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Participation Skills in Biology Practical per Class Level in Lugari, Kakamega County, Kenya

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Abstract:
Practicals form an essential part of the biology curriculum in Secondary Schools. At the end of every four years of secondary schooling, students are tested on their proficiency in practical skills. But according to the Kenya National Examination Council (KNEC) reports over years, the practical paper is performed poorly. These reports also indicate that, some of the required skills are not taught yet the same skills are tested in the secondary biology practical examinations. This study investigated the participation skills in biology practical per class level in Lugari, Kakamega County, Kenya. The study was carried out in Lugari District with the aim of assessing the efficiency of the practical skills necessary for biology practical examination. A descriptive survey research design was used to assess students' participation, compare their participation at the implementation stage and to determine factors affecting participation at the implementation stage of biology practicals. The respondents were also categorized per class level. A random sample of 10 public schools was selected from which 300 students were proportionally selected. Questionnaires and observation schedules were used to collect data. Data were analyzed using descriptive and inferential statistics. The findings of the study reveal that most students of the higher class level reported that they had less than five practical lessons per term. The study recommended that the Ministry of Education (MOE) through Quality Assurance and Standards to enforce government education policy directives on learner participation in the teaching-learning process through inspection of school facilities necessary for proper practical learning to take place. This study further recommends that teachers adopt a heuristic approach in teaching to enable learners to develop skills. It is hoped that these recommendations shall be useful and shall form part of the guidelines for all stakeholders in education to improve learning of biology practicals.

Keywords: *Biology Practicals, class level, participation skills*

1. Introduction

One of the most disturbing trends in education in Africa is low academic achievement in science and Mathematics. One of the Agenda of the meeting held by African Ministers for Education in Johannesburg, South Africa was Science Education. The meeting warned that unless Science Education improved, the continent's economies would fail to meet the Millennium Development Goals. In Kenya today, there is poor performance in the Kenya National Examinations science practicals. This has led to the introduction of the project, "Strengthening Mathematics and Science in Secondary Education" (SMASSE) by the Ministry of Education (MOE). The SMASSE project was introduced in Kenya by the Government of Kenya and the Japan International Cooperation Agency (JICA). This project was based on the "Activity Student Experiment and Improvisation" (ASEI) movement practiced in Japan. The SMASSE project emphasizes the use of experiment in learning Science.

Practical work is a teaching strategy that involves hands on activities conducted by the students under the guidance of the teacher. The teacher provides the students either singly or in groups with the materials and apparatus as well as instructions to be followed in performing the activities. The ability to follow instructions and the use of science methods and skills to solve problems with little help from the teacher is an important aspect of learning science.

There are four dimensions of practical work in biology. The first one is learning basic skills. These basic skills are essential and are necessary in order for the students to carry out practical work safely and reliably. These include correct use of for example Bunsen burner, reading measurements from instruments like measuring cylinders and thermometers accurately, heating liquids in test tubes and use of the Microscope. The second dimension is using practical activities to illustrate theory or concept. The reasoning behind this approach to practical work is that students will have a better understanding of a scientific or biological idea if they have done an

experiment to illustrate the idea. This might be true in some cases but sometimes the experiment may not yield the desired results. However, illustrative experiments can often be a great motivator for learning and act as an initiating step for further theory work.

The third dimension is proving a theory. This approach requires the student to generate the correct scientific answer by carrying out the experiment. The tasks are presented to the student as a list of instructions on a worksheet, on chalk board or practical manual. Critics of this approach say that science is reduced to 'cookery' with the student ardently following a recipe to arrive at the right answer. The fourth dimension is investigative work. It is also called exploratory work. This work differs from other types of practical work in a number of ways. First it requires the student to do his or her experiment. Second, it can take more time than conventional practical work. Thirdly, it requires students to evaluate their experiments and suggest improvements. Lastly, it encourages students to search information for themselves. In this type of practical work, the process of scientific investigation is seen to be as important as any product or result that the student may obtain from the experiment. Should the experiment fail, the student should be encouraged to find out why and how the procedure could be improved if the experiment were to be repeated.

The steady decline in the performance in KCSE biology practicals raises eyebrows. While the Government of Kenya has made attempts to improve the situation by in-servicing teachers to help learners acquire skills in practical work, and in the provision of teaching materials, this has not yielded positive results. It is not known immediately what could be responsible for this observation. It may be due to lack of students' participation in practicals during the learning process or due to the teachers' approaches in the teaching of biology or any other reasons. There is therefore need to compare students' participation skills in biology practical per class Level. The following hypothesis was formulated:

- $H0_1$: There is no significant difference in the level of students' participation in biology practical and their class level.

2. Literature Review

2.1. Assessment of Practical Work in Science

The system for evaluating students' activities in the laboratory can be classified into four major categories (Woolnough, 1991). These are:

1. Written evidence: these are written reports or items on paper and pencil tests.
2. Laboratory practical examinations: these are assignments on practical work on specific topics
3. Audiovisual and computer applications: these show the application of modern technology in the study of science
4. Continuous observation assessment: this is timely evaluation of students to establish how much of the practical concepts have been internalized.

Although evaluation on students' reports is one of the most common assessment method traditionally used, it is often quite subjective because variables such as neatness, writing skills, and degree of completeness can lead to biased evaluation. Moreover, written reports, whether completed inside or outside the laboratory do not provide direct information about students' skills in manipulating equipment, observing, organizing and performing investigation creatively and efficiently.

Research evidence has shown that the correlation between students' achievement in practical tests and their achievement based on written evidence is low (Robinson 1969, Tamir 1972; Ben Zri et al 1977; Doren, 1978). This calls for the need to develop measures to assess not only what the student reports but also what they actually do. Student psychomotor skills relating to their ability to perform experiments can be assessed in actual laboratory situations (Tamir, 1972).

Practical examinations should be designed to meet a number of specific criteria (Tamir, 1974). First students should be confronted by some real and intrinsically valuable problem which is comparatively novel. Second, the student should complete the investigation within a reasonable time, with the level of difficulty and the required skills commensurate with the objectives and experiences of the curriculum. Marking is then carried out according to a predetermined key of weighted scores for the skills of manipulation, self-reliance, communication, experimental design and measuring.

This type of practical examination utilizes systematic observation based on a list of specific criteria as opposed to an open-ended subjective type of assessment such as practical examinations that utilize systematic observations that are based on specific criteria are said to be closed-ended. But there is the open-ended assessment which is subjective but considered the best by examination boards in several countries (Whitford and Jones, 2000).

In open-ended assessment, students are usually examined by external examiners. There are several drawbacks to these types of examinations. Different examiners tend to apply different criteria to assess students' performance. In addition, the large number of students being tested makes it difficult to observe each student systematically. While individual teacher assessment is preferred, most teachers do not prefer this type of formal practice test due to problems that affect the reliability and the validity of the assessments (Mugenda and Mugenda, 1999).

Practical tests can also have undesirable effects on the teacher's choice of experiment. Some teachers tend to limit their choice of experiment to those closely related to the practical test. Brice and Robertson (1985) reported that teachers in the process of limiting themselves to the structured syllabus leave out important practical activities that are imperative to the development of the required scientific and research skills for the learners. Practical assessment thus is done for certification purposes only. In addition Garnett and O'loughorn (1989) report on a successful strategy for implementing laboratory testing at upper secondary and introductory tertiary level chemistry classes.

Nachmias and Linn, (1987) suggested the Computer as a laboratory partner and a source for obtaining feedback on students. They propose Micro-Computer based Laboratory (MBL) in which the computer is interfaced with traditional laboratory apparatus to collect graphically displayed data. Probes are interfaced with the computer to help students measure, record and graph quantities like force,

light, heart rate and temperature. The use of micro-computers in the laboratory provides immediate feedback while performing the experiment and the results are shown clearly on the screen by a table and a graph with the students then being able to analyze the data and make their own interpretations.

Continuous assessments on several occasions throughout the year are necessary to cover adequately the variety of tasks, skills and techniques which comprise a programme of practical work. Woolnough (1990) has shown that greater involvement in the continuous assessment of practical skills by teachers is likely to develop a greater awareness of the scope and objectives of laboratory work and to identify students' strength that otherwise might not have been reflected in more conventional assessments. Using continuous observation assessment methods, the teacher observes and rates each student during normal laboratory activities

This study aimed at assessing students performing a practical at the execution stage so as to find out what they really do rather than just asses a written report. This would help find out problems affecting students at this stage as the researcher observed the students perform the practical directly. This would then help the teachers in preparing students for the final assessment by the National Examination Council where the examiners only mark a written report but do not observe the learners perform the practical.

2.2. Problems Facing Biology Practicals in Secondary Schools in Kenya

Donnelly and Jenkins (1999) in their study on the effects of National Curriculum on aspects of secondary school science teachers' work reported that the emphasis of the secondary curriculum is on mental rather than written plans which undermine the bid for learners to develop the necessary practical skills that are learnt through practical work. They also found out that content had led to increased pressure on time for practical work. The large quantity of work means that practical lessons are reduced in order to finish the module content.

Mutsune (1983) in her study on the relationship between theory and practicals in Biology, found that the poor performance in practicals could be as a result of a number of problems involved in the assessment of the practical skills.

First, is the time given by the KNEC in assessing practicals such as observation and manipulating ability, to carry out experimental procedures is not adequate. Poor assessment may be due to the examiners inability to oversee the candidates through the practical.

Secondly is inadequate qualified teachers in classrooms and laboratories limited the learners ability in practical work since they lacked proper guidance on what they are supposed to do. Further, Tsuma (1998) argues that some teachers lack confidence and this may contribute to poor classroom management during practical work. This demoralizes the learners and reduces their confidence not only in their teachers but also in science as a whole as it is viewed to be hard.

Third is inadequate time for laboratory work reduces the learner exposure to practical activities. This was also observed to hinder the learners' ability to perform practical activities due to lack of manipulative skills (Mwiria 2004).

Fourth are the poor safety conditions in the laboratories and perpetual use of teachers' centred approaches that affect proper learning of practical lessons as the learners do not handle the apparatus. Learners do not also carry out the procedure themselves because of the limited resources and their poor working conditions (Mutsune, 1983). Inadequacy of resources is another problem being experienced in Kenyan schools. The problem of inadequate facilities is common and more serious in most schools in Kenya, there is a general under-funding education in developing countries where the purchase of science equipment and consumable materials is limited (UNICEF 1997; Chengeiywo (2002). This makes most teachers to resort to the use of teacher demonstrations instead of allowing the learners themselves to carry out experimental activities. This in turn limits the learners' exposure to practical activities which ultimately contributes to poor performance.

As a result Tsuma (1998) and Mwiria (2004) recommended that teachers should use locally available and cheap materials for demonstrations, with a great deal of improvisation. This can help solve the problem of inadequate equipment in the laboratory. Lunneta and Hoflein (1991), however assert that although action on the part of the teachers and students is encouraged, some science equipment cannot be improvised.

Lastly, Mukachi (2006) in his study on the extent to which the science process skills of investigations are used in practical work showed that most of the problems are associated with the students. They depict poor classroom management practices during practical lessons as well as poor planning in terms of time allocation and identifying of practical activities to cover up certain topics. The study revealed that the students tend to go beyond the objectives of the lesson and engage in other practical activities not related to the objectives of the lessons. This study aimed at finding out problems affecting student participation in biology practicals so as to look for solutions.

3. Methodology

A descriptive survey design was used to study the extent of student participation in biology practicals by class level and school type. The study was undertaken in Lugari District, western province, Kenya. Lugari district is one of the districts where poor performance in biology has been reported over the past five years in K.C.S.E. (KNEC Report 2009: Pg 54.). The study population was made up of students taking Biology in forms one to three. Thirty percent (n=10) of the schools were sampled (Kombo and Tromp, 2006). Simple random sampling was employed to select 20 %(n=2) boy schools, 30% (n=3) girl schools and 50% (n=5) mixed schools. The students were interviewed using one main questionnaire and one observation schedule. They had both structured (closed-ended) and un-structured (open ended) items in simple language.

The reliability of this research instruments was established by pilot testing. The questionnaire was administered to three schools outside the study area. The research instrument was reliable and valid to collect the data which helped to achieve the objectives of the study and confirm the hypotheses (Cronbach's $\alpha = 0.88$) To test the validity of the instruments further, a pilot study was carried out using 22 respondents from neighbouring Bungoma East District public secondary schools that were not used in the final study but

have the same learning environment as Lugari District. All research questions were analyzed using quantitative techniques provided by Statistical Package for Social Sciences (SPSS) version 12.0. . In inferential statistics, Pearson Product Moment Coefficient and t-test were used to establish the relationship between different variables at alpha level 0.05

4. Results

The second objective was to compare the level of students' participation at the implementation stage of biology practical per class level. This objective intended to establish whether learners at different level of development such as form ones, form twos and form threes had any significant relationship in the way they handle the biology practical lessons in their schools. The independent variable was the class level categorized as form ones, form twos and form threes. Cross tabulation techniques was used to show the number of counts occurring among different level of development for different activities that the students participated in. The percentage within the class level for different activities was also calculated. The means of the various class levels were compared and the t-test was employed to establish the relationship between different class levels and level of student participation in biology practical computed at alpha level 0.05 (Mugenda and Mugenda, 2003; Kerlinger, 1973).The hypothesis tested was "there is no significant difference in the level of students participation skills in biology practicals and their class levels". The findings are shown in Table 1

Class level Per term	**Mean number of practicals**	**t-test (2-tailed)**	
Form one	5.20	1.229	0.643
Form two	3.90		
Form three	6.10		

Table 1: Influence of class level on student participation in biology practical

The results in Table 4.5 show that form threes displayed the highest level of participation in biology practical (μ =6.10) followed by form ones (μ =5.20) while form twos displayed the lowest level of participation in biology practical (μ =3.90). There was, however significant difference between level of student participation in biology practical per class level (t = 1.229, p-value = 0.643), indicating that class level positively affected a students' participation skills in biology practicals. To determine the strength of the relationship between the level of student participation in biology practical s and the class level, correlation analysis was used (Table 2)

	Lower class level	**Middle class level**
Class level Pearson correlation sig.(2-tailed) N	1.000 0.000 30	-0.900** 0.000 30
Pearson correlation sig.(2-tailed)N	-0.900** 0.247 30	1.000 0.101 30
Pearson correlation sig.(2-tailed) N	-0.900* 0.075 30	0.500* 0.261 30

Table 2: Correlation Analysis between Levels of Student Participation Skills in Biology Practical per Class Level

Table 2 shows that here is a strong negative relationship between student participation skills in biology practical and students' class level (r = -0.900, p-value = 0.00). This indicated that as the learners move from lower to middle then higher class levels, the content level of difficulty increases which causes them to perform even poorer.

*The null hypothesis was **rejected** since there was significant difference between the level of students' participation skills in biology practicals and their class levels.*

Because the level of student participation increased from the lower to higher class level, the poor results in biology practical may be due to poor teaching and lack of exposure of learners to the required practical knowledge that should guide them for success in the higher class levels.

Results clearly show that there was a significant relationship between level of student participation in biology practical and the class levels. Because the level of student participation increased from the lower to higher class level, the poor results in biology practicals may be due to poor teaching and lack of exposure of learners to the required practical knowledge that should guide them to success in the higher class levels.

5. Summary and Conclusion

Over sixty percent of the respondents in form two and form three were unanimous that they did less than five practicals each term, while 59% of the form ones agreed that they had more than five practical lessons per term. Hence as learners advance in education, practical lesson are given lesser and lesser emphasis. This always makes learners reach their final year unprepared in practical work and this contributes immensely in the poor performance in biology practicals. Concerning adequacy of time for practical work, over 50 percent of the respondents in all the three class levels were unanimous that they had adequate time to finish the practical activities

they were given. This gives majority of learners the required exposure in handling practical activities. Regarding practical notebooks over 85 percent of the respondents across the three class levels did not have notebook specifically for biology practical work. This may be a major problem setback since majority of the respondents may take practical time as time for leisure and since it is rear to examine them in the same at lower class levels, this further muddy the waters. Over 70% of the respondents in the three class levels were rated below average in their ability to make right drawings and correct measurements. Hence the poor handling of practical activities is partly contributed by lack of time to practice the psychomotor skills, especially in the middle and higher class level, where most practicals are done. Similarly about the skill of recording results, over 70% of form ones and form threes were rated average. A still interesting finding was that over 80%of the form twos were rated below average. This again reflects the poor performance in this important skill at various class levels. Finally, about manipulation of apparatus and specimens, over 60%of form ones and twos were rated below average while 60 % of the forms threes were rated average. This implies that , probably form threes have developed more confidence in handling practical because of experience and more exposure to practical activities, as compared to the form ones and twos .

6. Recommendation

Biology teachers should adopt the learner centred approach in teaching so that learners may participate more in practical activities and learn by self-discovery. Teachers should increase the frequency with which they teach practical lessons and at the same time ensure that all practical activities done are discussed to enable learners understand the difficult concepts they are unable to conceptualize

7. References

i. Ben-zri, R., Hoften, A. S., and Kemba, R.F, (1977). Models of instructions in high school chemistry. Journal of Research in science teaching 18, 113-121.
ii. Brice, T.G.K, and Robertson, J.J. (1985). What can they do? A Review of Practical Studies in Science Education, 12,1-24.
iii. Chengeiywo, J.M, (2002). Problems Hindering the Effective Teaching of Science in Kenyan Schools. Egerton Journal of Education and Human Resources. 2(1). 49-61.
iv. Donnely, J.F and Jenkins, E.W. (1999). Science Education Policy, professionalism and change. Paul Chapman publishers limited.
v. Doren (1978). Biology Education Methodological Approach. Colorado: Lactern Publication.
vi. Garnett, P.O. and O'Loughron, M.O. (1989). Using practical tests to assess Laboratory work in chemistry, the Australian Science teachers Journal, 35, 4, 27-37.
vii. Kerlinger, F.N. (1986). Foundations of Behavioral Research. New York:Subject Publications.
viii. Kombo, D.K., and Tromp, L.A. (l1989). Proposal and thesis writing: Paulines Publications Africa, Dauggters of St. Paul.
ix. Lunneta and Hoffein (1991). Readings in science education McGraw-Hill Book Company (UK) limited.
x. Mugenda and Mugenda (1999). Action Guide in Teaching and Learning Science. Nairobi. MGC Limited, Kenya.
xi. Mugenda, O.M. and Mugenda, A.G. (2003) Research Methods: Quantitative and Qualitative Approaches. Nairobi: ACTS Press.
xii. Mukachi, F.W. (2006). The extent to which science process skill investigating is used in Biology. Unpublished MED Thesis, Egerton University.
xiii. Mutsune, M. (1983). Master's Thesis on relationship between theory and practical Biology at A level. University of Nairobi.
xiv. Mwiria, K. (2004 March 14). Improving performance in science and mathematics. Daily Nation newspaper Nairobi-Nation Media Group.
xv. Nachmias, R. and Linn, M.C. (1987). Evaluation of science laboratory data: the role of computer presented information, Journal of research in science teaching 24, 491-506.
xvi. Robinson, T.J. (1969). Evaluating laboratory work in high school biology; The American Biology Teacher, 34, 226-9.
xvii. Tamir, P. (1972). The practical mode-a district mode of performance in Biology, journal of Biology education 6, 175-82.
xviii. Tsuma, G.K. (1998). Science education in African context. Nairobi. Jommo Kenyatta Foundation.
xix. UNICEF, (1997) The state of the Worlds Children-1997. Oxford: Oxford University Press.
xx. Whitford and Jones .(2000). Assessement. Tough Decisions for Policymakers. Reprinted from Insights on Educational Policy, Practice, and Research Number 11, August 2000: Tough Love: State Accountability Policies Push Student Achievement
Location: http://www.sedl.org/policy/insights/n11/welcome.html
xxi. Woolnough, B. (1990).Improving practical teaching in science. Oxford University press. 84-88.
xxii. Woolnough, B. (1991). Practicals in school science. Philadelphia. Open University press.