that could be satisfactorily used to instruct learners. Reference books for teachers were moderately sufficient with teacher-book ratio standing at 3:1 while for students it stood at 10:1. Supplementary books for teachers stood at a ratio of 10:1 per book. The researcher considered a sharing ratio of 4:1 for textbooks as the most stretched limit for effective learning. Glassware, magnifying glass, slides and other apparatus that can be shared between two students were considered sufficient. Other teaching and learning aids like charts on each topic for a class of forty-five was considered sufficient as was a computer serving two students. All in all the provincial schools were fairly stocked with conventional resources while district schools with high student- resource ratio (Table 4.26) were largely lacking in sufficient resources.

### Findings from Lesson Observation Schedule

The researcher observed live lessons and recorded the observations using lesson observation schedule. The researcher sat at the back of the class as the teachers taught using resources in some classes and taught without in other classes. The researcher had visited the class before and briefed the students that he would learn with them when he comes back. Two evenly matched classes were selected in the three schools selected for classroom observation. One class was taught using teaching and learning resources while the other was taught by their teacher without resources as had been arranged between the teacher and researcher. The aim of classroom observation was to find out if the use of teaching and learning

resources had any effect on academic performance of the students based on administered test. The researcher selected three schools for observation. These schools were part of the sampled schools for classroom observation. The two tests were marked by the researcher. Differences between the results were analyzed. It was found that in each school, the stream that was taught using resources (2W) performed better than the one taught without resources (2E). The average marks obtained from evaluating students taught using resources was higher (54%) than those taught without (48%) showing that resource use during teaching improves performance. In the second observation the two cases 2W and 2E were both taught using resources and the classes scored 53 and 51 percent respectively. The tests were selected from KCSE past paper which had been standardized and marking scheme moderated by senior examiners.

### **Results from Use of Interview Schedule for Head teachers**

Structured interview using interview schedule was granted to the twenty- three head teachers in Siaya District one from each of the selected schools under study. They comprised quarter (25%) of the total number of head teachers in the district. The purpose of carrying out interview was to counter-check information given by the students and teachers in the questionnaire and have all inclusive and balanced view on all the factors involved in utilization of Biology teaching and learning resources and resultant student academic performances. The researcher captured responses from head teachers during the interview in a tape recorder which was later used to ascertain the level of resource use in the schools.

On the question of the adequacy level of biology teaching and learning resources in their schools, majority (80%) of the head teachers said they had inadequate resources while twenty per cent said they had adequate resources in their schools. It is instructive to note that the few (20%) head teachers who indicated they had adequate resources were from four provincial schools that are deemed to have sufficient resources according to list of schools from the DEO office. Enough or scarce, the utilization aspect of the teaching and learning resources is what determines whether learning objectives can be realized, taking into account what we want our students to know (Brown & Wragg, 1993). When asked to comment on resource utilization in their schools, many (60%) head teachers said that the available resources are not utilized to the maximum. Quarter (25%) said they were moderately utilized while minority (15%) said they were utilized to the maximum. Most of the principals felt that the available resources are not being used to the maximum.

Utilization of resources has its own challenges which head teachers –majority of who were active classroom teachers knew. Head teachers were quick to point out inadequacy of resources as the main challenges facing resource utilization. A quarter (25%) of head teachers however, blamed lack of improvisation as a major challenge with the same percentage (25%) identifying lack of exposure to the available resources as the challenge.

The researcher discerned that there existed a possible planning and knowledge gap on the part of the teacher (Lawton, Campbell & Burkitt, 1997) whose heads (25%) blame lack of exposure. The researcher then asked whether teacher training and qualification influence student achievements in biology. Many (60%) head teachers said yes, few (30%) said it affects to some extent while minority (10%) said it did not. The head teachers were asked whether they thought availability and utilization of biology teaching

and learning resources contributed to learners' achievements. Quoting from one head teacher who is also SMASSE biology the district, "Availability of resources provides students with more hands-on activity and enhances their understanding and performance. The head teacher's sentiments are in line with Sepulveda (1983) who reveals that use of instructional resources influences learning to a great deal.

The researcher posed a final question to the school head teachers on what could be done to improve student's achievement in biology. Their responses were varied and numerous. The researcher condensed and categorized the responses into four major suggestions (Table 23).

**Table 24: Head teacher's suggestions on ways of improving students' achievements in biology**

Suggestions	Frequency	Percentage (%)
More practical work (hands- on activities ) facilitated by the teacher	9	39
Expose them more to learning resources for individualized learning in groups (cooperative learning)	7	30
Proper training of teachers including in-service education and training (INSET)	3	13
Taking them for tours and visits and /or inviting experienced examiners to talk to them and guide them	2	9
Giving adequate assignments /homework to research on in the library , home or on the compound as personal project	2	9

Improvement of academic performance was central in the head teachers list of desires with thirty-nine per cent of the head teachers suggesting that more practical work should be done to enhance students' academic performance in biology. This view is shared by Bennars and Otiende (1994) and Ellington (1985). Proper training of teachers was suggested by the head teachers as a necessary prerequisite to good performance by teachers in class that could enhance students' performance. This is what the Kenya government in collaboration with Japanese government under JICA has been doing to strengthen the teaching of Science and Mathematics in Kenya under auspices of SMASSE. The suggestion by head teachers that more assignments be given (9%) resonates well with individualized learning method that Beswick (1977) sees as important in motivating learners. The head teachers further suggested that students should be exposed to learning resources in school (30%) which according to Parkinson (1994) is very effective in the learning process.

### **Head teachers view on Relationship between Utilization of Resources and Academic Performance**

Majority of Head teachers interviewed (39%) suggested that more practical work is required in order to improve biology performance in schools. This is in line with suggestions made by Saunders(1994) that much learning (83%) takes place when a teacher engages students' sense of sight and further says that students retain fifty per cent of what they are taught while seeing and hearing as opposed to twenty per cent retention of what they are taught through hearing alone. Teachers (26%) also suggested that using resources while teaching helps in clarity of ideas. Students said they sometimes use resources during teaching and learning process. This made teachers (65%) and head teachers (75%) say that students are performing poorly in biology. The researcher further proved using tests that academic performance improved when students are taught using resources (51%) than when they are taught without resources (48%). Siaya District mean score in Biology during the five years after INSET was started in the district increased by 0.8 compared to the period before INSET. In-service Education and training of teachers (INSET) is meant to train teachers on the practical approach of teaching science subjects and mathematics using teaching and learning resources. The findings on the relationship between utilization of resources and academic performance are that availability and proper utilization of T/L resources improves academic performance (Patel & Mukwa, 1993).

### **Summary**

Students mostly use print (95%) as major resource for leaning. This consists mainly of school text and reference books. Students rely on these resources for learning than teacher's relying on them for teaching (61%). The findings also indicated that some teaching and learning resources are made available in class by the teachers according to students (86%). Head teachers usually purchase the resources according to teachers (45%) and students (69%). The resources for teaching and learning are inadequate according to students (74%), teachers (65%) and head teachers (80%) and hence not used frequently. Teachers are involved in some degree of improvisation of resources (17%). Students are not motivated to use the teaching and learning resources on their own according to teachers (48%) and students (57%). Teachers (65%) also indicated that they do not frequently use some of the teaching and learning resources like *realia* and charts but during practical lessons. This means that teachers rely mainly on lectures (89%). The biggest challenge to utilization of resources is inadequacy of the resources according to students (33%) which they try to overcome by sharing the available ones (39%). Teachers resort to improvisation of resources where possible (17%) and to take students on academic trips for outdoor learning (57%). Biology as a practical science subject cannot be taught and understood without frequent exposure to practical activities. Teachers indicated that the major reasons for utilizing resources during teaching was for clarity of ideas (26%), creating interest in the learner (22%) and demystifying the subject by observing specimens (22%). Inadequacy of resources coupled by use of lecture as teaching method has resulted in reduced performance in examinations according to teachers (65%), students (25%), researcher in administered test (48%) and KCSE (mean of 5.47) between 1999 and 2003 before start of INSET in the district.

## Recommendations

Utilization of biology teaching and learning resources is very important for good results to be realized in biology. The following recommendations have been made by the researcher:

**i. Availing resources**-Basic resources should be made available by the head teachers. Teachers of biology should set up simple aquarium, vivarium and botanical gardens in schools. The government should also supply basic resources to schools through special funds.

**ii. Subsidy on imported computers**-The government should subsidize on costs of computer and related soft and hardware to make computers cheap to be afforded by schools. This will encourage teachers to employ use of ICT in instructions to make learning efficient.

**iii. Updating teacher training programmes**-To ensure new teachers go through the practical requirements of the changing syllabus and technological aspects of teaching like e-learning and innovative activities that emphasize resource use. Regular review of the teacher training programs in light of the changing educational trends is desirable.

**iv. Improvisation of teaching and learning resources**- Teachers should attempt to improvise resources in their schools based on knowledge from the INSET centres and training.

**i. Setting up of resource centres**-Schools and the surrounding community should be sensitized on preservation of teaching and learning resources and if possible a learning resource center should be set up centrally near a group of schools to enhance learning.

## Suggestions for Further Research

- a) The research which was carried out in One County -Siaya is not representative of the whole country. Similar research should be carried out in other districts.
- b) A research should be carried out on the extent to which biology teachers can improvise teaching and learning resources for use and recommendation given for further action to ensure availability and frequent utilization of biology teaching and learning resources in secondary schools in Kenya.
- c) A research should be carried out on why teachers do not frequently teach using the available resources in their schools.
- d) A study to be carried to investigate the relationship between continuous use of T/L resources and its impact on the future of student's scientific potential.

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