Efficacy of Kinesthetic Instructional Resources Utilization on Students' Performance in Biology in Secondary Schools in Kenya

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2.1 Abstract

Educators propose a wider range of stimulating and exciting materials to be used in teaching the concepts outlined in the curriculum to ensure that learners are actively involved in the learning process. The purpose of this paper was to investigate the efficacy of kinesthetic instructional resources utilization on students' performance in biology in secondary schools in Bungoma Central Sub- County in Kenya. The objective of this paper was to assess the availability of the wide range of kinesthetic instructional resources used in biology in secondary schools. The study was conducted in Bungoma Central Sub-County. Descriptive survey design was utilized in this study. The target population was the teachers of Biology; Laboratory Technicians and form three students in the secondary schools in Bungoma Central Sub- County. Stratified random sampling was used to select the schools from which respondents were picked. Purposive sampling was used to pick Biology teachers and laboratory technicians while simple random sampling was used to select students in the sampled schools. Data was collected using questionnaires, document analysis and observation schedule. Data was then analyzed using descriptive statistics. The study findings show that the predominant kinesthetic instructional resources available in most schools were black and white photographs and in some schools, these could only be accessed from the prescribed course books. The study also found that, most teachers, students and laboratory technicians perceived that the use of kinesthetic resources mainly coloured photographs simplified learning of biology and that they provide a better alternative to real specimen as they present the virtual reality of the latter. The conclusion made from this paper was that students need constant interaction with the subject teacher to develop the skills, attitude and knowledge about the photographs presented to them.

2.2 Introduction

Kinesthetic resources are tools and equipment that require learners to acquire knowledge through hands-on activities, role playing and realia. These resources create conditions for learning of biology during classroom instruction. In this paper, photographs are a form of kinesthetic instructional resources which were introduced some few years back as alternative to the real specimens. Photographs allow students to remember the details of the real specimen, to touch the virtual reality which could be rare and dangerous thereby getting involved in what is being learnt. Photographs also enable students to enjoy the opportunity to build and physically handle learning materials which will accord learners the chance to take notes from what they observe in the photographs. The photographs were introduced in place of real specimen due to the cost and other logistical factors, such as inavailability of some specimens needed for students' practicals experience. According to Aggarwal (1995), a teacher of biology should maximize the practical study by controlling relevant factors such as educational purposes, educational context and teaching materials.

The research was pegged on Edgar Dale's theory of learning (Dale, 1969) who posits that the rate of retention of information by learners depends on the method of teaching.

The most effective method of teaching is at the bottom of the core of experience, while the least effective method of teaching is at the top of the core. The cone of experience constructed shows that learners generally retain only 10% of what they read on their own while 90% of what they do as they perform a task. The more sensory channels involved in the interacting with the learning resources, the better the chance that many students can learn from it. The learning experiences at the bottom of the cone consists of field work, hands-on activities of the situated learning, these are ideal opportunities which can be exposed to learners to foster both effective and efficient teaching and learning.

In summary, the teacher should guide learners to do the real thing and not just reading about it or listening to someone describing it. The bottom line is, learners are supposed to be shown as many photographs as possible, so that they remember the details that can enable them answer the questions in biology practicals. As kinesthetic instructional resources, photographs offer three dimensional view of the real specimen which allows the learners to make observations in order to deduce useful information that is utilized in answering questions in biology practical. The objective of this paper was to establish the perceptions of teachers and students towards use of kinesthetic instructional resources in Bungoma Central Sub-County, Bungoma County.

2.3Research Methodology

2.3.1Research Design

This study was conducted through descriptive survey design. Descriptive survey involves collecting the information by interviewing or administering a questionnaire to a sample of individuals (Orodho, 2003). This design enabled the researcher to determine the present status of the population of the study with regard to a number of variables. It enabled the researcher to collect information about teachers' and students' attitude towards use of photographs in classroom teaching and learning. The study examined the situation as it is in Bungoma Central Sub-County. According to Mugenda (2003), descriptive survey involves collection of data in order to determine whether and to what degree a relationship exists between two or more quantifiable variables.

2.3.2 Study Area

This study was conducted in the secondary schools in Bungoma Central Sub-county of Bungoma County (see the attached map at the end of this paper). Bungoma is one of the four counties in the former Western province in Kenya. It is bordered by Busia County to the South, Kakamega County to the West and Trans Nzoia County to the East. According to the Ministry of Planning and Development, the population of Bungoma County is estimated at 1,630,939 which make it the third most populated County in Kenya. The Taskforce Report on Education in Bungoma County released in September, 2014 shows Performance in Biology paper three has been poor and only few schools manage the above average performance than the neighbouring sub-counties. The sub-county was ranked among the last of nine sub-counties of Bungoma County.

2.3.3 Study Population

This research was conducted in Bungoma Central Sub-County which according to the Ministry of Education statistics has thirty-one (31), secondary schools, both public and private secondary schools. The target populations for this study were the teachers of biology who are seventy three (73); there are sixty one (61) laboratory technicians and 1526 form three students (ministry of education statistics).

2.4 Sampling Techniques and Sample Size

The sample size was determined using the following technique:

2.4.1 Sampling Techniques

The schools were selected using stratified random sampling (based on the category of the schools, please see overleaf) to ensure that there was equal representation of all types of secondary schools. The biology teachers and laboratory technicians were selected using purposive sampling technique. The students from non-coed schools were selected using simple random sampling, where small pieces of paper were picked at random, and those who picked papers bearing even numbers were given questionnaires. In the mixed schools, stratified sampling techniques were used to ensure gender equality.

Categories of Schools by School Type

Category of school	Boys'	Girls'	Mixed	Total
Extra County	-	1	-	1
County	3	3	2	8
Sub County	2	1	2	5
Private	-	-	1	1
Total	5	5	5	15

2.4.2 Sample Size

The study involved 202 students, 45 teachers of biology teachers and 28 laboratory technicians from 15 secondary schools. In each school, participating classes were randomly sampled, equal samples of boys and girls were selected to participate in the research.

2.5 Data Collection Instruments

This study used questionnaires as the main tool for collecting data. The selection of questionnaires as data collection tools was guided by the nature of data to be collected, the time available and objectives of the study. The overall aim of this study was to investigate the influence of availability and utility of a varied range of photographs as learning resources. The study was mainly concerned with views, opinions, perceptions and attitudes. Such information can be collected through the use of questionnaires (Touliato and Compton, 1988; Bell, 1993).

2.5.1 Questionnaire

A questionnaire is a collection of items to which a respondent is expected to respond usually in writing. The researcher used three questionnaires; Biology Teachers' Questionnaire, Students' Questionnaire and Laboratory Technicians' Questionnaire. The items in these questionnaires were open ended, closed type and Likert type scale questions. The questionnaire for biology teachers sought to collect information with regard to their background, including age, professional qualification, and their perception towards utility of Photographs during classroom instructions and the challenges encountered in the course of utilizing the photographs. The students' questionnaire on the other hand sought to establish the students' perception towards use of photographs during teaching and learning of biology, find out the extent of utility of photographs during teaching and learning of biology in their schools and their opinions about utility of photographs in learning of biology. Lastly, the Laboratory Technicians' Questionnaire also sought to establish the background information of the laboratory technician and to establish the availability and frequency of utility of the photographs during practical sessions in school.

2.6 Ethical Consideration

The permission to carry out this research and to use information obtained was sought from relevant authorities and the concerned parties. Permission was obtained from the university, NACOSTI (National Council of Science Technology and Innovation) and the participating schools. The researcher kept any personal information confidential and did not allow any unauthorized person to access it.

2.7 Data Analysis Procedure

The data captured from the field was coded, analyzed and presented in the form of percentages, frequencies, tables and figures. These were ideal because the data was mainly descriptive in nature.

2.8 Results

A total of 202 respondents involving the teachers of biology, form three students and laboratory technicians were interviewed and the results are shown in the tables and figures below.

Demographic Data

Summary of Respondents by Gender

Gender	**Male**	**Female**
Students	125	77
Teachers	40	5
Laboratory technicians	15	13
Total	180	95

Source: Field Data

From demographic data captured included the respondents' gender composition, level of education and duration of service for those who are working as teachers and laboratory technicians. The data was solicited to enable the researcher get the background information on the schools in the study sample. The background information assisted the researcher in generalizing the study findings to the sample population. The study was conducted among 202 form three students, 45 teachers of biology and 28 laboratory technicians. The male students were 125(61.9%) while the female students were 77(38.1%), the male teachers of biology were 40(88.9%) the female teachers of biology were5 (11.1%) and the male laboratory technicians were 15(53.6%) while the females were13 (46.2%). Thus, the findings of the study gave a good representative sample of the gender.

Availability of Photographs as a form of Kinesthetic Instructional Resources

Type of photographs used during teaching

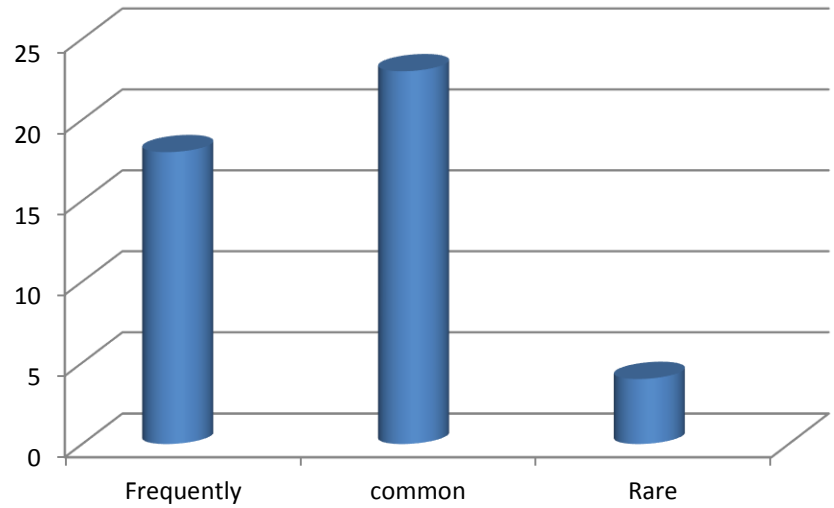
Type of photographs	**Frequency**	**Percentage**
Coloured	17	37.8
Black and white	22	48.9
Both	6	13.3
Total	45	100

Source: Field Data

The results in table above show that 22 (48.9%) use black and white photographs in their day to day learning of biology, only 17(37.8%) indicated that they use coloured photographs while 6(13.3%) use both coloured and black and white photographs. Akinbobola (2005) determined that facilities including 3-dimensional ones are potent to high academic achievement of students since they enhance teaching and learning processes. They discuss reasons why these types of resources effectively motivate students and enhance learning. The findings from this research differ a little with the findings of above research. Photographs highlight the most important aspects that should be focused on. According to Akinbobola & Ikitde (2008),

Tanner & Allen (2004), Mlambo (2011) have all shown that instructional resources such charts, photographs among others, act as advance organizers on students' motivation to learn biology. The photographs particularly sequence and chain the story map, highlighting only the main ideas in a simplified table, flow sequence and matrix.

Then, if black and white photographs are utilized in teaching and learning of biology, the research sought to find out how frequent these photographs are utilized.



Frequency of using Black and White Photographs

The findings in the figure above show that black and white photographs are commonly used in the schools that participated in this research. From the results, black and white photographs are utilized frequently. The research findings by Samikwo (2013) concluded that teaching and learning resources impacted positively on students' achievement, the results in this research show that there is only slight improvement in performance, but still below average.

Availability of black and white photographs in schools

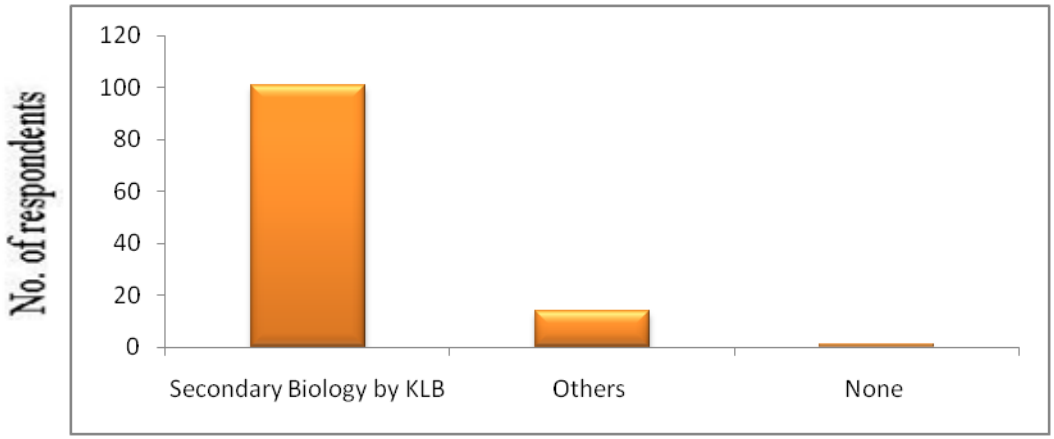
Availability	Frequency	Percentage
Very Common	12	26.7
Common	19	42.2
Rare	11	24.4
Very rare	3	6.7
Total	45	100

Source: Field Data

Data from table above shows 12(26.7%) teachers of biology indicated that black and white photographs are very common in schools in Bungoma Central Sub- County, while 19(42.2%) biology teachers showed that these black and white photographs were common, 11(24.4%) and 3(6.7%) respectively opined that these black and white photographs are rare in their schools.

The nature of photographs matter a great deal because whereas black and white photographs were common, they do not give virtual reality of the real specimen. The photographs can only be used when the real specimen is unavailable, so that it can allow the learner to manipulate and interact with most features that can enable him/her to make meaning out of it. Quist (2000) observed that planning instruction allows the teacher to organize material in a way that will interest students and provide a variety of activities and tasks suitable for the range of ability in class. Black and white photographs themselves lack the pertinent features that do not interest learners.

The source of photographs used in teaching biology



Source of photographs used in teaching and learning of biology

The data in figure above shows that 145(71.8%) students obtain the photographs from text books published by KLB, but 1(0.5%) who indicated none may not be conversant with the shift from using real specimens to the photographs while the 56(27.7%) who showed other sources of photographs included among others, using the camera to take the photographs while on school trips, processing those photographs and using them in the classroom. The reason was to cut on the costs of making trips for viewing real specimens.

2.9 Conclusion

The conclusion drawn from the findings are as follows:

The teachers of biology mainly use black and white photographs because they are readily available in the prescribed biology course books. The coloured photographs even though are better in terms of clarity of the details and appeal to the students, are quite expensive and are bought at high prices. The black and white photographs lack virtual reality and other pertinent features which learners use to process the information for use to solve the questions in biology practical examination. The experience of teachers and qualification influenced the frequency of utility of kinesthetic instruction resources in teaching and learning of biology. Part of the experience is the ability to source for the materials which are locally available within the school and even without the school compound. The materials that could not be carried could be taken in the form of photographs. To take a photograph of specimen require that the teacher should be in possession of a camera and should have the skill to take a three dimensional view of the specimen. This avails the rare specimen in the class room for utility by the learners. Adding colour is a feature to be manipulated by the person handling the camera and the ability to add colour ensure that the pertinent feature of the real specimen are clearly visible.

When the photographs are availed to the learners frequently, learning becomes easier. The easy with which learners manipulate the photograph ensures that they can observe as many features of the photograph as possible to obtain the information needed to answer the questions in biology examination. This improves learning which is evident in good performance in biology examination.

The course books were frequently utilized as reference materials, but they contain only black and white photographs. Among all other instructional resources, text books were a cornerstone of reference for both teachers and learners. Kinesthetic resources only supplement what the text books have already highlighted. The opinion of teachers, students and laboratory technicians that coloured photographs are better is pegged on the fact that they provide opportunities for effective learning of biology. The students would then perform better on those questions in biology that require interpretation of biological functions than those that utilize black and white photographs.

Curriculum materials play a very important role in availing the kinesthetic instructional resources to the learners. Students enjoyed active learning that was student-centred for instance class experiments and group work involving minor modification of photographs presented to them by the teacher. The teacher's presence in class served as a motivation for the students to frequently ask questions for clarification of complex concepts.

Kinesthetic instructional resources alone cannot enable the learners to manipulate, therefore, realia and models are inculcated to make learning biology both effective and efficient. This means that learning resources should complement each other for learning to be realized. Realia makes learners have realistic understanding of the subject being taught, it motivates learners to search for the evidence of pertinent features that could not come out clearly when using the photographs. The schools that were visited had realia in the form of botanical gardens containing floral specimen, while many of the schools had preserved animal specimen in bottles which could be retrieved to meet the need for realia. Photographs were introduced in form one and it offers learners opportunity to interact with the photographs as they progress through different levels. The innovative ways highlighted in the third objective aims at addressing the challenges of utility of the available photographs for learning to take place. Early preparation is very important as it impacts positively on learner preparation. The earlier the students get used to instructional resources the more they utilized them for actual learning. Other factors that play a significant role in preparation of learners are knowledge of the syllabus where kinesthetic resources are prescribed for use by the teachers and the learners. Some specimen like blood and body tissues sometimes elicits contrary reaction from the learner given the social background of the learner. The photographs of these specimens are used to counter such reaction enabling the learners to freely manipulate and process the information without much ado.

The cost of procuring the photographs is very high given the fact that the price of the albums and compiled materials of the photograph depends on the vendors. The teachers who take time to acquire the photograph, prepare the photograph to be availed to the learner and take a step of processing the photograph like finding out magnification of the photograph, labeling of the same photograph and taking putting some details about the photographs as foot notes enabled students to grasp the fact better that just presenting raw photographs to the learners. Laboratory technicians have little experience with the photographs and it therefore boils down to the teacher to guide learners and technicians on what to do with the photographs. The technicians contacted by the researcher were not qualified and many of them were laboratory assistants. In some schools especially below average school teachers were multitasking as both laboratory technicians and teachers of biology. Some schools were even using the form four leavers who have no training and experience with the photographs. Students learn a lot from mentors and paragons in their chosen field of study therefore it is a clarion call upon the Ministry of Education to train and post the personnel who can take that position.

2.10 Recommendations

In line with the conclusion drawn above, the study recommends that:

i. The students need constant interaction with the subject teacher to develop the skills, attitude and knowledge about specimen presented to them. The teacher in this manner is the teacher being the subject matter expert will be transmitting the content needed by the learner.

ii. The schools head teachers being managers of school's resources should consider themselves as members of the assessment team with regard to performance and therefore ensure proper acquisition, evaluation of kinesthetic instructional resources and avail these resources in schools in readiness to be used by the students. They should provide leadership necessary for strengthening the performance of their schools in the biology department.

iii. Furthermore principals should ensure that Heads of Departments work as one with the subject teachers of biology to promote performance in the subject. This includes among others, changing the attitude of the subject teachers and students positively towards the subject and encourages the sponsors to fund the department of biology and be keen to boost performance in biology.

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