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Passive Pedagogy in Biology Teaching on Achievement of Learning outcomes: the Kenyan Experience

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Abstract: **Biology is an important scientific discipline that contributes to vital scientific innovations such as medicine and genetic engineering. School curricular are being aligned and pedagogical approaches integrated to embrace the benefits of Biology. However, as many countries in the modern world gears towards enhancing the achievement of Biology learning outcomes, in Kenya, the examination reports indicate that from 2013 to 2023, students continually achieved low outcomes in Biology in the National Examinations. This study set out to examine Passive Pedagogy in Biology Teaching and its impact in achievement of learning outcomes in Nairobi County schools. Passive pedagogical techniques were evaluated and their impact on learning outcomes observed. The study started with a survey followed by qualitative study of selected schools in accordance with the findings of the survey. The study targeted 114 public secondary schools. The sample size was 114 for the quantitative phase and 57 for the qualitative phase. Data was collected using questionnaires, in-depth interview guides, Focused Group Discussion (FGD) guide and class observation guide. The study respondents were: Biology teachers, students and Biology specialists from: Kenya Institute of Curriculum Development (KICD), Centre for Mathematics, Science and Technology Education Africa (CEMASTEA) and Lecturers of Biology education at Kenyatta University (KU). The study concluded that teaching of Biology using passive pedagogy was deficient contributing to achievement of low order learning outcomes**

Keywords: **Passive pedagogy, achievement of learning outcomes, teaching and learning.**

1. INTRODUCTION

Productivity in health, technology, education, and energy has been realized through scientific research, innovation (Xue & Li, 2021). Teaching and learning of science disciplines is therefore eminent in realizing vital development in countries. Evidence from research has shown that education systems are not up to the challenge in science teaching, leading to a decline in achievement of learning outcomes in science disciplines (Fernandes, Rodrigues, & Ferreira, 2019). Biology is a life science that contributes to vital scientific innovations such as medicine and genetic engineering. Research studies note that concerns raised regarding Biology teaching, including the pedagogy and the introduction of technologies, among other concerns, have not been addressed. Given the place of science in socio economic development of a country, there is need for countries to ensure that sciences are taught in a manner that exemplifies high quality (Xue & Li, 2021).

The development of the health sector in Kenya, just like in other countries, depends on the quality Biology teaching. In support, the Sessional Papers, namely No. 14 of 2012 and No. 2 of 2015, advocate for high-quality teaching and learning of sciences. The Kenya National Examination Council reports of 2013-2020 have, however, shown poor achievement of learning outcomes in Biology. This being the scenario, there was a need to examine the teaching of Biology so as to address the dismal achievement of learning outcomes in Biology (KNEC, 2022).

Nairobi City County was selected for this study because it has the most diverse of characteristics representing the Kenyan educational context as a whole such as: diverse ethnic groups, varied socio-economic status and varied representative categories of schools in Kenya.

2. LITERATURE REVIEW

Methods and techniques employed during the teaching and learning process influence achievement of learning outcome (Schilbert & Scheersoi, 2022). In other words, the way in which the subject matter is presented to learners determines the extent to which the learning outcomes are achieved.

A study by Vincent-Lancrin, Vidal, & Yu (2023) carried out in the USA explored the relationship between passive learning methods, such as traditional lectures, and long-term retention of mathematical concepts among high school students. Through a longitudinal study spanning an academic year, the researchers compared the retention rates of students exposed to passive learning with those engaged in more active learning approaches. Findings revealed a substantial decline in long-term retention among students relying on passive learning methods. Implications for instructional practices and curriculum development should therefore emphasize active pedagogies in teaching and learning.

In another study by KNEC, (2022) in Kenya, it was noted that passive instruction is designed to promote student rote learning; just requiring learners to remember concepts. Mbati et al (2020) in their study espouse that, in Kenya, contrary to the recommended active learning pedagogy, teacher centered methods of instruction, especially the lecture method, dominate science classroom practices. Mbati et al (2020) warn that teacher centered methods often give a pseudo impression that effective learning has taken place as implied. The researchers argue that there is a difference when students are assessed on memorized material and when they are assessed on the application bit of the memorized material. This scenario of teaching science using passive pedagogical techniques despite serious warning by researchers should therefore be looked into. Findings on the kind of learning outcomes achieved by using active learning pedagogical techniques are yet to be documented by researchers.

3. METHODOLOGY

This study adopts a mixed-methods approach, specifically utilizing an explanatory sequential design. This two-phase methodology is structured to yield a robust, multi-dimensional understanding of the phenomenon. The design begins with the collection and analysis of quantitative data to establish broad, objective trends regarding pedagogical practices and academic achievement. In the subsequent phase, qualitative data is intentionally gathered to elaborate on, explain, and provide deeper contextual nuance to the initial quantitative findings, thereby offering a holistic view of the Kenyan classroom experience.

To align with the explanatory sequential design, the study utilized a rigorous, two-tiered sampling strategy. In the Quantitative Phase, the study targeted all 114 public secondary schools in Nairobi City County. The study sampled 114 teachers one from each school. This widespread inclusion ensured maximum statistical power and representativeness when assessing baseline biology learning outcomes and the prevalence of passive teaching methods across the County. In the Qualitative Phase, a purposive sub-sample of 57 respondents across the schools (representing slightly more than 50% of the initial sample) is selected. This subset is drawn based on specific criteria derived from the quantitative results—such as schools exhibiting typical, exceptional, or anomalous achievement outcomes. This targeted sampling facilitated an in-depth, qualitative exploration of the underlying pedagogical dynamics driving the quantitative data. In the first phase, quantitative data was primarily gathered through structured questionnaires administered to biology educators. This data was analyzed through descriptive and inferential statistics to identify significant correlations. Following this, the qualitative phase utilized in-depth, semi-structured interviews and targeted classroom observations within the selected schools to explore the lived experiences of teachers and students. This qualitative data was subjected to rigorous thematic analysis. Ultimately, the findings from both distinct phases were integrated during the final interpretation stage, allowing the qualitative narratives to effectively explain and contextualize the quantitative metrics surrounding passive pedagogy in biology education.

4. FINDINGS AND DISCUSSIONS

Findings from the Quantitative Study

The study assessed pedagogical techniques used in Biology teaching and its influence on the achievement of learning outcomes. In the quantitative study, the teachers who participated in the survey were presented with 11 statements depicting different pedagogical techniques and asked to indicate whether they agree with the statements. The 11 statements were:

PTBT1: Teachers should show how an experiment works (depicting demonstration method of teaching-passive)

PTBT2: Explanation of Biology facts and definitions provide core of Biology teaching (depicting explanation method -passive)

PTBT3: Well prepared lectures are efficient and for most Biology topics (depicting lecture method-passive).

PTBT4: Biology teachers have in mind specific answers to the questions they pose in class (depicting question and answer method but which is teacher centered-passive)

PTBT5: Students carry out experiments on own their own using apparatus provided (depicting experiment method-active)

PTBT6: Students work in groups make written reports of the and present their findings (depicting collaboration learning-active)

PTBT7: Students have an ongoing project in my school (depicting project method-active)

PTBT8: Biology students are provided time in class for exchanging among themselves (collaboration-(active)

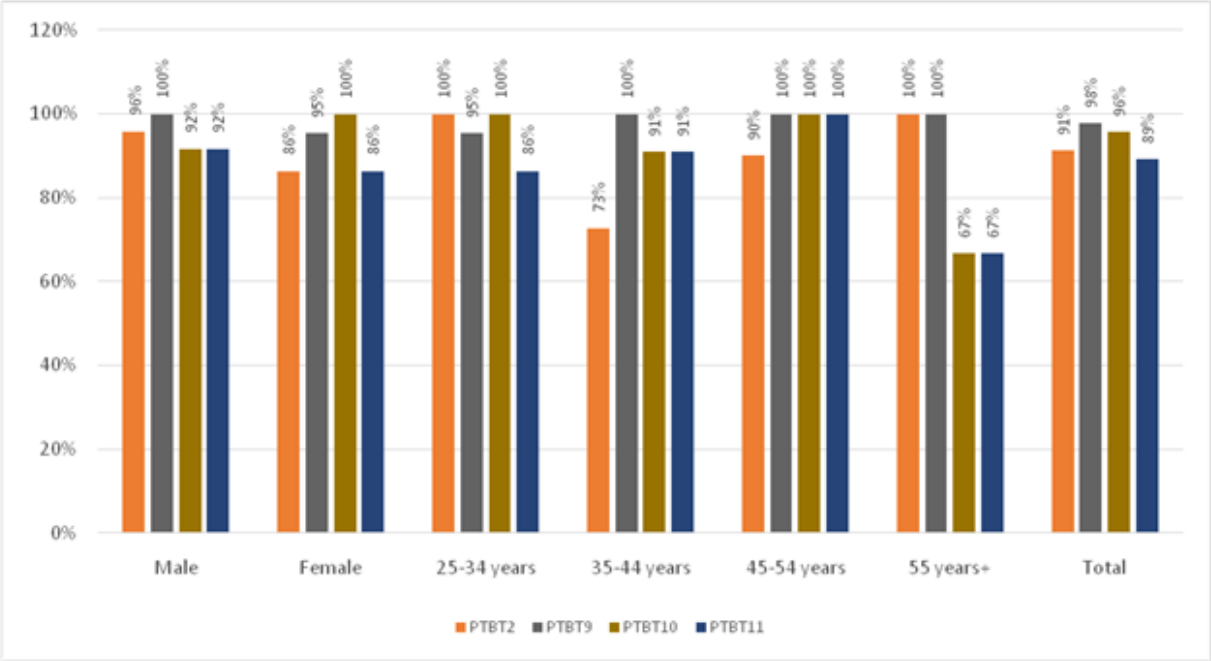
PTBT9: Some time in Biology teaching is used for students to explore material question and share ideas (depicting inquiry method-active)

PTBT10: Students identify and solve real problems during Biology Classes (problem solving method -active)

PTBT11: Students are guided to find the truth about Biology themselves by independent thinking. (Depicting discovery learning-active)

Among the 11 statements concerning teaching pedagogies, four were most agreed. Figure 1 shows the most agreed pedagogical techniques by teachers.

Figure 1: Pedagogical Techniques in Teaching Biology agreed by Most Teachers



The four most agreed statements concerning teaching pedagogies included:PTBT9: Some time in Biology teaching is used for students to explore material question and share ideas, which was agreed on by 96% of the teachers;PTBT10: Students identify and solve real problems during Biology classes, agreed on by 96% of the teachers; PTBT2: Explanation of Biology facts and definitions provide core of Biology teaching, which was agreed on by 91% of the teachers while; PTBT11: Students are guided to find the truth about Biology themselves by independent thinking, 89% of the teachers. Many teachers

however also agreed that explanation technique, though a passive method, is important in helping learners to understand concepts and definitions of Biology. This means that teachers may not entirely do away with passive methods of teaching but may use them accordingly to bring to context what learners experience through the active methods of teaching.

Further, the Biology teachers who participated in the survey were asked to indicate on a scale of 1-5 (1 lowest rate and 5 highest rate) how useful they found the various statements on pedagogical teaching techniques regarding achievement of learning outcomes.

Table 1 shows the responses about the usefulness of the various teaching techniques in achievement of learning outcomes.

Table 1: Pedagogical Techniques on Achievement of Learning Outcomes

Rating		PTBTR1	PTBTR2	PTBTR3	PTBTR4	PTBTR5	PTBTR6	PTBTR7	PTBTR8	PTBTR9	PTBTR10	PTBTR11
Gender	Male	3.88	4.21	4.00	3.79	4.17	4.21	3.96	4.17	4.33	4.25	4.46
	Female	4.00	4.23	3.55	3.77	4.14	4.27	3.55	4.09	4.36	4.27	4.50
Age	25-34 years	4.14	4.36	4.23	4.00	4.45	4.32	4.05	4.18	4.32	4.41	4.45
	35-44 years	3.64	3.64	3.55	3.82	4.27	4.36	4.00	4.36	4.45	4.18	4.45
	45-54 years	4.10	4.40	3.10	3.60	3.40	3.80	3.00	3.70	4.40	4.10	4.60
	55 years+	3.00	4.67	3.67	2.67	4.00	4.67	3.33	4.33	4.00	4.00	4.33
Experience	4 years or less	4.38	4.25	4.13	4.13	4.50	4.63	3.88	3.88	4.25	4.25	4.38
	5-10 years	3.91	4.26	3.78	3.96	4.22	4.30	3.91	4.30	4.48	4.43	4.57
	11-15 years	3.60	3.20	3.80	4.00	4.00	4.00	3.60	4.00	4.00	4.00	4.00
	16-20 years	5.00	5.00	1.00	2.00	5.00	3.00	2.00	4.00	4.00	5.00	5.00
	21-25 years	3.75	4.50	3.50	3.75	4.00	4.25	4.25	4.50	4.50	4.50	4.75
	30 years and above	3.60	4.60	4.00	2.60	3.40	3.80	3.00	3.60	4.20	3.40	4.40
	Total	**3.93**	**4.22**	**3.78**	**3.78**	**4.15**	**4.24**	**3.76**	**4.13**	**4.35**	**4.26**	**4.48**

Six out of 11 of the pedagogical techniques were rated as considerably useful to very useful in contributing to high achievement of learning outcomes. These included: discovery, collaborative, inquiry, problem solving, group discussion, explanation and experimentation techniques. Guiding of students to find the truth by independent thinking which is discovery learning was the highest rated in terms of usefulness, with 4.48 out of 5. Other than the explanation method which is a passive method, teachers are agreeing that active methods are what may contribute to the high achievement of learning outcomes.

Findings from the Qualitative Study

the researcher went ahead to also seek from the Key Informants the place of passive pedagogy in Biology teaching. Key informant X noted this:

> ***KI Q: How should teachers use passive pedagogy in teaching Biology? KIX***
>
> *Passive pedagogy like lecture method, question and answer is wrong transfer of concepts leading to failure. However, some explanation and demonstrations would be useful but should not take centre of the learning. But then even if it is question and answer they should be open ended leaving learners to think wide. Not those ones which the teacher has known answers already and learners only need to recall.*

Key informant X discouraged passive pedagogy because according to the informant, it is wrong transfer of concepts. He indicated that some methods like explanation and demonstration may be used but should not take the center of the learning process. Methods like question and answer should be open ended and not the kind of questions with known answers requiring the learner only to recall.

Key informant W, on the same concern about use of passive pedagogy, had this to say.

> ***KI Q: How should teachers use passive pedagogy in teaching Biology? KIW***
>
> *We discourage Passive pedagogy because it mainly promotes rote learning. However, for instance, for risky experiments or where apparatus are few, the teacher may use demonstration method. But even in the demonstration the teacher should involve the students as much as possible. For new concepts, a teacher may use explanation before engaging the learners to experiment and research.*

Key informant W, just like key informant X, discouraged passive pedagogy. The informant stated that some passive methods like demonstration may be used to illustrate risky experiments or in a situation where the apparatus are few. KIW also noted that a teacher may use explanation method to introduce new concepts before engaging the learners further.

These findings agree with Mbati et al (2020) who warns that teacher centered methods should be discouraged because they often give a pseudo impression that effective learning has taken place as implied. These findings show that the place of teacher centered methods which promote passive learning should be minimal. It is unfortunate however because the findings of the current study showed a contrary state whereby the teacher centered methods dominated the Biology lessons instead.

The researcher further sought to find out how teachers use passive pedagogical techniques from the learners through the FGDs. The learners had this to say:

> ***FGD Q: Describe how your teacher often takes you through a Biology lesson from the beginning to the end of the lesson:*** **School V**
>
> *R3*: *The teacher enters the classroom greets us then summarizes the last topic. After summarizing, he asks some questions. Then we continue with the new topic.*
>
> *R4*: *After the teacher introduces that topic he mostly dictates for us notes. at the end he asks us a few questions and ends the lesson.*

The learners in school V indicated that their teacher after greeting them summarizes the last topic. The teacher then asks a few questions from the last topic and introduces a new topic. The teacher dictates notes and towards the end asks a few questions.

The researcher then observed a lesson in school V and this is how it went:

Class observation: The place of passive pedagogy: School V

T: Good morning. In our last lesson we talked about the parasite Ascaris lumbricoides that is the roundworms.

T: What are the two hosts of Ascaris lumbricoides? Yes L1

L1: Man and pig.

T: What are the adaptive features of Ascaris lumbricoides?

L2: They are thin to fit in the intestines.

T: Yes. You can read more about the other adaptations. (pause).Today we will be talking about schistosoma (writes on the board, dictates notes on schistosoma mentioning the host of schistosoma, its adaptive features, how its spread and prevention measures. (The teacher writes the difficult words on the board.) Now answer the following questions. (writes questions on the board).Tomorrow we have a CAT. Make sure you revise. We have come to the end of our lesson.

Just as the learners in school V had indicated in the FGD, their teacher after greeting them reviewed the last lesson by doing a summary. The teacher asked a few questions from the last lesson and then introduced the new concept for the day's lesson. The teacher dictated notes on the new concept and gave questions at the end of the lesson.

From the learners FGD and the class observation in school V, the domineering teaching methods in school V included: lecture method and question and answer method of which both are passive methods. The teacher was dominant in the class discourse. The scenario in school V was similar to school U and T. This finding shows that the teacher centered methods were not just domineering in Biology lessons but were the only methods used in some schools across the teaching and learning of biology subject.

In school R and S, the teachers' teaching approaches were more or less similar but different from school Q, U, V and T. the lessons went as follows in school S and R according to student FGDs:

FGD Q: Describe how your teacher often takes you through a Biology lesson from the beginning to the end of the lesson

School S	*School R*
R2: When she comes to class, greets us, introduces new topic and explains.	*R1: She projects every lesson. we are able to see and then she explains it to us. After greeting us, she plays a video and explains it further. Now we are able to see and understand. You know when you are taught something and it is just theory it becomes monotonous. But when you are exposed to videos and what is happening, you are able to remember.*
R1: She give us notes then we read from KLB to add more.	*R3: She really teaches well. She explains the videos and gives us examples of real experiences in life.*
R3: After the topic we watch a video; we discuss the video	*R4: She teaches in a unique way unlike some teachers who like want to fix information in your head instead of making you to understand the concept. R5: Emphasizes on KCSE concepts such as writing the correct spelling.*
R1: She gives us assignment after the lesson	

In schools R and S, their teachers projected and played videos during the lesson. In school S, the teacher gave notes and learners read from the textbooks to add to any other notes. After explaining and giving notes, the teacher played a video and explained it to the learners. The teacher in school S then gave assignment to the learners. In school R, the teacher played

a video and after that explained the concepts in the video. She explained in a unique way and brought the realities to the learners' understanding rather than force learners to understand information. The learners in school R also appreciated that their teacher emphasized on KCSE question and correct spelling of biological terms. In both school S and R, the following methods came out: question and answer, demonstration through video and explanation. In both schools, there was an attempt to involve the learners through demonstrations and videos but still the teacher centered methods majored.

The researcher then observed a lesson in school R which went thus:

Class observation: The place of passive pedagogy: School R

T: watch the video on the screen... What are the adaptive characteristics of ascaris lumbricoides?

L: Thin to fit in the host's intestines

T: There are two more points remaining...

T: How can you prevent ascaris lumbricoides?

T: What are the two forms of snails that cause schistosoma? note the spelling. emphasized.

T: (teacher writes questions down) These are some past KCSE questions. attempt by the next lesson.

The teacher in school R begins by displaying a video after which she asks questions regarding the video and explains to the students. The teacher then gives past KCSE questions about the topic for assignment. The teacher was keen on the spelling of biological terms. The methods of teaching that dominated include: demonstration through the video, explanation and question and answer methods. The teacher dominated the talk throughout the lesson. The findings from the class observations concurred with the learners' FGD in school R. It seemed that their Biology teacher was keen on preparing learners for summative evaluation (KCSE) more than engaging in active pedagogical methods like problem solving, group discussions and inquiry-based learning. Perhaps these learner-centered methods were avoided as they would consume a lot of time at the expense of the time needed to prepare for examinations.

From the FGDs and class observations in schools R,S,T,U and V, passive methods of teaching were the center of teaching. No active methods of teaching were observed during the lessons or discussed in the FGDs. These findings are in sync with the findings from a study by (Superfine, Ko, & Goldman, 2022) who state that despite the knowledge of the usefulness of active methods in Biology teaching and learning, teacher centered methods of instruction, and especially the lecture, question and answer and explanation methods, dominate Biology classroom practices. This finding is defeatist because just as many researchers have reported that there is lack of practice of learner centered methods in Biology classrooms, the findings of this study similarly find the same scenario. What is even worrying is that teachers are aware that active methods may yield higher learning outcomes, but are somehow unable or unwilling to fully implement the preferred learner-centered methods.

In the qualitative approach, the researcher sought from the key informants how use of passive pedagogy influence achievement of learning outcomes. The key informants had this to say:

KIQ: how does use of passive pedagogy influence the achievement of learning outcomes? *KIX*

All those passive methods encourage rote learning and memorization. Those methods can only help learners achieve low order cognitive outcomes such as recall and at most understanding. This kind of learning also brings fatigue to learners causing them to get disinterested. You cannot expect achievement of skill outcomes from passive methods. If a teacher is very good in explaining and demonstration, learners may understand via explanation and may be develop observation skills through demonstrations and observing videos.

The key informant X stated that use of passive pedagogy encourages rote learning and memorization so learners can only achieve low order cognitive outcomes such as remembering. If the teacher is very good in explaining they may achieve understanding learning outcomes. If the teacher uses demonstrations and videos, the learners may achieve understanding

outcomes and also develop observation skills. For affective outcomes, the key informant said that passive pedagogy makes learners to be bored and may therefore develop a negative attitude to learning Biology. From these findings, learners may never achieve higher order learning outcome with passive methods being the center of learning in Biology classrooms.

On the same note the key informant W said the following on how passive pedagogy influenced achievement of learning outcomes:

> ***KIQ: how does use of passive pedagogy influence the achievement of learning outcomes?*** *KIW*
>
> *With passive pedagogy in Biology we can only achieve low order cognitive outcomes. Unfortunately, it is what is happening in most schools. It gives a wrong impression that learning has occurred. Efforts should be made to change this practice and move towards active pedagogy.*

The key informant W informed that the only learning outcomes that learners can achieve from passive pedagogy are low order cognitive outcomes. The informant indicated that it was unfortunate that passive pedagogy was the common practice which gave an impression that learning has happened while in the actual sense it hasn't and therefore advised a change towards active pedagogy. These findings agree with the findings of Mbati et al (2020) who note that passive instruction is designed to promote student rote learning; just requiring learners to remember concepts. These findings therefore indicate that for effective learning and achievement of higher order learning outcomes, passive methods of teaching should only play a subsidiary role to the learner centered methods of teaching.

5. CONCLUSION

The study concluded that passive pedagogy which was found to encourage rote learning and memorization giving a false impression that learning has taken place were dominant. This study therefore concludes that the use of pedagogical techniques common in practice in Nairobi County enhanced achievement of low order learning outcomes such as memory and understanding. Consequently, low interest in Biology subject.

6. RECOMMENDATIONS

Teacher training institutions such as universities should train teachers to utilize a variety of pedagogical techniques apart from passive pedagogy. Additionally, schools through principals should provide a wide range of material resources while teachers and learners should improvise other material resources to enhance pedagogy in favor of high achievement of Biology learning outcomes.

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