International Journal of Sciences: Basic and Applied Research (IJSBAR)

ISSN 2307-4531
(Print & Online)

http://gssrr.org/index.php?journal=JournalOfBasicAndApplied

Teachers' Perceptions on Effectiveness of The KCSE Biology Practical Assessment Approach in Testing Experimenting Skills in Secondary Schools in Siaya County, Kenya

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Abstract

Assessment is an important aspect of teaching/learning process in secondary schools. The Kenya Certificate of Secondary Education (KCSE) biology practical assessment approach introduced in the year 2005 by the Kenya National Examinations Council (KNEC) is one in which out of the three questions tested in the paper, only one question, mostly food tests involve handling apparatus and specimens by the candidates. In the other two questions, the candidates observe photographs and photomicrographs presented in the paper and then answer questions. The approach was adopted with an aim of reducing the problems of cheating in biology practical examinations. However, its effectiveness in the assessment of Science Process Skills has not been ascertained. The purpose of this study was to establish the perceptions of teachers' on the effectiveness of the assessment approach in testing science process skills. Descriptive survey research design was used in this study. The target population comprised all trained secondary school biology teachers in Kenya. Accessible population were a total of 108 secondary school biology teachers in Siaya County. Proportional stratified sampling and simple random sampling was used to select the subjects of study.

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Proportional stratified sampling was used to ensure the study sample was derived from all the six sub-counties that constitute Siaya County, while simple random sampling was used to obtain study sample from each sub-county. A total of 90 teachers formed the study sample. Biology Practical Teachers' Questionnaire (BPTQ) was used to generate data from the respondents. Five research experts from the Faculty of Education and Community Studies, Egerton University, validated the instruments. The reliability of the instruments was estimated using Cronbach's Alpha coefficient. Pilot-testing was conducted in the neighbouring Kisumu sub-county, Kisumu County. Reliability coefficient for the questionnaire was 0.85. Data analysis was carried out using descriptive statistics which were frequencies, means and percentages. The findings of this study indicated that, in teachers' perception, the assessment of science process skills is not effective in the KCSE Biology Practical Assessment Approach. It was therefore recommended that a lot of hands-on activities, manipulation of specimens and handling of apparatus be reinforced in the testing of biology practical skills. The findings of this study are important in improving the testing of Biology practical paper by KNEC and teaching laboratory lessons by Biology teachers through recommendations.

Keywords: Science Process Skills; Assessment; Experimenting Skill; Photomicrographs; Perceptions; KCSE Biology Practical Assessment Approach; Effectiveness.

1. Introduction

Biology is one of the science subjects offered in Kenyan secondary schools according to author in [1]. Good quality, appropriate biology experiments and investigations are the key to enhanced learning and clarification and consolidation of theory. Biology aims at equipping the learners with the knowledge, attitude and skills necessary for preserving the environment, according to author in [2].

The broad aims of the Biology Syllabus, posits author in [1] are to enable students to: Communicate biological information in a precise, clear and logical manner; develop an understanding of interrelationships between plants and animals and between humans and their environment; apply the knowledge gained to improve and maintain the health of the individual, family and the community; relate and apply relevant biological knowledge and understanding to social and economic situations in rural and urban setting; observe and identify features of familiar and unfamiliar organisms, record the observations and make deductions about the functions of parts of organisms; develop positive attitude and interest towards biology and the relevant practical skills; demonstrate resourcefulness, relevant technical skills and specific thinking necessary for economic development; design and carry out experiments and projects that will enable them understand biological concept; create awareness of relevant knowledge, skills and attitude for further education and for training in related scientific fields, and acquire a firm foundation of relevant knowledge, skills and attitudes for further education and for training in related scientific field, contends author in [1].

An overview of biology practical syllabus and tests internationally and regionally has revealed that emphasis is given to hands-on/practical activities. The approach used in testing biology practical skills both internationally and regionally emphasises testing of experimenting skills, says author in [3]. Author in [4] and [5] have questions that require students to physically handle specimens as they make observations, drawings and

conclusions. Over the years in Kenya, the testing of biology as a science subject in KCSE has been done in such a way that students do both theory paper(s) and a practical paper. The theory papers were and are designed to test mainly cognitive knowledge of the students whereas the practical papers emphasised laboratory skills. The previous testing of biology practical examinations in KCSE was such that in all the three questions tested, the candidates were allowed to manipulate apparatus or handle the actual specimens while answering questions, according to author in [6]. However from the year 2005 the KNEC changed their format of setting the practical paper by replacing the actual specimens that were provided to students during the examinations with their images in the form of photographs (for multicellular organisms or their parts) and photomicrographs (for unicellular structures), citing cheating problems, asserts author in [6]. KNEC argued that when practical confidential instructions were sent to teachers earlier so that they could start assembling the specimens to be used in the examinations, the teachers were using this information to drill their students in all aspects of the specimen that could be tested.

The concern however is that biology is a science subject in which students should be tested on practical skills by allowing them to observe, cut, measure, and cross examine actual specimens among other things as they respond to questions in the examinations. This is not possible with photomicrographs and photographs. It is also possible that the approach of replacing specimens with photomicrographs and photographs may make the teachers not to see the need of taking students through biology practical lessons in the laboratories which are viewed as laborious and time consuming but instead resort to the use of photomicrographs and photographs similar to those used by KNEC in testing.

The study was carried out in Siaya County, Kenya and its scope was restricted to only qualified Biology teachers who prepare candidates for KCSE biology practical examination were studied. The qualified Biology teachers were those with diploma, degree or masters' level pre-service teacher education. The study also mainly delved on the testing of one science process skill, experimenting skill, which is considered to be involving a lot of hands-on activities.

The study relied on the honesty of the respondent teachers from whom data was collected and also focussed only on the extra-county schools. The study made assumptions thus; the teachers' teaching experience in terms of handling the candidate classes did not vary significantly, teachers who participated in the study came from schools with resources which are more or less similar and that the class sizes were within the Ministry of Education recommendation of 40-50 students.

2. Statement of the Problem

The KCSE biology practical paper testing involves a study of photographs and photomicrographs in two out of the three questions done in biology practical paper. It is only in one question where candidates handle apparatus and reagents as they answer the question. This is unlike in Physics and Chemistry practical papers where in all the questions tested, the candidates practically handle the apparatus and chemicals as they carry out experiments and answer questions based on the observations. It is also a departure from the previous biology practical examination which emphasised 'hands-on' approach in all the three questions. The possibility, however, is that

the new testing approach in biology promotes the acquisition of theoretical skills rather than the experimenting skills. No empirical study has however been conducted in Siaya County so far to assess teachers perception on the effectiveness of this testing approach in assessing experimenting skills. This study, therefore, sought to investigate the teachers' perception on the effectiveness of the KCSE biology practical assessment approach in testing experimenting skills which are basically hands-on.

3. Objectives of the Study

This study was guided by the following objectives:

i. To determine the extent to which hands- on activities are conducted during the KCSE biology practical assessment approach in secondary schools in Siaya County.
ii. To determine whether sufficient specimens are provided for candidates to handle during the KCSE biology practical assessment approach in secondary schools in Siaya County.
iii. To determine whether, in the perception of teachers, all the five steps of experimenting are followed when answering questions during the KCSE biology practical assessment approach in secondary schools in Siaya County.

4. Research Questions

i. Does the KCSE biology practical assessment approach involve adequate hands-on activities?
ii. Does the KCSE biology practical assessment approach involve provision of sufficient specimen to candidates?
iii. Does the KCSE biology practical assessment approach have the questions involve following all the five experimenting steps when giving responses?

5. Literature Review

Experimenting Skills

Authors in [7] describe experimenting as an integrated process skill that includes other process skills like observation, interpretation, planning and reporting. Integrated process skills are involved when learners conduct experiments. They formulate hypothesis, design experiments and makes a generalizations after collecting data. A central feature of experimentation is said to be the idea of control in order that possible alternate, interpretations of a situation may be eliminated. It is a systematic approach to solving a problem. Usually experimenting is synonymous with the algorithm called scientific method which follows these five basic steps: Problem Identification-->Hypothesis-->Predictions-->Test of Predictions--> Evaluation of Hypothesis. It is an important skill to the learners in that during experimenting the learners acquire the other integrated skills.

Biology Practical Assessment

The practical examination traditionally assesses how much the students have learned in the practical classes in

terms of practical skills, says the author in [2]. An end of course practical examination may not provide students with the best opportunity to demonstrate the skills they have developed during the course since the examination should also reflect the assessment of laboratory skills such as dissection and drawing. The best dissections are often done when a student works carefully and precisely. Authors in [8] argue that if a goal of the course is acquisition of skills, then penalisation for mistakes does not advance the learning of those skills.

Assessment which is perceived as threatening and which provokes anxiety may encourage students to take an in-depth learning approach according to author [9]. The practical examination would fall under this category of "threatening and anxiety provoking" and we know that a large proportion of students think memorisation is the appropriate method of study for this subject. The authors in [2] argue that if we reduce the emphasis on formal examinations and increase the value of ongoing practical assessment (dissections, drawings and scientific reports), we may achieve better outcomes for the students in terms of what they learn and how they study Biology.

Biology practical assessment approach should be that which poses the demand of doing science on the learners, as opposed to simply hearing, writing or reading about it. It should engage students and allow them to test their own ideas and build their own understanding according to author [10]. Therefore, it is difficult to imagine a science-testing program without doing science experiences.

According to author [11], hands-on activities will also help learners' to encourage their creativity in problem solving, promote student independence, improves skills such as specifically reading, arithmetic computation, and emphasizes that children learn better when they can touch, feel, measure, manipulate, draw, make charts, record data and when they find answers for themselves rather than being given the answer in a textbook or lecture.

An overview of the approaches used in testing biology practical skills both internationally and regionally Nuffield Foundation, [4]; WAEC, [5], and CDE, [3], alongside the general objectives of biology practical in Uganda UNEB, [12] attests to the fact that biology practical exams should test for and as well emphasise acquisition of practical skills.

Science Process Skills

The term science process skills refer to a set of broadly transferable abilities appropriate to many science disciplines and reflective of the behaviour of scientists, maintains author in [13]. According to authors in [14], science process skills are mental and physical abilities and competencies which serve as tools needed for the effective study of science and technology as well as problem solving and individual societal development. Authors in [15] view science process skills as cognitive and psychomotor skills employed in problem solving, problem identification, data gathering, transformation, interpretation and communication.

Authors in [16] point out that standard-based activities should engage the students in observing; asking and identifying questions and problems; identifying dependent and independent variables; formulating hypotheses; designing and conducting experiments; manipulating independent variables; collecting data; organising data;

displaying data; inferring from data; generalising; applying generalisations; communicating results; and formulating new hypotheses. They argue that inquiry makes learning more interesting and engaging and can have lasting effects on one's mind. Author [17] asserts that the use of science process approach to the teaching of biological concepts should be a rule rather than an option to biology teachers, if we hope to produce students that would be able to acquire the necessary knowledge, skills and competence needed to meet the scientific and technological demands of the nation.

According to author [18], the basic science process skills apply specifically to foundational cognitive functioning in especially elementary grades. They represent the foundation of scientific reasoning learners are required to master before acquiring and mastering the advanced integrated science process skills, explain author [19]. Author [20] cited in [18], maintain that basic science process skills are interdependent, implying that investigators may display and apply more than one of the skills in any single activity. For instance to *measure* the area of a habitat, the biology student may start by *observing* the habitat, then *measure* the dimensions and communicate the same using a symbol. Thereafter the student may *calculate* the area. In this scenario, the student was involved in the skill of *observing*, *measuring* and *calculating*. The basic science process skills include observing, inferring, measuring, communicating, classifying and predicting, author [20]. From this, it appears the basic science process skills provide an intellectual groundwork in problem solving. The KCSE Biology Practical Assessment Approach.

Currently, KNEC uses mainly photographs, diagrams and photomicrographs in testing practical skills in biology in the KCSE assessment approach as opposed to other sciences (Chemistry and Physics). Out of the 3 questions in biology practical paper, only in one question are candidates required to manipulate apparatus. The other two questions are answered from diagrams, photographs and photomicrographs, by author in [20]. In Chemistry and Physics practical examinations, all the 3 and 2 questions respectively engage students in practical or hands- on activities. The biology practical paper takes $1^{3}/_{4}$ hours as opposed to $2^{1}/_{4}$ hours taken by both physics and Chemistry practical papers.

The use photographs and photomicrographs to replace the real specimen deny the students the opportunity to manipulate the specimen and learn more about it. This preposition is supported by authors in [21] who argue that practical work is a central theme of lessons and assessment in the natural sciences. They insist that a student cannot be considered to have acquired science practical skills without handling and manipulating specimens and apparatus. The KCSE biology practical paper can be improved by allowing questions with more practical activities to dominate.

6. Methodology

Research Design

The study used descriptive survey research design. The main purpose of this design is to find out how the members of a population distributed themselves on one or more variables espouses the author in [22], which in this study shows how effective the KCSE biology practical assessment approach tests the experimenting skills.

This design involves observing and describing behaviour of a subject without influencing it in any way according to author in [23]. The author in [24] points out that descriptive survey is a method of collecting information by interviewing or administering a questionnaire to a sample of individuals. It can be used when collecting information about peoples' attitudes, opinions, habits or any other educational or social issues, explains author in [25].

The design was appropriate for this study since the KCSE biology practical assessment approach under study had already been used for several years and the researcher did not have the opportunity to manipulate the approach. The major purpose of this design is description of state of affairs as it exists, according to author in [26]. In this study, perception of the biology teachers was sought on whether the KCSE biology practical assessment approach (independent variable) effectively tests experimenting skills (dependent variables).

Sample Procedure and Sampling Size

Sample Procedure

Both Stratified random sampling and Simple random sampling were used to select a study sample from the list of trained Biology teachers in the County. Stratified sampling was used since different Sub-counties were involved hence the population was considered to be heterogeneous, according to author in [22]. The following formula was used to determine the sample quota each Sub-county was expected to contribute to the total sample size:

$$\text{Sample size per Sub} - \text{county} = \frac{\text{Total Sample Size (90)} \times \text{Sub} - \text{county Population}}{\text{Total Population of study (108)}}$$

Using the above formula, Table 1 was developed to guide on the number of respondents each sub-county was to contribute.

Sampling Size

The general rule in the determination of sample sizes is to use the largest sample possible, expounds authors in [27,28]. Author in [29] explains that a smaller sample results in larger error than a larger sample. Author in [30] asserts that sample sizes usually range from 60 to 300 respondents with most averaging about 200, although the nature of the study dictates the specific size of the sample. The proposed minimal sample size for survey research is 15 in each group as far as authors in [27] are [31] concerned. According to author in [32], the minimum sample size for a descriptive survey research is 10% of the accessible population. Authors in [33] used a formula for calculation of appropriate sample size from a given finite population and out of their calculations came up with a table relating any population of study to the sample population required.

According to this table (Appendix 1), 80 Biology teachers should be sampled from a population of 108 in the study area. However, author in [30] proposes a percentage adjustment of 10% to 30% to initial sample sizes to compensate for attrition, respondent refusal to participate, or other circumstances. This is for in-person data

collection instrument which gives an upward adjustment of 8 to 24. In this case, the researcher therefore settled for a sample size of 90 which falls within the proposed range after upward adjustment.

Table 1: Number of Respondents per Sub-county in Siaya County

Sub-county	Number of Respondents
Bondo	15
Rarieda	17
Gem	19
Ugenya	13
Ugunja	11
Siaya	15
Total	**90**

Source: Constructed by the researcher.

Simple random sampling is important in reducing the influence of extraneous variables in a study, as espoused by authors in [28]. Table 5 was used by the researcher to randomly pick the Sub-county sample summing up to a total sample of 90 teachers from the total population of 108 by balloting. This procedure is justified for selection of small samples as opposed to the use of tables of random numbers according to author in [34]. According to author in [34], this method is satisfactory where there are no systematic differences.

7. Instrument of the Study

The instrument used to collect the data required to achieve the objectives of this study was constructed by the researcher. The instrument was Biology Practical Teachers' Questionnaire (BPTQ- Appendix II), which was used to solicit information from Biology teachers teaching in extra-county secondary schools in Siaya County who have handled examination classes.

Validity and Reliability of the Research Instruments

Validity of the Research Instrument

Five research specialists from the Faculty of Education and Community Studies of Egerton University helped to validate the instrument, whose focus was face and construct validities according to authors in [29] and [31].

Two secondary school teachers helped in content validation of the instruments. The teachers were those who had conducted academic research in the past and had the knowledge of objectives and principles of the KCSE Biology Practical testing. The validation procedures concentrated on face, content and construct validities of the instruments.

In constructing the instruments, the researcher made the questionnaire items as relevant, objective and clear as possible to improve face validity. The researcher proof-read the questionnaire items and effectively eliminated systematic/non-random error which would have been due to poor validity of the instruments, says author in [22].

8. Reliability of the Research Instruments

To estimate their reliability, the instrument was pilot–tested by the researcher himself on teachers from the neighbouring Kisumu sub- county, Kisumu County. This was done after sampling but before the actual study began. The acceptable pilot sample size is 1% to 10% of the sample size, asserts author in [28]. Eight teachers were used in the pilot study.

After piloting, Cronbach's Alpha coefficient was used to estimate the reliability of the instrument. The use of Cronbach's alpha coefficient was appropriate since the items were not scored dichotomously and scores took a range of values, this according to author in [35]. This is a general, all purpose formula applicable to all types of scales and requiring only one administration of the instrument. Cronbach's Alpha coefficient was computed using the Statistical Package for Social Sciences (SPSS) version 17.0. The reliability coefficient of 0.85 was acceptable to the researcher. It was found to be within the range of a reliability coefficient of 0.7 and above acceptable in educational science research as suggested by authors in [28]. According to authors in [36], an alpha value of 0.7 is considered suitable to make possible group inferences that are accurate enough. Since the reliability coefficient was within the range, the questionnaire items were not reviewed and corrected and instructions not redrafted for more clarity as proposed by authors in [37].

9. Data Collection Procedures

The researcher sought research authorisation from the National Commission for Science, Technology and Innovation (NACOSTI) of the Ministry of Education, Science and Technology through the Board of Postgraduate Studies, Egerton University to collect data. The researcher then sought permission from Siaya County Director of Education to be allowed to visit schools. The researcher then visited each school whose teachers' were sampled for the study where the head teachers' permission to conduct the study had been sought. The researcher himself met the sampled teachers and explained to them the nature and importance of the study. The researcher thereafter administered the questionnaires by himself to the sampled teachers and involved them in setting the date for collecting back completed questionnaires to improve the return rate where he could not get back with the questionnaire.

The researcher sampled 80 teachers for the study from a population of 108. However a percentage adjustment of 10% was added to the initial sample to compensate for any attrition or respondents who may not have been able to participate. This led to a total number of 90 teachers being sampled. Out of the 90 questionnaires issued, 86

were returned, yielding a return rate of 95.6%. This return rate was satisfactory for the study.

10. Results and Discussion of Results

Results

Teachers' Perceptions on the Levels to which Experimenting Skills are Tested.

Teachers were required to indicate the extent to which experimenting skills are tested by the KCSE Biology Practical Assessment Approach. They were to indicate the extent of involvement in hands-on activities in the questions, provision of specimens for students to handle when answering questions, duration taken by the paper because of practical activities involved and whether the five steps in experimenting are followed. Their responses were categorised and scored in the range of one to five. 1 represented 'Strongly Disagree, 2 'Disagree', 3 'Undecided, 4 'Agree' and 5 'Strongly Agree'. Their responses, frequencies and means are presented in Table 2.

Table 2: Levels of Testing of Experimenting Skills (N = 86).

Aspects of Experimenting	**Responses and Frequencies**					
1	**2**	**3**	**4**	**5**	**Mean**	
Hands-on activities	16	23	26	20	1	2.62
Provision of specimens	31	27	20	5	3	2.09
Following five experimenting steps	12	24	18	27	5	2.87
Aggregate Mean						**2.53**

Out of 86 respondents, 65 respondents representing 75.58% indicated they strongly disagree disagree or undecided that the biology practical testing approaches involves hands-on activities. They believe that the KCSE biology testing approach does not adequately involve hands-on activities. With inadequacy of the hands-on activities, the teachers contend that the candidates may not have enough room for manipulation to warrant adequate testing of science process skills.

Twenty four point four two percent (24.42%) of the respondent teachers, however, indicated their agreement that the paper has enough hands-on activities for the candidates. There was only one respondent who 'Strongly Agreed' that the paper involves adequate hands-on activities. In the teachers' perspective, the candidates have adequate involvement in hands-on activities.

With a mean response score of 2.62 on this aspect of experiment involvement, it is evident that the teachers

largely disagree that the KCSE biology practical testing approach involves adequate hands-on activities. It therefore implies that, in their perception, the questions in the paper are mostly minds-on just like in the theory papers in biology.

When asked on their level of agreement on the experimental aspect of provision of sufficient specimens to candidates during practical examinations, only 9.30% of the teachers agreed that the KCSE biology practical testing approach provided the candidates with enough specimens. This small percentage of teachers believes that the specimens provided are sufficient to be able to test the manipulative skills of the candidates as they handle the specimens.

However, on the same aspect of experimenting, an extremely large number of teachers (90.70%) either disagree or are undecided that this testing approach provides candidates with sufficient number of specimens to allow testing of their manipulative skills. This indicates that the teachers are not satisfied with the extent of provision of specimens during biology practical testing.

The mean response score of 2.09 further indicates that the teachers disagree with the assertion that this testing approach provides sufficient number of specimens to the candidates. In their opinion, the candidates do not access sufficient number of specimens to handle during examinations. They believe the paper ought to offer more specimens to be handled by the candidates to warrant being an ideal practical paper.

Teachers were then asked to indicate their level of agreement that the KCSE biology practical testing approach follows the five steps in experimenting when answering questions. These five steps are; Problem Identification, Hypothesis, Predictions, Test of Predictions and Evaluation of Hypothesis. The effectiveness of an experiment relies on following these steps in answering experimental questions. Sixty two point seven nine percent (62.79%) of them either disagreed or were not sure. Forty one point eight six percent (41.86%) of them flatly disagreed with this assertion. To them, therefore, the experimental questions are not as effective since they do not involve these five steps.

Thirty seven point two one percent (37.21%) of the respondents agreed that the KCSE biology practical questions follow the five steps in experimenting in answering them. They believe, therefore, that the experiments are effectively set since the candidates follow the five steps in experimenting when answering the questions. However, with a mean response score of 2.87, it can be concluded that, in the perception of the teachers, the practical questions set do not follow the five steps in experimenting when answering them. The teachers assert that the testing approach is not as effective as it ought to be in testing the experimenting skills of the candidates as it does not allow the candidates to follow the five steps in experimenting.

The aggregate mean response score of 2.53 for the three aspects of experimenting shows that the teachers' mean response was 'Disagree'. This implies that, according to the teachers, the KCSE biology practical assessment approach does not give opportunities for the candidates to carry out experiments to a satisfactory extent. They disagreed with the assertion that this approach tests the experimenting skills to a good extent. All the four aspects of experimenting considered in this study were rated poorly by the teachers**.**

11. Discussion of Results

The results of the study show that, in the view of teachers, the experimenting skills are not effectively tested by the KCSE biology practical assessment approach. Seventy seven point nine one percent (77.91%) of the teachers who participated in the study indicated that testing of experimenting skills was very effective, ineffective or only slightly effective in the KCSE biology practical assessment approach. They affirmed that the students do not adequately exhibit their experimenting skills in tackling this paper. To them, this paper is weak in tapping their experimenting skills as acquired during their class work. A small percentage of the teachers (22.09%), however, believe that the KCSE biology practical paper effectively tests the experimenting skills of the candidates.

According to author in [38], the complete process of science cannot be learned by merely reading, listening, memorising or problem solving but effective teaching requires active mental involvement. All sciences are built with information from direct experiments and the nature of the subject rests heavily on the interaction between the theory and the experiment. For conceptualisation to occur, learners must be both mentally and actively involved. For this reason, the experimenting skills of the learners gathered over the study period need to be effectively assessed both formatively and summatively. The KCSE biology practical assessment approach has therefore failed with respect to this.

The findings are however, not in agreement with authors in [39]. They assert that use of experiments as teaching tools in the classroom has been steadily increasing over the past two decades since their pedagogical advantages have become more apparent. Author in [40] posits that the primary advantage of experiments is their ability to get the students to be actively involved in the class and in the learning process. The experimenting skills must, therefore, be essentially tested if the KCSE biology practical testing approach has to remain relevant and exciting to the learners.

The results agree with the findings of authors in [41] who posit that teachers need to devote a greater portion of their lesson time to helping students use ideas associated with the phenomena they have produced rather than seeing the successful production of the phenomenon as an end to itself. According to authors in [42], practical work is an essential component of science and vocational subjects. The findings are also in agreement with authors in [2], who believed good quality, appropriate biology experiments and investigations are the key to enhanced learning and clarification and consolidation of theory. They claimed Biology experiments aims at equipping the learners with the knowledge, attitude and skills necessary for preserving the environment. Since we test what has been taught, the assessment approach should contain all the skills imparted on students during teaching.

On the extent to which experimenting skills are tested, the study further established that teachers disagreed that the testing approach involves adequate hands-on activities. Seventy-five point five eight percent (75.58%) of them indicated they strongly disagree, disagree or undecided that the biology practical testing approach involves adequate hands-on activities. They believe that the KCSE biology testing approach does not adequately involve hands-on activities. With inadequacy of the hands-on activities, the teachers contend that the candidates may not have enough room for manipulation to warrant adequate testing of science process skills.

Twenty four point four two percent (24.42%) of the respondent teachers, however, indicated their agreement that the paper has enough hands-on activities for the candidates. There is only one respondent who 'Strongly Agreed' that the paper involves adequate hands-on activities. In their perspective, the candidates have adequate involvement in hands-on activities. With a mean response score of 2.6163 on this aspect of experiment involvement, it is evident that the teachers largely disagree that the KCSE biology practical testing approach involves adequate hands-on activities. It therefore implies that, in their perception, the questions in the paper are mostly minds-on just like in the theory papers in biology.

This finding is supported by authors in [43] who pointed out that the mere recall of knowledge without the ability to transfer it in a working situation later on cannot be viewed as acquisition of a good standard of quality, which the goals of education intend to achieve in a society. The essence of practical work in any of the pure sciences, and indeed in real life situations, is to expose the learners to a glimpse of the actual work environment where theories are translated into work output. The testing of such practical skills, therefore, needs to involve more of doing than explaining. This justifies the need to include more hands-on activities than minds-on activities in any biology practical assessment tool.

This finding is further supported by author in [44] who posits that in science education, one route to achieve better performance is the active student-centred methods of school work such as class discussions, excursions, field work, problem solving, with laboratory work as a flagship. The students are best made active by engaging them in hands-on activities. A practical assessment that does not allow and test the involvement of candidates in hands-on activities is therefore not appropriate.

The study also established that, in teachers' perspective, the KCSE biology practical assessment approach does not provide sufficient specimens for the candidates to handle during examinations. When asked on their level of agreement on the experimental aspect of provision of sufficient specimens to candidates during practical examinations, only 9.30% of the teachers agreed that the KCSE biology practical assessment approach provided the candidates with enough specimens. This small percentage of teachers believes that the specimens provided are sufficient to be able to test the manipulative skills of the candidates as they handle the specimens.

However, on the same aspect of experimenting, an extremely large number of teachers (90.70%) either disagreed or were undecided that this testing approach provides candidates with sufficient number of specimens to allow testing of their manipulative skills and elicit students' interest. This indicates that the teachers are not satisfied with the extent of provision of specimens during biology practical testing.

The mean response score of 2.09 further affirms that the teachers disagreed with the assertion that this testing approach provides sufficient number of specimens to the candidates. In the teachers' opinion, the candidates do not access sufficient number of specimens to handle during examinations. They believe the paper ought to offer more specimens to be handled by the candidates to warrant being an ideal practical paper.

This finding is supported by authors in [21] who argue that practical work is a central theme of lessons and assessment in the natural sciences. They insist that a student cannot be considered to have acquired science

practical skills without handling and manipulating specimens and apparatus. An ideal practical paper, therefore, would be that which provides the candidates with ample opportunities to have access to, observe and manipulate specimens and apparatus. The KCSE biology practical assessment approach has failed in this by only providing very few or no specimens and apparatus at all.

12. Summary

The extent of experimenting as indicated by four aspects used in this study was found to be poor, according to the teachers. The aggregate mean response score of 2.45 for the four aspects of experimenting shows that the teachers' mean response was 'Disagree'. This implies that, according to the teachers, the KCSE biology practical assessment approach does not give opportunities for the candidates to carry out experiments to a satisfactory extent. They disagreed with the assertion that this approach tests the experimenting skills to a good extent. All the four aspects of experimenting considered in this study were rated poorly by the teachers.

13. Conclusion

Based on the findings of the study, teachers perceive that the KCSE Biology Practical Assessment Approach is slightly effective in testing experimenting skills. The extent of experimenting on the basis of the four aspects of experimenting used in the study was found to be poor.

14. Recommendations

i. The three questions set in the paper should be practical-oriented requiring hands-on activities to give the candidates more opportunities to demonstrate experimenting skills. Minds-on activities should be limited to the theory papers or to principles that cannot be tested through hands-on activities.
ii. More specimens should be provided to learners to observe and manipulate as they answer questions. The use of photographs and photomicrographs as substitutes for real specimens should be limited to only what cannot be actually brought in realia form, for example, large or fierce animals or poisonous plants.
iii. The KNEC needs to solicit more funding necessary for providing specimens, chemicals and apparatus used in practical examinations to reduce the vice of cheating in practical examinations and also allow students to manipulate specimens and apparatus.
iv. The teachers should use varied student-centred teaching approaches in their lessons to make learning more participatory and expose students to learning environments other than the classroom. They should not tailor their teaching to conform to the KCSE approach in assessing practical skills.

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