



Multimedia Instructional Strategy and Secondary School Students' Academic Achievement in Biology

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Abstract The study investigated the effects of multimedia instructional strategy on secondary school students' academic achievement in biology. Three hypotheses tested at 0.05 level of significance guided the study. The design of the study was quasi-experimental with 286 Senior Secondary students selected purposively from two senior secondary schools in Adamawa state, Nigeria. Instrument used for data collection was an achievement test tagged Biology Achievement Test (BAT) adapted from WAEC tests from 2005-2015. The instrument was content validated by three experts and Cronbach alpha Formula was used for testing its reliability. The reliability coefficient of 0.76 was obtained. The treatment lasted for six weeks and data were analysed using Analysis of Covariance (ANCOVA). The result of the study revealed that, students taught biology with multimedia instructional strategy performed better than those taught with lecture method. Furthermore, male students outperformed their female counterparts. It was recommended that, Federal and state ministries of education should make provision of computers and projectors in secondary schools. State governments and school authorities should organize training and workshops for biology teachers on the use of multimedia instructional packages. Curriculum planners and curriculum development bodies in Nigeria like NERDC should design curriculum and make policies that will incorporate the use of multimedia strategy in teaching and learning biology at Secondary School level.

Keywords Multimedia, Students, Achievement, Biology, Gender

Introduction

Countries all over the world, especially the developing ones like Nigeria, are striving hard to develop technologically and scientifically, since the world is turning scientific and all proper functioning of lives depend greatly on science. It is in realization of this fact that the federal government of Nigeria in her National Policy on Education stated that the goals of science education in Nigeria shall be: "to produce scientist for national development; and to provide knowledge and understanding of the complexity of the physical world, the forms and the conduct of life" [1].

Biology as a branch of science and a prerequisite subject for many fields of learning contributes immensely to the technological growth of the nation [2]. Among others, the objectives of teaching biology at secondary school level as stated by the National Policy on Education [1] involves ability of the learners' to develop awareness of the environment, to have meaningful and relevant knowledge in biology necessary for successful living in a scientific and technological world and to make room for technological advancement. Biology is introduced to students at senior secondary school level as a preparatory ground for human development, where career abilities are groomed, and potentials and talents discovered and energized [1]. Biology curriculum was designed to provide students with the knowledge of the key concepts in biology, to promote their knowledge of the world around them, as well as develop broadly applicable skills such as



problem solving, communication, critical thinking and objective reasoning ability to prepare the students for work place and self-sustainability in the world economy [1].

Despite the importance and popularity of biology among Nigerian students, performance at senior secondary school level has been poor [2]. Studies have shown a high enrolment and low performance trend of students in internal and external biology examinations [3-5]. This poor performance in biology has been linked to a number of contributing factors among which are poor methods of instruction [6], wide area coverage of the subject [7], insufficient instructional materials [8-9]. Also some concepts are said to be difficult for teachers to teach as well as for students to learn [10]. Ibe [11] noted that the observed deterioration in students' performance in biology may have been contributed to by the inability of biology teachers in incorporate multimedia materials in teaching the subject. Conventional strategies with no multimedia incorporation adopted by teachers at senior secondary school level in Nigeria have been identified as one of the major factors contributing to poor performance of students in biology (Kareem, 2003; Umar, 2011; Ahmed & Abimbola, 2011). Researchers such as Atadoga and Lakpini (2013) found that the persistent low academic achievement in biology is attributed to teacher instructional strategies among others. Instructional strategies are decisions about organising people, materials and ideas to provide learning [12]. They are viewed as both the teaching methods and the materials used in the process of teaching. Instructional strategies are techniques teachers use to help students become independent, strategic learners. The instructional strategies used in teaching biology at the senior secondary school level do not seem to impart the best performance in the subject. Usman [13] emphasized that the present mode of teaching biology in secondary schools whereby teachers' adopt only the lecture method without multimedia incorporation does not provide for sequence of learning experiences.

The information age has brought about meaningful change in teaching and learning especially in science including biology, researchers felt the need for an instructional system supported by technology for a meaningful learning. Available multimedia packages could be incorporated in teaching biology to facilitate effective teaching and learning and to improve students' performance in the subject. Media refers to the channel used to present instruction, such as a book-based medium, video-based medium or a computer-based medium. Mayer [14] defines multimedia as the presentation of the learning material using both pictorial form and verbal form such as spoken and printed text. Sharma [6] refers multimedia as computer-mediated information that is presented concurrently in more than one medium. It is the integration of multiple forms of media including text, graphics, audio, video, animation at the same time to deliver lesson [15-17]. Multimedia combines text, audio, visual, graphic, and dynamic elements, such as animation and video. This presents learners and teachers with unique learning resources that can be used in a wide variety of ways to stimulate various forms of learning. Through multimedia, teachers motivate students to learn by using their different senses and through audio-visual presentation of information, the students obtain clearer and more complete knowledge of the outside world and themselves. The most significant feature of the multiple forms of media is that they allow for the presentation of knowledge in numerous ways. Thus students can learn about abstract principles through text and can see the application of those principles through an animation or a video example. This presents the opportunity for deeper levels of understanding, particularly if the presentational qualities are fully and deliberately exploited to achieve this purpose. According to Mayer [14] multimedia learning occurs when people build mental representation from words (such as spoken text or printed text) and pictures (such as illustrations, photos, animation or video). As been seen from this definition multimedia learning refers to the learner's construction of knowledge from words and pictures. The ability to code a stimulus in two or more different ways increases the chance of remembering that item compared to if the stimulus was only coded one way. Since these media can now be integrated using a computer, there has been a virtual explosion of computer based multimedia instructional applications.

Multimedia instruction can best be presented with the aid of computer known as computer-based multimedia instruction, and in such a case the whole learning material is delivered via computer with the learning content (text, picture, graphic, audio, video, animation, etc) is stored in CD-ROM or computer file [18-19]. As presentation tools, computer can combine text, graphics, audio, video, and virtual environments to communicate complex ideas, concepts and scenarios [20]. Projectors are generally use in conjunction with a laptop or desktop computer, to project the computer screen image on to a screen or wall. They are extremely useful and effective



teaching tools that facilitate a range of learning opportunities when connected to a desktop computer in whole class teaching scenarios. Information prepared on a computer could be better projected for larger audience using a Liquid Crystal Display (LCD) projector. PowerPoint presentation could be used in the classroom for supporting student learning by combining computer and projector to display slides for illustrating a lesson. Slides may contain text, graphics, sound, movies, animation and other objects which may be arranged freely [21]. PowerPoint gives the user the opportunity to incorporate visual and auditory aspects to a presentation. It can be regarded as a good instructional medium and a key for facilitating an effective teaching-learning process. In biology, computer helps students visualize objects that are difficult or impossible to view. For example, computers can be used to display human anatomy, internal structure of human and animal cells. Software are already developed which shows actions of viruses and bacteria which if teacher were to teach such; apart from the danger poses to both teacher's and student's health these micro-organisms cannot be well learnt without seen them in action. Law is already promulgated in some part of the world against killing animal for experimental purpose instead models and computer animation could be used by students for experiment in life science. There are so many species of living organisms that cannot be found here in Nigeria, and yet must be learnt by students; with the aid of computer all these are made available to students as if they are in real forms.

Gender disparity permeates any aspect of human endeavour including students' performance, and studies involving science and gender factors have been unresolved. Gender issues have been documented to affect achievement [22-23] Gender gap in science education is an impediment to advancement in science and technology [22]. Omoniyi [24], Ewumi [25], Opara [26], Eriba and Sesugh [27] reported that gender has significant influence on achievement while Olukemi [28], Mohammed [29], Danmole and Adeoye [30], Afuwape [31], reported otherwise. This study determined the effects of multimedia incorporated instruction, the study also included gender as a moderating variable to determine their effects on secondary school students' academic achievement in biology.

Purpose of the Study

The purpose of the study was to determine the effect of teaching multimedia instruction on senior secondary schools students' achievement in Biology. Specifically the study determined:-

1. the effects multimedia instruction and conventional lecture method on of senior secondary school students' academic achievement in biology
2. the effects gender on senior secondary school students' academic achievement in biology
3. the Interaction effects of treatments and gender on students' academic achievement in biology

Hypotheses

The following hypotheses were formulated and tested at 0.05 levels of significance.

Ho₁: There is no significant effect of treatments on students' academic achievement in biology

Ho₂: There are no significant effects of gender on students' academic achievement in biology

Ho₃: There is no significant interaction effect of treatment and gender on students' academic achievement in biology.

Research Methodology

The study adopted quasi-experimental pre-test, post-test, non-equivalent control group design. The population of the study consisted of all Senior Secondary Schools students (SSS 2) offering Biology in Yola education zone, Adamawa State. The justification for using SSS 2 students in this study is because the targets groups were already familiar with the subject, unlike SS 1 who were freshly introduced to the subject or SS 3 students who are facing their final year examination. A sample of 286 SS II biology students was used for the study. Purposive sampling technique was used to select two co-educational secondary schools. The criteria for selecting a school are; the school must be a co-educational senior secondary school, the school must have laboratory the school must have a biology teacher with at least bachelor degree in biology and education, the biology teacher must have at least 5 years teaching experience. Simple random sampling technique was then used to select four intact classes, two from each school. The classes were assigned randomly to experimental



and control groups. Two classes were assigned to experimental group while the other two were assigned to control group. The instrument used for the study was tagged “Biology Achievement Test (BAT)” consisted of 50 multiple choice objective tests adopted from West African examination past question papers from 2005-2015. The items together with the contents (digestive system, transport system and excretory system) were spread in line with the cognitive domain of Blooms taxonomy of educational objectives. To ensure content validity the instrument were subjected to thorough scrutiny by three experts from the department of science education, Modibbo Adama University of technology, Yola. The instrument was subjected to reliability test in one secondary school which is not part of the study sample, but have similar educational background, offering biology as a subject. 0.76 was obtained when subjected to Cronbach alpha reliability test. The data was collected using Biology Achievement Test (BAT). One research assistant was selected from each school and they were given one week induction training on the use of multimedia incorporated instruction. Lesson plans and materials were also given to them. In the experimental group, the materials were prepared on a slides which was projected using projectors in conjunction with a laptop computer, the slides contains images and animation pictures of digestive system, transport system and excretory system while the control group was taught using conventional (lecture) method without any form of multimedia. Before the commencement of the treatment, a pre-test was administered to both the experimental and control groups to ascertain their entry behaviour. This was followed by the treatment which lasted for four weeks and then post-test was administered the end of the treatment to both the experimental and control groups using the same instrument BAT but was reshuffled. The collected data was analysed using descriptive statistics for the research question and Analysis of Covariance (ANCOVA) for the hypotheses tested at 0.05 level of significance. The decision rule for testing the hypotheses was based on comparing the p-value with 0.05 level of significance, if $p < 0.05$ the null hypothesis is rejected but if $p > 0.05$ the null hypothesis is not rejected.

Results and Discussion

Ho₁: There is no significant effect of treatments on students’ academic achievement in biology.

Table 1: ANCOVA summary of students’ academic Achievement in biology

Source	df	F	Sig.	Partial eta Squared
Pretest	1	47.18	0.000	0.144
Teaching methods	1	534.76	0.000	0.656
Gender	1	9.05	0.003	0.031
Gender*Treatment	1	1.29	0.257	0.005
Error	281			
Corrected total	285			

The result of the analysis in table 2 shows that, the computed $F = 534.76$ ($df 1, 285$) $P = 0.000$. Since the computed p-value (0.000) is less than 0.05 level of significance, the null hypothesis is rejected. This implies that, there is significant effect of treatment on students’ academic achievement in biology in favour of experimental group. The partial eta squared value of 0.66 indicated that, 66% of the difference in score is accounted by the multimedia instruction group according to Cohen (1988) guideline. This shows that the multimedia instructional strategy is effective in enhancing students’ achievement in biology.

Ho₂: There is no significant effects of gender on students’ academic achievement in biology.

The result shows that, $F = 9.05$ ($df 1, 285$), $P = 0.003$. The computed p-value of 0.003 is less than 0.05 level of significance, therefore, the null hypothesis is rejected. This implies that there is significant effect of gender on students’ academic achievement in biology in favour of males.

Ho₃: There is no significant interaction effect of treatment and gender on students’ academic achievement in biology.

The computed $F = 1.29$, ($df 1, 258$) $P = 0.257$. The computed p-value (0.257) is greater than 0.05 level of significance. Based on the results, the null hypothesis is not rejected which implies that there is no significant interaction effect of treatment and gender on students’ achievement in biology.



Findings of the study

1. There is significant difference in the mean achievement scores of students taught biology with multimedia instructional strategy and those taught with lecture method. Students taught biology using multimedia instructional strategy performed better than those taught using lecture method.
2. There is significant difference in the academic achievement of students based on gender when taught biology using multimedia instructional strategy. Male students performed better than their female counterparts.
3. There is no significant interaction effect of treatment and gender on students' academic achievement

Discussion of Results

The result of the study shows that there is a significant difference in the academic achievement of the students in experimental and control group. The significant difference indicates that multimedia strategy enhances students' performance much more than the traditional lecture method. The significant difference could be as a result of the ability of the multimedia to provide both audio-visual presentation of the material. Multimedia instruction exposed students to a variety of graphics, pictures and animation pictures, which drew students' attention more and involved more of their sense organs. The findings of the study is in line with the findings of Adegoke [32]. The results of this study contradict the findings of Cetin [33] who found that the group taught with traditional teaching method performs better than the treatment group taught using CAI and Adeyemi [34] who reported no significant difference between students taught with computer aided instruction and traditional method. Vernadakis, Zetou, Avgerinos, Giannousi and Kioumourtzoglou [35] also reported no significant differences in a comparison of testing results between traditional instruction (TI) and multimedia computer assisted instruction (MCAI) methods. They reported equal improvement in learning with TI and MCAI method.

The results of the analyses also indicated significant difference in the performance of male and female students taught biology using multimedia instructional strategy. The findings agree with that of Usman [36], Eriba and Sesugh [37], Opara [26], Aggarwal and Dutt [39] which in their various studies found gender differences in favour of male students. In a study by Eriba and Sesugh [37] on gender differences in achievement found that boys outperformed girls in science and mathematics achievement. In support of this, Usman [36] findings revealed that senior secondary male biology students perform well in any rigorous work than their female counterpart.

The study disagree with the findings of Satyaprakasha and Sudhanshu [39], Abidoye [40], Gambari, Falode, & Adegbenro, [41], Nwoke, [42] which reported that gender had no influence on academic achievement of students. The findings revealed that gender has no significant effect on the academic achievement of students taught using multimedia-based instructional package.

Higher performance of male students in Multimedia group can be attributed to factors like differences of males and females attitude towards computer technology, their learning styles etc. Males generally have a more positive attitude toward computers, the primary medium for digital images, than females [43]. Hoska [44] who found that female run away from computer technology classroom and perform poorly in science and technology learning task. Males are generally more sensitive to visual stimuli (i.e., graphics, images, charts, etc.) than females [45]. Males were found to be significantly more inclined to replace traditional teaching activities with ICT resources [46]. Male students prefer multimodal instruction whereas most female students prefer single mode instruction [47]. This could be also due to the fact that some female students believe that science is too difficult and not important for their future.

Conclusion

Based on the findings of this study, it can be concluded that multimedia instruction improved senior secondary schools students' academic achievement in biology Male students performed better their female counterpart.

Recommendations

Based on the findings of the study, the following recommendations were made:



1. Federal and state ministries of education should make provision of computers and projectors in secondary schools.
2. State governments and school authorities should organize training and workshops for biology teachers on the use of multimedia instructional packages.
3. Curriculum planners and curriculum development bodies in Nigeria like NERDC should design curriculum and make policies that will incorporate the use of multimedia strategy in teaching and learning biology at Secondary School level.

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