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Effectiveness of the use of practical pedagogy in improving teaching and learning in biology

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Abstract

Practical work can be conducted both in the laboratory and out of the laboratory. The purpose of this study was to find out the effectiveness of using practical work in teaching and learning of Biology. The problem of this study was the continued poor learner performance in Biology. Two objectives guided the study as follows: To find the proportion of teachers using practical work in teaching and learning of Biology in secondary schools in Gucha South Sub County and to determine teacher effectiveness in using practical work in teaching and learning Biology in secondary schools in Gucha south sub-county. The target population was 42 Biology teachers in Gucha south sub-county. Saturated sampling technique was used to select all the 42 teachers in the sub County. Data was collected by use of the Biology Teachers' Questionnaire and the Biology Teaching Observation Schedule. The data was analyzed by use of both qualitative and quantitative data analysis techniques. The findings reveal that the use of practical work in teaching of Biology is still low. It is also concluded that the use of practical work in the sub-county is less effective; furthermore, most of the Biology practical lessons are content-biased which hinders the effectiveness of the practical activity. The findings of this study may be important to inform the educationists and curriculum developers on the extent of use of practical work in Biology. It will also inform education stakeholders on the effectiveness of using practical work in teaching and learning of Biology in Gucha south sub-county which in turn will provide room for improvement.

Key words: Effectiveness, Learning, Pedagogy, Practical work, Teaching

1.0 INTRODUCTION

Use of practical teaching has its history in early American education. America and Britain are known to have initiated and embraced science practical teaching in the nineteenth century. In many countries there has been great attention directed towards the effective implementation and practice of science education at the secondary school level (Beyessa, 2014). China and India are the two outstanding countries that are strengthening their science curriculum standards in various ways with an aim of becoming economic and industrial powerhouses so as to compete effectively with developed countries (Daba, Anbassa, Oda & Degefa, 2016).

According to Kambaila, Kasali, and Kayamba (2019), planning an instructional approach that focuses on learners through the use of visual guide, fieldwork, and handling realia are valuable assets in effective Biology instruction as compared to just telling. Biology is a science that involves both theory and practical work if it must be taught or learnt effectively. In such a case, a laboratory is crucial for effective practical learning in science. Without practice either individually or in groups all that have been learnt ends up as inert knowledge (Daba & Anbassa, 2016).The new models in learning put emphasis on students as active responsible learners while the teacher is seen as a facilitator of the learning process (Ndioho, 2007). Kambaila et al. (2019) further posit that learners tend to remember things seen unlike those that are merely said. They further observe that a sense of achievement is felt within both the learners and teachers when Biology practicals coincide with what has been learnt in theory.

Atieno (2015) posits that the classroom interaction that governs verbal communication between the teacher and the learner are learned in the course of children's learning experiences. Many signals pass between the teacher and the learner, which convey feelings about a topic and give information, which helps to organize conversation. The Biology teacher therefore remains the sole person who can effectively facilitate concepts, skills and attitude learning. When effectively done, this shall result in improved learner academic attainment.

Studies continue to show the quality of the teacher is directly proportional to learner performance. Arokoyu and Chukwu (2017) observes that if a teacher is ineffective in methodology, then the learners under this teacher's tutelage are likely to achieve inadequate progress academically. Practical work forms an essential component of the Biology curriculum in secondary schools (Ngakhala, Toili & Tsikhalia, 2017). They further reiterate that, the use of practical work is a teaching strategy that involves hands-on activities conducted by the learners under the guidance of the teacher. Imanda, Omwenga, Andima and

Obuba (2020) posits that during practical activity, the teacher guides the learners to follow given instructions; hence a facilitator. The Gucha South sub county mean mark obtained by candidates in KCSE Biology examinations since 2016 has been perennially below 30% (MOE, 2021). The poor performance in Biology in the sub County might be partly attributed to teacher-centered methodologies during classroom instruction. This gap in literature necessitated the present study to be conducted. The present study therefore sought the proportion of Biology teachers using practical work and whether it is effective.

Statement of the Problem

Biology instruction requires that the teacher makes a good choice of the method to use so as to enhance greater learner understanding. The practical teaching method has been favored in varied literature; however it is not clear how effective practical work is when used during Biology classroom instruction. The problem of this study was that, despite the continued emphasis on the use of practical work in teaching Biology among other factors, learner performance in Biology examinations is still wanting.

Objectives of the Study

The study was guided by the following study objectives:

1. To find out the proportion of teachers using practical work in teaching and learning of Biology in secondary schools in Gucha South Sub County.
2. To determine teacher effectiveness in using practical work in teaching and learning Biology in secondary schools in Gucha South Sub County.

2.0 REVIEW OF RELATED LITERATURE

There is evidence that students find practical work relatively useful and enjoyable as compared to other science teaching and learning activities. In fact, since 1988, the National Curriculum of England emphasis on more practical work has made it become an important aspect of Biology, chemistry and physics lessons (Kolucki and Lemish, 2011). Other studies continue to show that the laboratory is a crucial learning resource for effective practical activities in the learning of science (Iloeje, 2005; Killermann, 2010). Visual sense is the highest of all senses, and it is necessary for effective Biology practical activities. Moeed, (2011) observes that, teachers have resolved to a tendency of teaching for examinations which deviates the methodology from learner-centered approaches. The focus on students' needs to remember the concepts acquired was to ensure they could remember and recall them

for examination purposes and reduced opportunities to learn for understanding. For many children, what goes on during Biology practical contributes little to their learning of science due to the way the teacher presents it (CEMASTEA, 2011; Imanda, 2013; Ngakhala et al., 2017). This position prompted the present study to be conducted.

The findings from a study by Abrahams and Millar (2008), reveals a significant difference between the effectiveness of practical work in the domain of observables and in the domain of ideas. Yet many teachers do expect students to learn theoretical ideas through practical activities; as a consequence of actions carried out with objects and materials. The teachers in the study sample frequently included the learning of scientific ideas amongst their objectives for a practical lesson. This, however, contrasted with the absence of any overt evidence of planning how students might learn such ideas from what they did and observed, either in the oral or written instructions on the task or in the way these were presented. Very little time was devoted to supporting the students' development of ideas. These reviewed studies create a gap in methodology and content that the present study aimed at filling.

3.0 METHODOLOGY

The study adopted a descriptive survey research design. The study was conducted in Gucha south sub-county which is one of the 11 sub-counties in Kisii County. There are 23 public secondary schools in the sub county. The target population for this study was the Biology teachers in the public secondary schools in Gucha south sub-county. Saturated sampling technique was used to select all the 42 biology teachers. . All teachers took part in the study since the total study biology teachers population in the sub County was too small to draw a sample from. As Kanwarjit (2012) notes this method is less cumbersome as it eliminates the need for assigning numbers to the names of schools as simple random sampling does. Data collection instruments included Biology Teachers' Questionnaire (BTQ) and the Biology Teaching Observation Schedule (BTOS).

The BTQ and BTOS were designed by the researcher. During the design, close consultation with Kisii university research experts was done to ensure their validity. A pilot study was carried out before the actual study in which two Biology teachers participated. Reliability of the instruments was determined through the test-retest method (Orodho, 2009). The instruments were administered by the researcher followed by coding to minimize subjectivity. Both qualitative and quantitative data analysis techniques were employed. The responses were transferred into a summary table by tabulating. Responses in the BTQ were tallied to establish frequencies which were then converted into percentages. Open-ended responses

were recorded word for word and summarized into themes that emerged. For each Biology teacher observed, the percent use of a category was obtained by calculating using the formula that follows:

No. of time behavior units occurred X 100

Total number of times units observed

The ratio of content-based transactions was calculated as a fraction of all transactions recorded. Time spent on content and process, practical and theoretical work was calculated from the BTOS and presented in percentages. These revealed the orientation and emphasis in the lessons observed.

4.0 RESULTS AND DISCUSSION

4.1 Use of Practical work in Teaching and Learning of Biology

The data obtained through the BTOS shows the proportion of lessons with practical work. Table 1 shows the proportion of lessons observed having practical activities.

Table 1: Proportion of Biology Teachers Integrating Practical work in their Lessons

School category	Biology lessons observed	Lessons with practical activity	% lesson with practical activity
Extra-county	3	1	33
County	5	2	40
Sub-county	7	2	29
Total	**15**	**5**	**34**

From the results in Table 1, the county schools had the highest percentage of use of practical activity at 40%. The average use of practical work in the sub-county is 34%. This percentage is much lower considering the myriad of literature including Biology course books, research findings and in-service training that have emphasized on the use of practical work in teaching of Biology. In other similar studies, CEMASTEA (2011) reports that of the total study population in Kenya only 25 % were using practical activities in their Biology lessons. Similar findings were obtained from independent studies by Mbaka (2009) and Imanda (2013) who found 31% and 34% respectively. The Kenyan education curriculum recommends greater integration of practical work in Biology lessons. It is therefore unfortunate that with all the resources that are being spent to emphasize the practical teaching and learning of Biology in secondary schools there are a paltry proportion using such

activities. In the present study, the findings of interest were the content that was being taught in the 15 lessons observed in the classroom observation as shown in Table 2.

Table 2: Content Taught During the Classroom Observation

Lesson. No.	Teacher's Name (Pseudo name)	Class/Form Taught	Content/ Lesson Topic
1	ANN	2	Mechanism of gaseous exchange in insects
2	BLE	3	Measurement of growth- sigmoid growth curve
3	CHRIS	2	Anaerobic respiration
4	DAN	1	Factors affecting energy requirement in man
5	ELLY	1	Adaptation of ileum to its functions
6	FAN	3	Growth and development in insects
7	GREG	1	Digestion in the mouth and Stomach
8	HIL	2	The role of the kidney in excretion
9	INA	1	Digestion and absorption in the ileum
10	JIL	2	Mechanism of inspiration and expiration
11	KELL	3	Types of germination
12	LIZ	3	Structure and function of the flower
13	MINA	4	Probability in genetic crosses
14	NICK	2	Plant excretory products
15	OLOO	1	Factors affecting energy requirement in man

For confidentiality and anonymity purposes, the names used in Table 2 are not the teachers' real names. From Table 2, out of the above 15 lessons observed only 5 had practical work. These were the lessons taught by Mr. Dan, Ms. Gall, Mr. Hill, Ms. Kell and Mr. Nick. However, the content that was taught as illustrated in Table 2 is evident that there is a wealth of practical activities in each of the 15 lessons. For instance the lesson that was taught by Ms. Ann, she could have displayed insects such as a grasshopper in class with hand lenses for learners to observe how spiracles open and close. Alternatively learners would have observed these structures under a microscope. There were many opportunities where practicals could be used. For instance, Mr. Ble on sub-topic measurement of growth, various parameters could be appropriate; such as measuring height or weight of students. These findings concur with those from a study by Ngakhala et al (2017) whereby over 60% of the respondents in form two and form three were unanimous that they had done less than five practicals in each school term.

4.2 Teacher Effectiveness in Using Practical Work in Teaching and Learning Biology

In teaching, using Biology practical activity is one thing and the practical activity being effective is another independent thing. The respondents were asked how effective their practical activity is in as far as equipping the learners with hands-on experience and observation skills. A proportion of 79% of the respondents reported that their practical work was effective in the aforementioned aspects. Only 21% responded that the practical work was not effective.

In the lessons observed which had practical activity, the time spent on content and process was calculated for each of the aspects in the BTOS. The instrument was divided in two sections: teacher talk and, talk and activity initiated and/or maintained by pupils. In part 1 of the teacher talk section, there were three subsections.

a) Teacher asks questions or invites comment

The Biology teachers were observed on various aspects under this subsection. The observation revealed that content had 36 units of observed classroom transactions while process had 23. This represents 61.12% and 38.98% respectively.

b) Teacher makes statement

From the observation carried out on the Biology teachers, it was revealed that 23 units were observed on Biology content representing 62.16% and 14 units on Biology process representing 37.84%.

c) Teacher directs pupils on to sources of information

On this behavior, it was observed among the Biology teachers that 15 units representing 60% was more of Biology content while 10 units representing 40% was more of Biology process.

In part two of the BTOS, where we had talk and activity initiated and/or maintained by pupils, the observed transactions were as follows.

d) Pupils seek information or consult

The Biology teachers during the observation revealed 10 units representing 55.56% on content. On the other hand, eight units representing 44.44% showed progress as predominating their Biology lessons.

e) Pupils refer to teacher

In the classroom observation of Biology teachers, it came out clear that 14 units representing 66.67% portrayed content bias while 7 units representing 33.33% showed Biology process.

Classroom observation of Biology teachers, revealed that sub-sections (a), (b), (c), (d) and (e) had a bias towards content hence such teachers can be rated as content- based. Science

teaching is expected to be more process-based for increased understanding of science concepts (Imanda et al., 2020). The indication is that although the practical work was practiced in the lessons, learners were given minimum opportunity to explore the material. This implies that the lessons were practical but with minimum learner manipulation which makes it less effective. The findings of the present study corroborates those from a study by Sani (2013) who found out that students' experience of practical work as implemented in the study could lead to a surface approach to learning rather than deeper learning for understanding.

One of the lessons observed (taught by Mr. Hill) was about the role of the kidney in excretion. In this lesson, learners were given a longitudinally dissected mammalian kidney, and then the teacher started teaching and giving notes. In the whole lesson that lasted for 40 minutes it was only in two minutes at the start of the lesson that he referred the learners to the realia he had given them. This is a clear indication that some practical work is done in class but with low efficacy.

5.0 Conclusion and Recommendations

5.1 Conclusions

The study revealed that Biology teachers in Gucha South sub-County use practical work during instruction to a lesser extent. Most of the methods they use are conventional teacher-centered instructional methodologies. Furthermore, in cases where the practical method is used, there was less emphasis on the Biology process. The lessons are more content based thus with minimum biology processes.

5.2 Recommendations

The study recommends that Biology teachers need to be frequently sensitized through capacity building on the need and importance of use of the learner-centered practical method. Furthermore there is need for adequate lesson planning with greater emphasis to be laid on the Biology practical processes unlike the way the case is as of now where more emphasis is on Biology content.

REFERENCES

Abrahams, I. & Millar, R. (2008). Does Practical Work Really Work? A Study of the

Effectiveness of Practical Work as a Teaching and Learning Method in School Science. *International Journal of Science Education,* 30(14), New York: Taylor and Francis

Arokoyu A. & Chukwu, J. C. (2017). Biology Teachers Methods of Teaching and Academic Performance of Secondary School Students in Abia State, Nigeria. In the *Journal in Emerging Trends in Education Research and Policy Studies JETERAPS). 8*(4):228-231 Retrieved from: jeteraps.scholarlinkresearch.com

Atieno, E. O. (2015). Learning Conditions and Students' Characteristics that Enhance Effective

Teaching and Learning of Biology in Secondary Schools in Migori District, Kenya. *Merit Research Journal of Education and Review. 3*(5): 200-207, from: http://www.meritresearchjournals.org/er/index.htm

Beyessa, F. (2014). Major Factors that Affect Grade 10 Students' Academic Achievement in Science Education at Ilu Ababora General Secondary of Oromia Regional State, Ethiopia. *Int. Letters Soc. Humanistic Sci.* 32:118-134.

CEMASTEA, (2011). Effective Resource Mobilization, Prioritization and Utilization for Quality

Education, *Training Manual for Secondary Schools' Principals Workshop*. Nairobi: CEMASTEA.

Daba T. M. & Anbassa, M. S. (2016). Factors Affecting Implementation of Practical Activities in

Science Education in Some Selected Secondary and Preparatory Schools of Afar Region, North East Ethiopia. *International Journal of Environmental and Science Education. 11*(12) 5438-5452

Daba, T. M., Anbassa, B., Oda, B. K. & Degefa, I. (2016).Status of Biology Laboratory and Practical Activities inSome Selected Secondary and Preparatory Schools of Borena Zone, South Ethiopia. In *Educational Research and Reviews. 11*(17): 1709-1718 from: http://www.academicjournals.org/ERR

Iloeje, O. S. (2005) 'Certificate Practical Biology Paperback – September, 2005', (September 1981), p. 2005

Imanda, O. C. I. (2013). Evaluation of the Impact of "Strengthening of Mathematics andScience

in Secondary Education" (SMASSE) Programme on Performance in Biology in Secondary Schools in Emuhaya District, Kenya. Unpublished Master's Thesis, Maseno University

Imanda, I. C. O, Omwenga, E., Andima, G. &Obuba, E. (2020). Contribution of Learners' Biology Practical Process Skills' Competency on their Achievement in Biology. *Journal of Research Innovation and Implications in Education, 4*(4): 1 - 13. Retrieved from: www.jriie.com.

Kambaila, Kasali & Kayamba (2019). Assessing the Effects of Biology Practical Activities on Academic Performance of Senior Secondary School Students, Zambia. *Journal of Education and Practice 10*(24):116-124. Retrieved from: www.iiste.org

Kanwarjit, S. (2012). *Methodology of Educational Research*. India: Lotus Press.

Killermann, W. (2010) 'Research into Biology Teaching Methods', p. 2010. Doi: https://doi.org/10.1080/00219266.1998.9655628.

Kolucki, B. & Lemish, D. (2011). *Communicating with Children; Principles and Practices to Nurture, Inspire, Excite, Educate and Heal. First edition.* Philadelphia, USA: Open University Press. Retrieved from: www.openup.co.uk.

Mbaka, T. O. (2009). The Role of Head teachers in the Implementation of Strengthening of Mathematics and Science in Secondary Education Project inPublic Secondary Schools in Kilifi, Kenya. Unpublished Master's Thesis, Maseno University.

Ministry of Education (MOE), 2021. KCSE 2020 - Results Analysis for Gucha South Sub-County.

Moeed, H. A. (2011). Science Investigation in New Zealand Secondary Schools: Exploring the Links between Learning, Motivation and Internal Assessment in Year 11. Unpublished Doctoral dissertation, Victoria University of Wellington, Wellington, New Zealand.

Ndioho, O. F. (2007). Developing Basic Laboratory Skills for the Effective Conduct of BiologyPracticalsBiologyPanel Series 2007 Jos: Akin Press and Services.

Ngakhala, J. N., Toili, W. W & Tsingalia, H. (2017). Participation Skills in Biology Practical per Class Level inLugari, Kakamega County, Kenya. In *International Journal of Innovative Research and Development 6(6):245-249.*Retrieved from:www.ijirid.com

Orodho, A. J. (2009). *Elements of Education and Social Science Research Methods*. Maseno:

Kanezja.

Sani, S. S. (2013). Teachers' Purposes and Practices in Implementing Practical Work at the Lower Secondary School Level. *The 5th World Conference on Educational Sciences – WCES: In Procedia - Social and Behavioral Sciences 116* (2014): 1016 -1020. Retrieved from: www.sciencedirect.com