E-ISSN: 1115 - 8425 P-ISSN: 3027-012X
MPRI-JAEE | INTERNATIONAL JOURNAL OF ASSESSMENT & EVALUATION IN EDU.
VOL. 09 NO. 8 – JULY. 2025

EFFECT OF THE INTERNET-TOOLS ON ACADEMIC PERFORMANCE OF BIOLOGY STUDENTS IN FEDERAL COLLEGE OF EDUCATION ZARIA, KADUNA STATE

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DOI: https://doi.org/10.70382/mejaee.v9i8.067

Abstract

This study examined the effect of internet-based tools on the academic performance of biology students at the Federal College of Education, Zaria, Kaduna State. Using a quasi-experimental design, 100 NCE II students were divided into control and experimental groups. The experimental group was taught using internet tools, while the control group received traditional lectures. Results showed significant improvement in the performance of students exposed to internet tools, with males outperforming females. T-test analysis confirmed significant differences in performance by teaching method and gender. The study recommends ICT training for teachers and increased investment in digital infrastructure to enhance biology education.

Keywords: Internet Tool and Academic Performance Biology students, Quasi-experimental design, and ICT training.

Introduction

Education is an important aspect of scientific development. When citizens of a country are educated, it is key to social, economic, and political stability. It is an instrument for societal development and the advancement of human knowledge, fostering harmonious relationships and interactions with the environment. The introduction of Western education in Nigeria in the early 19th century brought with it a variety of teaching methods and instructional materials. Instructional materials were meant to assist teachers in presenting lessons in a manner that would be well understood by students. Indeed, part of a teacher's professional responsibility is to prepare lessons

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properly, with a major component being the selection of appropriate instructional materials to ensure effective lesson delivery. Some of the initial teaching aids used by teachers included maps, charts, flip charts, and physical objects. Over time, with the development of technology, slides, transparencies, audio materials, and videos were introduced. Mhlolo (2017) states that this enhanced the ability of teachers to teach more effectively, enabling students to learn in more concrete ways.

Constructivism is the framework of this study, based on the premise that reflecting on what we see and touch gives us the experience and knowledge of the unknown, which helps us create, construct, and modify, thereby giving us a better understanding of how and what we want to be in life. This framework is linked to the present study because the integration of internet-based learning tools in teaching Biology aligns with the constructivist idea. The internet is a cognitive stimulant, and constructivists believe that meaningful learning is a cognitive process involving brain stimulation. The cognitive process includes memorization, understanding, remembering, and analyzing what is learned, leading to conclusions that help the individual gain a sense of living in relation to what was learned. Internet-based learning tools enhance such cognitive learning, contribute to the achievement of mastery goals, and improve the level of competence.

Education ensures the acquisition of knowledge and skills that enable individuals to increase their productivity and improve their quality of life, as demonstrated by biology experts (Dangana et al., 2021). Biology as a field of study involves teachings that are directed toward deductive reasoning and inductive reasoning. Deductive reasoning involves teaching and learning from general ideas to specific details, while inductive reasoning involves teaching and learning from specific observations to broader generalizations and theories (Trochim, 2016). Deductive analysis and inductive reasoning are essential in the course development of Biology as one major science subject (Usman, 2021). Therefore, the teaching of Biology entails the use of the Internet to expand both deductive and inductive reasoning, where knowledge of biological behavior and phenomena is critically studied for life sustainability.

Many efforts have been made to prioritize Information and Communication Technology (ICT) in Nigeria's education system. The use of the internet in teaching and learning is seen as a means to improve accessibility, efficiency, and the quality of learning by facilitating access to resources, services, remote exchanges, and collaboration. The internet can be conceived as a rich, multi-layered, and ever-changing text for information dissemination and a medium for collaborative interaction between individuals and computers, regardless of geographical limitations (Usman, 2024). The internet today is a worldwide entity whose nature cannot be easily or simply defined. To many, the internet is a large computer network linking millions of smaller computers at various sites across different countries, belonging to thousands of businesses, governments, research institutions,

educational organizations, and others. To internet users, it is a global community with an active life.

The introduction of the computer opened up opportunities for the Biology Education sector. Most schools in Nigeria today use computers as learning tools, and the World Wide Web has created a wider platform for the teaching and learning of Biology in secondary schools. Today, several instructional materials and learning tools have made classrooms almost borderless. Yusuf (2019) states that the primary purposes of curriculum implementation are to achieve the objectives of instruction, retention, and the transfer of knowledge. Evoh (2017) mentions that internet-based tools serve as instructional mediums that allow alternative approaches to curriculum implementation. With internet-based learning, teachers no longer need to worry about whether an instructional material is appropriate for the lesson being taught, its relevance, the simplification of concepts, or the accuracy of teaching aids, because the materials are seen as real-life, accurate representations.

Recent technology has enabled several new methods of transmitting information. Internet-based methods can be classified into two broad categories: (1) computer communication and conferencing and (2) information access, retrieval, and use. Computer communication and conferencing methods include email, mailing lists, newsgroups, interactive messaging or "chat" sessions, and video conferencing. Information available on the Internet can take various forms, such as text, data, graphs, and pictures.

Portrayal (2020) states that professional teacher development opportunities are more easily provided when the pedagogy of learning and teaching, along with the digital representations of relevant Biology topics, are available with internet tools. Teachers can then see the immediate pedagogic benefit to students' learning, even among the weakest learners. On the other hand, interactive technology encourages active learning, so teaching should no longer center around transferring content from teacher to student.

The development and expansion of modern technology, which involves the use of internet-based learning tools, have become part of teaching and learning in Nigerian Secondary Schools, Colleges of Education, Polytechnics, and Universities. However, despite these advancements, not every school utilizes these tools in their teaching. To promote the use of recent technology, the Federal Government of Nigeria has made several efforts to ensure that all Colleges of Education are ICT-compliant by providing computers and installing internet facilities across the state. Internet-based tools provide educational platforms that offer academic information via the World Wide Web, providing free lessons, information, teaching and learning strategies, and promoting research activities for both teachers and students. Some of these internet-based tools include

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Dassault, Centegage, Khan Academy, Encarta Microsoft, Wikipedia, ERASYAPP, Slide Rule, and Google Scholar.

Computer literacy programs and seminars are organized for secondary school teachers to complement the efforts made by both government and non-governmental organizations to ensure full compliance. However, despite these opportunities, the effectiveness of internet-based learning tools in teaching Biology, especially in Kaduna State, has not yet been established and documented. Despite the expansion and efforts made by the Kaduna State Government and the Federal Government, not every teacher or school has adopted the use of internet-based learning tools in the teaching and learning of Biology.

Statement of the Problems

Biology has been taught in schools for many years, yet teachers continue to struggle with how to effectively help students fully understand the subject. Many students perceive Biology as overly broad and difficult to grasp, while the textbooks are often too complex, contributing to inconsistent results in exams like NECO and WAEC. The growing call for the integration of internet-based learning tools in Biology teaching at the Federal College of Education, Zaria, Kaduna State, seeks to improve the efficiency and effectiveness of the Biology curriculum. The successful implementation of these tools requires not only the readiness of the school but also the proficiency of its teachers. However, even in developing countries like Nigeria, internet-based learning faces significant challenges. These include the lack of adequate and functional computers, the high cost of internet installation and maintenance, and unreliable power supply. Despite these challenges, the Federal College of Education, Zaria, has begun utilizing some internet-based learning tools in its biology teaching. This study, therefore, aims to investigate the impact of these internet tools on the academic performance of Biology students at the Federal College of Education, Zaria, Kaduna State.

Objectives of the Study

The objectives of this study are to:

1. determine the effect of internet-tools on academic performance of biology students in Federal College of Education Zaria, Kaduna State.
2. find out the impact of Internet – Tools on Academic Performance of Federal College of Education Zaria Students taught Biology Internet-Based Learning Tools with respect to gender difference in Kaduna State, Nigeria.

Research Questions

In order to provide the research with sense of direction or focus, the following research questions are put forward:

1. What is the effect of the use of Internet – Tools on the Academic Performance of Federal College of Education Zaria students in Biology in Kaduna State?
2. Are there any gender differences in the Academic Performance of students taught Biology using Internet – Tools?

Hypotheses

The following Hypotheses are postulated in accordance with research question:

Ho_1: There is no significant difference between Academic Performances of students taught Biology with traditional method, and those taught with Internet – Tools.

Ho_2: There is no significant difference between Academic Performances of boys and girls taught Biology with the Internet – Tools.

METHODOLOGY

This study adopted a quasi-experimental research design, specifically the Pretest-Posttest design. Two groups were involved: the experimental group and the control group. Both groups were pretested to assess their prior knowledge of the topic, and post-tests were administered after the treatment to evaluate the effect of the intervention. The study population consisted of all NCE II Biology students for the 2021/2022 academic session at the Federal College of Education, Zaria. The NCE II Biology students were categorized into three combinations: Biology-Computer, Biology-Integrated Science, and Biology-Mathematics, with a total population of 1,006 students (350 males and 656 females). The sample size for the study was 100 students, selected using a randomization table. The instrument used for data collection was the Biology Achievement Test (BAT), which was adapted from the 2022 and 2023 WAEC past question papers on the topic of respiration. The test consisted of 20 items, and the reliability coefficient of the instrument was calculated as r = 0.85. The participants were assigned to two groups: the experimental group, which was taught respiration using computer-based tools, and the control group, which received traditional lecture-based instruction on the same topic. The teaching process lasted for three weeks, with each group meeting for two hours per week, resulting in a total of six hours per group and 12 cumulative hours for both groups. After the treatment, a post-test was administered. Students were given one hour to complete the test, after which the completed tests were collected, marked, and coded. Descriptive statistics, including means, mean gain, and standard deviation, were used to address the research questions. A t-test was used to compare the results and assess the homogeneity of the data collected, as well as the effectiveness of the treatment on the experimental and control groups.

Results and Discussion

Research Questions One: What is the effect of the use of Internet-Tools on the Academic Performance of Federal College of Education Zaria students in Biology in Kaduna State?

The determination of the effectiveness of Internet-Based Learning Tools on the Academic Performance of Federal College of Education Zaria Students was evaluated by comparing the pre-test and post-test scores of the two groups (experimental and control). The computed scores obtained are summarized in Table 1.

Table 1: Mean Academic Performance of the two groups before and after the experiment.

Status	Stages	N	Mean	Std. Deviation	Std. Error
Control	Pre-test	50	45.13	4.882	0.690
	Post-test	50	65.42	5.313	0.751
Experimental	Pre-test	50	57.89	19.559	2.766
	Post-test	50	73.83	15.942	2.255

The mean scores in the table revealed that Academic Performances of both groups improved after the experiment. But among the experimental group that was exposed to the use of the Internet-Based Learning Tools, the improvement was relatively higher. The scores before the experiment were 45.13±4.882 and 57.89±19.559 for the control and experimental groups but after the experiment the Academic Performances rose to 65.42±5.313 and 73.83±15.942 for the two groups respectively. From these observations, the use of the Internet -Tools could be said to be effective for the teaching of Biology among the secondary school students. The actual significance of this observed variability in the efficacy of the two methods is tested in the related hypothesis.

Research Questions two: Are there any gender differences in the Academic Performance of students taught Biology using Internet-Tools in Kaduna State?

To find out the impact of Internet-Tools on Academic Performance of the Federal College of Education Zaria Students taught Biology Internet-Based Learning Tools with respect to gender, the Mean Academic Performance for the male and female students were computed and compared along with that obtained by the group in the pretest scores. Table 2 present the summary of the Academic Performances.

Table 2: Variability in Academic Performances of male and female students taught Biology with Internet-Based Learning Tools before and after the experiment.

Stages of the experiment	Gender	N	Mean	Std. Deviation.	Std. Error
Pre	Male	38	76.11	9.073	2.619
	Female	12	52.13	18.453	2.993

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Post	Male	38	88.97	7.841	2.264
	Female	12	69.05	14.849	2.409

From the observed mean scores in the table, there was a notable variability in the Academic Performances of the male and female students before and after the experiment. Both groups could be said to have improved in Academic Performances after the experiment. In the table the Academic Performances of the male improved from 76.11±9.073 before the exposition to the use of the Internet-Based Learning Too to 88.97±7.841 after the experiment. The Female on the other hand increased their Academic Performance from 52.13±18.453 to 69.05±14.849 after the experiment. This is a clear indication that the experiment generally improved the Academic Performances of the male and female students exposed to the use of the Biology Internet-Based Learning Tools or teaching the subject. From the mean score, the male could be said to have a higher Academic Performance than their female counterparts in the group. The observed variability in the means is subjected to test of significance in the related hypothesis.

HO1: There is no significant difference between Academic Performances of students taught Biology with traditional method and Internet based learning Tools among Federal College of Education Zaria students in Kaduna State.

This hypothesis tested the observed variability in the mean scores of students in the control (taught with conventional method) and experimental group (taught same subject with the Internet based learning tools) after the experiment (Post-test). The test was carried out with the two-sample t-test procedure because of the two groups involved. A summary of the result is presented in Table 3.

Table 3: taught with Internet Two sample t-test on Academic Performance in Biology between students of control group and those in the experimental based learning tools.

Status	N	Mean	Std. Deviation	Std. Error	t-value	DF	P-value
Control	50	65.42	5.313	.751	3.539	98	.001
Experimental	50	73.83	15.942	2.255			

(t-critical at 98 DF = 1.98 at 0.05 level of significance)

The test as indicated in the table revealed that the students differ significantly in their Academic Performance by the method used in teaching them the subject (P > 0.05). The t-value observed in the test at the 98 degrees of freedom (DF) is higher than the critical value of 1.98 and the observed probability level of significance is 0.001. With these

observations, there is enough evidence to reject the null hypothesis. The null hypothesis which stated that there is no significant difference between Academic Performances of students taught Biology with traditional method and Internet based learning Tools among Federal College of Education Zaria students in Kaduna State is therefore rejected. In other words, the use of Internet based learning tools is more effective for teaching biology than the conventional method of teaching the subject at the Federal College of Education Zaria in Kaduna State.

HO2: There is no significant difference between Academic Performances of boys and girls taught Biology with the Internet-Tools among Federal College of Education Zaria students in Kaduna State.

This hypothesis with the post-test Academic Performance students in the experimental group who were exposed to the use of Internet based learning tools for teaching Biology applied in the experiment. The hypothesis was tested with the two-sample t-test procedure. The result of the test is summarized in Table 4.

Table 4.4: Two sample t-test on Academic Performance of male and female students taught biology with the Internet Based Learning tools

Gender	N	Mean	Std. Deviation	Std. Error	t-value	DF	P-value
Male	12	88.97	7.841	2.264	4.434	48	.000
Female	38	69.05	14.849	2.409			

(t-critical at 48 DF = 2.02 at 0.05 level of significance)

The test revealed that male and female students differ significantly in their Academic Performances after their exposure to the use of the Internet based learning tools in teaching the subject ($P < 0.05$). The observed t-value in the test is 4.343 obtained at the 48 degrees of freedom compared with the 2.02 that stands for the critical value at the same degree of freedom. The observed level of significance was 0.000. By this observation, the null hypothesis which stated that there is no significant difference between Academic Performances of boys and girls taught Biology with the Internet-Tools among Federal College of Education Zaria students in Kaduna State is therefore rejected.

Discussion of the Result

This study evaluated effectiveness of Internet-Tools for teaching biology in Federal College of Education Zaria of Kaduna State by comparing students' Academic Performances with that of the conventional method. Two hypotheses were tested in line with the objectives and research questions of the study. In hypothesis I, the Academic Performances of the students who were taught biology with the Internet-Tools were

compared with those in the control group who were taught the same subject with the conventional lecture method. The test revealed that the students who were taught with the Internet – Tools performed significantly better than their counterparts who were taught with the conventional lecture method. The null hypothesis was therefore rejected. The finding here is consistent with the report of Mhlolo (2017), who stated that the use of ICT enhances the ability of teachers to teach more effectively and allow the students to learn in more concrete ways. The finding is in line with the report of Mikre (2017) cited in Tinio (2019), where it was stated that ICTs are making dynamic changes in society and that its usage is influencing all aspects of life. Such influences stated in the report are felt more and more at schools because ICTs provide both students and teachers with more opportunities in adapting learning and teaching to individual needs.

Hypothesis II tested the significance of the variability obtained in the Academic Performances of male and female students taught biology with the use of the Internet-Tools. The two sample t-test procedure used for the test revealed that the male students differed significantly in their Academic Performances when compared with the female counterparts in the group. The null hypothesis was therefore rejected.

Conclusions

Based on the findings from the result obtained from the experimental data, the researcher concluded that the use of Internet based learning tools is significant effective for improving teaching and learning of Biology in Federal College of Education Zaria of Kaduna state especially for improving students' Academic Performances.

Recommendations

Based on the conclusion drawn on this study the following recommendations were put forward:

1. Greater emphasis should be placed on training teachers to use computers effectively. At the least courses on basic word processing skills and computer vocabulary should be offered. These simple lessons would ease the fears of many teachers.
2. Federal College of Education Zaria in Kaduna State should develop a long-term plan to budget more money for technology, in recognition of its potential benefits especially the public schools in order to ensure that all the Internet facilities and its accessories are easily replaced before Governments Intervention as contingencies.
3. Schools in Kaduna State that located in the villages with power supply problems, internet reception problems, big generators as alternative power supply, or other means of power supply should be provided to the schools. Soft wares should be provided to in excess to provide the needed information from the internet.

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