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# INFLUENCE OF LABORATORY FACILITIES ON STUDENTS' PERFORMANCE IN SCIENCE SUBJECTS IN PUBLIC SECONDARY SCHOOLS IN MACHAKOS SUB-COUNTY, KENYA

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**Abstract**

*The purpose of the study was to establish the influence of laboratory facilities on students' academic performance in science subjects in public secondary schools in Machakos Sub-County, Kenya. The study objectives were; to establish the availability of laboratory facilities and equipment in public secondary schools, to find out the extent to which the science teachers use laboratory facilities in teaching science subjects, to establish the relationship between laboratory facilities and the students' academic performance in science subjects.The study employed a descriptive survey research design where the target population consisted of 75 principals, 350 teachers and 4500 form three students of the public secondary schools in Machakos Sub-County. Questionnaires were used to collect data. Quantitative data was analyzed using statistical Package for Social Sciences and the results presented in frequency tables, bar graphs and percentages to make meaningful conclusions. From the study it was established that; there is no significant relationship between availability of laboratory facilities and students' performance in science subjects, there is significant relationship between laboratory facilities and the students' academic performance in science subjects, teachers use of laboratory facilitiesin teaching science subjects had significant effect on students' performance in science subjects and managing class sizes pose a significant challenge to principals in provision of laboratory facilities in public secondary schools. This study recommends that principals should work hand in hand with parents, sponsors and other stakeholders in education to prioritize the provision of adequate laboratory facilities.*

***Keywords**: Laboratory facilities, students' performance, science subjects.*



## 1.0 Background to the Study

Education is a key pillar to both national and personal development (Ohba, 2011). It helps any society fashion and model individuals to function well in their environment. Boit, Njoki and Chang'ach, (2012), highlighted the benefits of education as: improving the productive capacity of the society, reducing poverty by mitigating its effects on population. Apart from

the economic benefits that it is argued this would bring, by better preparing young people for the numeracy demands of modern work places and raising the overall skill levels of the workforce, there are also social benefits tied to improving access for larger numbers of young people to past- school education and training opportunities and laying stronger foundations to skills for life learning, health and nutrition. In Kenya, secondary education plays a vital role in creating a country's human resource base at a level higher than primary education (Achoka, Odebero, Maiyo&Mualuko, 2007). The vital role played by secondary education may partly explain the Kenyan government's decision to introduce Free Secondary Education (FSE) in public secondary schools in order to increase its demand (Ohba, 2011).

In Kenya, the education system is largely examination oriented, where its quality tends to be evaluated in terms of the number of students passing national examinations (Eshiwani, 1993). However, the students' academic performance of science subjects has always been wanting in Kenya hence drawing a widespread interest on improving the students' performance in science subjects ; physics, Chemistry and Biology and particularly at the secondary school level.

One of the vehicles by which the process in inquiry can be leant is the laboratory where the student experiences the inquiry process, thus the study in a laboratory is an integral and essential part of science subjects. Science laboratory activities are hands-on experiences which emphasis process skills (Dike, 2008) which Agbo (2003) posited as motor skills that help the scientists to find answers to problems and enhance the learning of science. Laboratory activities stimulate learners interest as they are meant personally engage in useful scientific activities and experiments. This affords the learners the basic skills and scientific methods of problem solving. Ado (2003) further opined that it is very necessary that students manipulate materials and equip in learning of Science through equipment; this will help them not only to acquire science process skills and new knowledge but also scientific attitude such as honesty, open-mindedness and cooperation as moralities of science and enhance understanding and retention of difficult concepts and procedures. Laboratory facilities give students some basic insight into scientific concepts and leave them with feeling of the reality of science which in turn improves their academic performance in examination (Habu, 2005).

For successful achievement of academic performance in schools there is need to provide key physical infrastructure which include:- science laboratory, school library, classrooms and various types of solid waste disposal. Science laboratory is central to scientific instruction

where theoretical work is practicalized where else practicals in any learning experiences involve students in activities such as observing, counting, measuring, experimenting and recording (Ogunniyi, 1983). Without proper and well- equipped science laboratory, it is not possible to carry out the science teaching process effectively in any school or educational institution.

The interest in raising levels of achievement has led to a focus on identifying the range of factors that shape achievement as well as understanding of how these factors operate to limit, as well as enhance the achievement of different groups of students. Such efforts include the introduction of SMASE Project and in-service training for the teachers. This study will therefore seek to establish the influence of laboratory facilities on students' academic performance of science subjects in Machakos Sub-County.

Despite the efforts put in place by the Kenyan Government to improve students' performance in science subjects, the Kenya Certificate of Secondary Education (KCSE) results released in the five years have indicated poor grades in Machakos Sub- County,contrary to the expectation of students, teachers and parents (Gok, 2016). The dismal performance in science subjects for the last five years is summarized in the table below.

**Table 1: Machakos Sub-County KCSE Performance in Science Subjects 2012-2016**

| **Year** | **Meanscore Chemistry** | **Meanscore Physics** | **Meanscore Biology** |
|---|---|---|---|
| 2012 | 4.8 | 4.2 | 5.6 |
| 2013 | 4.6 | 3.8 | 5.8 |
| 2014 | 4.3 | 3.6 | 5.4 |
| 2015 | 4.5 | 3.8 | 4.5 |
| 2016 | 4.2 | 3.4 | 4.2 |

Several studies have been carried out to establish the factors that contribute to poor performance in secondary schools; however such studies focused on students' attitude towards education, cultural factors and personal characteristics of students. Although the above factors have been found to affect students' performance, there is still need toresearch on anyother factors that influencestudents' performance in science subjects. This study therefore seeks to establish the influence of laboratory facilities on students' academic performance in science subjects in K.C.S.E in public secondary schools in Machakos Sub-County, Kenya.

**2.0 Overview of how Students Learn in Science Subjects**

Hofstein and Lunetta (1982), Lazarowitz and Tamir (1994), and Lunetta (1998) suggested that laboratory activities have the potential to enable collaborative social relationships as well as positive attitudes toward science and cognitive growth. These researchers noted that the more informal atmosphere and opportunities for more interaction among students and their teacher and peers can promote positive social interactions and a healthy learning environment conducive to meaningful inquiry and collaborative learning. The laboratory offers unique opportunities for students and their teachers to engage in collaborative inquiry and to function as a classroom community of scientists. Such experiences offer students opportunities to consider how to solve problems and develop their understanding.

Other studies demonstrated distinct benefits in students' achievements and productivity when cooperative learning strategies were utilized in the classroom-laboratory (Tobin, 1990). In the intervening years, research intended to examine the effects of student collaboration and the development of "classroom community of scientists" has been increasingly visible. Okebukola and Ogunniyi (1984) compared groups of students who worked cooperatively, competitively, and as individuals in science laboratories and found that the cooperative group outperformed the other groups in cognitive achievement and in process skills.

Similarly, Lazarowitz and Karsenty (1990) found that students who learned science subjects in small cooperative groups scored higher in achievement and on several inquiry skills than the students who learned in a large group class setting. Several papers have reported that the more informal atmosphere and opportunities for more interaction among students and their teacher and peers can promote positive social interactions and a healthy learning environment conducive to meaningful inquiry and collaborative learning (DeCarlo&Rubba, 1994).

**2.1 The Effects of Laboratory Facilities on Students' Academic Performance**

A laboratory has been conceptualized as a room or a building specially built for teaching by demonstration of theoretical phenomenon into practical terms (Ogunniyi, 1984). It can also be described as a place where theoretical work is practicalized whereas practicals in any learning experience involve students in activities such as observing, counting, measuring, experimenting, recording, observation and carrying out field work. Farombi (1998) argued the saying that "seeing is believing" as the effect of using laboratories in teaching and learning of science and other science related disciplines as students tend to understand and recall what they see than what they hear or were told. Laboratory is essential to the teaching

of sciences and the success of any science course is much dependent on the laboratory provision made for it. Affirming this, Ogunniyi (1983) said there is a general consensus among science educators that the laboratory occupies a central position in science instruction. According to Ango (1986) laboratory work stimulates learners' interests as they are made to personally engage in useful scientific activities and experimentation; promotes that science is not only product or process; affords the learner the basic skills and scientific method of problem solving and knowledge obtained and promotes long term memory.

Laboratory helps to provide a forum wherein the learner is given the exercise to subjects, his beliefs, ideas, statements, theoretical propositions etc. to some forms of experimental test (Soyibo, 1990). To maintain and arouse the interests of students in subjects involving laboratory work, the teacher should be effectively involved in order to transfer knowledge and facts to learners for a good performance in any examinations. In line with this, one then pauses to ask, to what extent has laboratory been able to achieve its objectives. Odulaja and Ogunwemimo (1989) highlighted that the teacher assumes a position of dispenser of knowledge with the laboratory serving the function of drill or verification. They further explained that at the other extreme, the teacher assumes the position of guide to learning and laboratory as a place where knowledge is discovered. However, there are growing evidences that teachers do not exhibit behaviours which are complementary to achieving the stated objectives. They include methods of teaching practical work; inadequacy or absence of well-equipped laboratories; high enrollment of students; inadequacy of resources for teaching and learning practical work; quantity and quality of teachers.

**2.2 The Extent to which the Laboratory Facilities are used by Teachers in Teaching Science Subjects**

Tobin and Gallagher (1987) found that science teachers rarely, if ever, exhibit behavior that encourages students to think about the nature of scientific inquiry and the meaning and purposes for their particular investigation during laboratory activities. On the basis of a comprehensive study on implementation of the laboratory in schools in British Columbia, Gardiner and Farrangher (1997) found that although many Science subject teachers' articulated philosophies appeared to support an investigative, hands-on, minds-on approach with authentic learning experiences, the classroom practice of those teachers did not generally appear to be consistent with their stated philosophies.

Several other studies have reported that very often teachers involved students principally in relatively low-level, routine activities in laboratories and that teacher–student interactions focused principally on low-level procedural questions and answers. Marx et al. (1998) reported that science teachers often have difficulty helping students ask thoughtful questions, design investigations, and draw conclusions from data. DeCarlo and Rubba (1994) reported similar findings in chemistry laboratory settings. Earlier, Shymansky and Penick (1978) had written that teachers do not perceive that laboratory activities can serve as a principal means of enabling students to construct meaningful knowledge of science, and they do not engage students in laboratory activities in ways that are likely to promote the development of science concepts.

In addition, many teachers lack experience with assessment methods aimed at assessing their students' understanding and performance in the science laboratory (Yung, 2001). As a result, in many cases, students' final grades do not include a component that directly reflects their performance in laboratory work and their understanding of that work. Furthermore, Brickhouse and Bodner (1992) reported that students' concern about their grades has a strong influence on teachers' practices.

**3.0 Research Design**

This study used survey design. Survey research is commonly used when the researcher is interested in collecting of data in order to answer questions concerning the current status of a phenomenon (Cohen, 2000).The survey design was chosen because it is appropriate for educational fact-findings and gives a great deal of information which is accurate. It also enabled a researcher to gather data at a particular point in time and use it to describe the nature of the existing conditions.

**3.1 Location of the Study**

The study was conducted in Machakos Sub-County, Kenya. Machakos Sub-County is $37.4681^{o}$ East and $1.3304^{o}$ South. Machakos Sub-County neighbors Makueni County to the South, Athi River Sub-County to the West, Mwala Sub-county to the east and Kathiani Sub-County to the north. The climate is semi arid with hilly terrain with an altitude of 1000 to 2100 meters above sea level. Subsistence agriculture is mostly practiced with maize and drought-resistant crops such as sorghum and millet. In addition, tourist related activities such as camping, hiking safari, ecotourism and cultural tourism and music festivals among many

more are more excitingly done due to the highly terrain. The hospitality industry in the region is decent.

### 3.2 Target Population

Borg and Gall, (1989) defines the target population as the population to which the researcher wants to generalize the results of the study. Machakos Sub-County has 75 public secondary schools, 350 secondary schools teachers, 2350 boys and 2150 girls in form three (Sub-County Director of Education, Machakos; 2016).

### 3.3 Sampling Techniques and Sample Size

The study used both purposive and simple random sampling procedures to select one (1) National School, one (1) Extra County School, two (2) County Schools and seventy (70) Sub County Schools (Machakos Sub-County Education office, 2016). The sample of the study was 23 principals, 105 teachers and 351 students. The distribution of the sample is shown in table 2 below.

**Table 2: Population and Sample Size**

| School Category | Total Number | Sample Size | Percentage of the total schools |
|---|---|---|---|
| National Schools | 1 | 1 | 100 |
| Extra County Schools | 1 | 1 | 100 |
| County | 2 | 2 | 100 |
| Sub-County | 70 | 21 | 30 |
| **Subjects** | | | |
| Principals | 75 | 23 | 30 |
| Teachers | 350 | 105 | 30 |
| Students | 4500 | 351 | 78 |

### 3.4 Research Instruments

The researcher used three questionnaires and observation schedule to conduct the study. The questionnaires were administered to the principals, teachers and students. The researcher used close-ended questions, open-ended questions, and contingency and matrix questions. Open ended items required the subjects to give direct views. Close- ended items required definite answers.

## 4.0. Research Findings

### Availability of Laboratory Facilities and Equipment

The first objective of the study was to establish the availability of laboratory facilities and equipment in public secondary schools. Principals and teachers were asked to indicate the

adequacy of laboratory facilities in their schools. Responses by the teacher respondents are summarized table 3 on page 8.

**Table 3: Adequacy of Laboratories**

| Adequacy | Frequency | Percentage |
|---|---|---|
| Very adequate | 10 | 9.7 |
| Adequate | 23 | 22.3 |
| Inadequate | 70 | 68.0 |
| **Total** | **103** | **100** |

Findings in table 3 show that 68% of the respondents indicated that laboratory facilities in their schools were inadequate whereas only 22.3% stated that the facilities were adequate. This implies that the learning of practical skills in the science subjects was highly comprised. The findings of this study concurs with those of Yadar (2011) who argued that no course in science subjects can be considered as complete without including some practical work which is carried out in the laboratory. Shortage of such laboratories facilities may contribute to low performance especially in science subjects.

The responses of principal respondents on availability of laboratory facilities for specific science subjects are summarized and presented in table 4 below.

**Table 4: Situation of the Laboratory Facilities**

| Facility | Very Adequate% | Adequate% | Not Sure% | Inadequate% | Very Inadequate% |
|---|---|---|---|---|---|
| Chemistry laboratory | | 8.7 | 13.0 | 34.8 | 43.5 |
| Biology laboratory | | 4.3 | 8.7 | 48.0 | 39.0 |
| Physics laboratory | | | 17.4 | 56.5 | 26.1 |
| Computer laboratory | | | 8.7 | 26.1 | 65.2 |

**N=23**

Findings in table 4 show that: the chemistry laboratory are very inadequate as indicated by 43.5% of the respondents, biology laboratory are inadequate as indicated by 48%, physics laboratory are inadequate as indicated by 56.5% and computer laboratories in the schools are very inadequate as indicated by 65.2% of the respondents. This implies that the situation of the laboratory facilities in the schools in the study area is very devastating thus science education programs in the schools are ineffective. The findings concur with Balogun (1982) who asserted that no effective science education program can exist without facilities for practical teaching like laboratories. Laboratory is essential to the teaching of sciences and the

success of any science subject is much dependent on the laboratory provision made for it and lack of it contributes to dismal performance in science subjects.

**Extent to which the Science Teachers use Laboratory Facilities**

The second objective of the study was to find out the extent to which the science teachers use laboratory facilitiesin teaching science subjects. Principals and teachers were asked to indicate how often they make use of the laboratory facilities in teaching science subjects. Responses by the teacher respondents are summarized table 5 below.

**Table 5: Extent to which Teachers use Laboratory Facilities**

| Extent | Frequency | Percentage |
|---|---|---|
| Very great extent | 29 | 28.1 |
| Great extent | 52 | 50.5 |
| Moderate extent | 12 | 11.7 |
| Little extent | 10 | 9.7 |
| **Total** | **103** | **100** |

Findings in table 5 show that teacher respondents noted that teachers make use of the laboratory facilities in teaching science subjects to a great extent as indicated by 50.5% of the respondents. This implies that science teachers are ready and willing to use laboratories in teaching science subjects so as to help students understand the sciences and improve their performance. The finding differs with those of Shymansky and Penick (1978) who asserted that teachers do not engage students in laboratory activities in ways that are likely to promote the development of science concepts. In order to maintain and arouse the interests of students in sciences, the teachers should be effectively involved in order to transfer knowledge and facts to learners for a good performance in examinations.

**Relationship between Laboratory Facilities and Students' Performance in Science Subjects**

The third objective of the study was to establish the relationship between laboratory facilities and the students' academic performance in science subjects. Teachers were asked to indicate the extent to which availability of laboratory facilities affect performance of students in science subjects. Responses are summarized and presented in table 6 on page 10.

**Table 6: Extent to which Laboratory Facilities affect Students' Performance in Science Subjects**

| Extent | Frequency | Percentage |
|---|---|---|
| Very great extent | 41 | 51.2 |
| Great extent | 25 | 31.3 |
| Moderate extent | 11 | 13.8 |
| Little extent | 3 | 3.7 |
| **Total** | **80** | **100** |

Findings in table 6 show that 51.2% of the respondents indicated that availability of laboratory facilities affect performance of students in science subjects to a very great extent. This implies that schools with well-equipped laboratories have better results in the school certificate science examinations than those that are ill-equipped. The finding concurs with Soyibo and Nyong (1984) that schools with well-equipped laboratories have better results in the school certificate science examinations than those that are ill-equipped and lack of adequate exposure to practical work is one of the contributing factors to dismal performance in examinations. Laboratory work stimulates learners' interests as they are made to personally engage in useful scientific activities and experimentation which promotes that science is not only product or process but also affords the learner the basic skills and scientific methods of problem solving and knowledge obtained and promotes long term memory.

## 5.0 Conclusion

From the results presented and discussed in section 4.0 above, it was concluded that that public secondary schools in Machakos Sub-County have inadequate laboratories facilities for science subjects(chemistry, biology, physics); teachers to a large extent used laboratory facilities to teach science subjects and that there is a positive relationship between availability of laboratory and students performance in sciences subjects.

## 6.0 Recommendations

Based on the research findings, the study recommends that;

1. Secondary principals should avail more laboratory facilities to ease the problems of inadequacy of laboratories in public secondary schools.
2. Science teachers should be encouraged and motivated to use science laboratory facilities more often to promote the acquisition of practical skills in Science subjects which may enhance better performance in science subjects.

3. The government should provide some laboratory equipment to schools to subsidize their costs and encourage the local chemical manufacturers to produce moreaffordable chemicals and laboratory equipment.

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