Effects of Multimedia Integrated Instruction and Demonstration Method on Secondary School Students Achievement in Ecological Concepts in Udi Education Zone

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Abstract

The study focused on the effects of multimedia integrated instruction and demonstration method of teaching on secondary school students' achievement in ecological concepts. Two research questions guided the study and three hypotheses were tested at 0.05 level of significance. The study adopted quasi – experimental design specifically, pre-test post-test design. The population of the study consisted of 3,054 secondary school year two (SS2) students offering biology in Udi Education Zone of Enugu State. The sample size for the study was 105 SS2 Biology students. The instrument used for data collection was Biology Achievement Test (BAT) validated by experts in Science Education and one experienced Secondary School Biology teacher. BAT reliability was established using Kuder-Richardson formula 20 which yielded reliability coefficient of 0.98. Data relating to research questions were analysed using mean and standard deviation while the hypotheses were analysed using analysis of covariance (ANCOVA). The findings of the study revealed that multimedia integrated instruction significantly improved students' achievement in ecological concepts and there was no significant difference between male and female students taught with the same method of instruction. Based on this, recommendations were made that seminars, workshops and orientation exercises should be organized by the government and educational agencies to familiarize teachers of biology with the approach of multimedia integrated instruction.

Keywords: Multimedia, demonstration, achievement, ecology

Introduction

Biology is a natural science that deals with the living world, how it functions and what these functions are, how it develops, how living things came into existence, and how they react to one another and with their environment. It is a prerequisite subject for many fields of learning (medicine, pharmacy, nursing, agriculture, forestry, biotechnology and nanotechnology) that contributes immensely to the technological growth of the nation. This includes

Biology is seen as one of the core subjects in Nigerian secondary school curriculum. Because of its importance, students enrol for biology in the senior secondary school certificate examination (SSCE) more than Physics and Chemistry. 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 (Federal Republic of Nigeria, 2013). The quality and quantity of science education including biology received by secondary school students are geared toward developing future scientists, technologists, engineers, and related professionals (Kareem, 2003). In spite of the importance and popularity of Biology among Nigerian students, achievement at senior secondary school level has been poor.

The WAEC Chief Examiner's Reports show that the percentage number of students who passed at a credit level and above has continue to fluctuate and have not increased as expected. Conventional teaching methods adopted by the few biology 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 (Ahmed & Abimbola, 2011; Kareem, 2003; Umar, 2011). The conventional teaching method is classroom-based and consists of lectures and direct instructions conducted by the teacher. These teacher-centred methods emphasize learning through the teachers' guidance at all times. Students are expected to listen to lectures and learn from them.

The teacher often talk to the students instead of encouraging them to interact, ask questions, or make them understand the lesson thoroughly. Most classes involve rote learning, where students depend on memorization without having a complete understanding of the subject. Just passing the tests, consisting of descriptions, matching, and other forms of indicators, is all that matters to complete the curriculum (Adegoke, 2011; Umar, 2011). The persistent use of this method makes students passive rather than active learners. It does not

promote insightful learning and long–term retention of some abstract concepts in biology like ecological concepts (Ahmed & Abimbola, 2011). Biology teachers usually adopt lecture method in teaching in order to cover the syllabus within the stipulated time and this does not give room for proper understanding of the subject. The WAEC Chief Examiners report (2016) noted that the rush over the topics to cover the scope could be responsible for students' poor performance in Biology. From research evidence, educators see the pressing need to reconsider the techniques and methods of instruction at senior secondary school level. In order to arrest students' attention, interest, curiosity, promote their long-lasting retention, future involvement and ensure outstanding performances, the use of activity stimulating and student-centred approach need to be embraced. One of the promising approaches, according to Adegoke (2010), involves multimedia presentations supported in visual and verbal formats supplemented with pictures, animations, texts, and narration.

This technology provides a learning environment that is self-paced, learner-controlled and individualized. The concept of ecology in Biology draws the attention of the researcher as a topic that needs eclectic instructional design approach for proper accommodation and assimilation of knowledge such as multimedia instructional strategy. Ecological concepts are one of the difficult concepts in Biology. Ecology is the study of interaction among organisms and their environment. WAEC Chief Examiners (2015) reported the inability of students to answer questions on ecology. Thus, the researcher wants to find out the relative effectiveness of multimedia integrated instruction as compared demonstration method of teaching (which is also a good method for teaching biology) on secondary school students achievement in ecological concepts.

Multimedia is defined as the combination of various digital media types such as text, images, sound and video into an integrated multi-sensory interactive application or presentation to convey a message or information to an audience. The power of multimedia lies in the fact

that it is multi-sensory, stimulating the many senses of the audience. It is also interactive, enabling the end users of the application to control the content and flow of information. This has introduced important changes in the educational system and impacted on the way information is communicated to the learners. With multimedia, the process of learning can become more goal oriented, more participatory, flexible in time and space, unaffected by distances and tailored to individual learning styles, and increase collaboration between teachers and students. Multimedia enables learning to become fun and friendly, without fear of inadequacies or failure. Multimedia can be defined as an integration of multiple media elements (audio, video, graphics, text, animation) into one synergetic and symbiotic whole that results in more benefits for the end user than any one of the media element can provide individually.

Similarly, Ogunbote and Adesoye (2006) expressed the view that multimedia technology adds new dimension to learning experiences because concepts are easier to present and comprehend when the words are complemented with images and animations. The authors further stated that it has been established that learners retain more when a variety of senses are engaged in impacting knowledge; and the intensity of the experience aids retention and recall by engaging social, emotional and intellectual senses.

Students' interest and retention could be aroused and retained through the use of multimedia instructional approach (Adegoke, 2010). Furthermore, Starbek, Eriavec, and Peklai (2010) reported that students acquire better knowledge retention and improved comprehension skills more than the other groups when taught genetics with multimedia. Similarly, they found that students who were taught food and nutrition at senior secondary school level, and pupils taught primary science at nursery and primary school levels using multimedia, performed better and had better retention than those taught with traditional methods respectively. Apart from the use of multimedia, demonstrations can be conducted to verify facts and concretize knowledge.

Demonstration means to clearly show by reason or proof; explaining or making clear by use of examples or experiments. In demonstration method, teachers and students are given opportunity to put their ideas and views together (that means that students are active in the learning process). Notwithstanding this benefit, if the class is large, all the students might not have the opportunity to participate. It can be said that in demonstration method, teachers really perform certain kinds of experiments. Students observe it and ask various kinds of questions concerning the experimental function performed by the teacher. After observation, students are required to explain every step taken by the teacher. Thus, the students feel a kind of compulsion to concentrate solely on the experimental processes conducted by the teacher.

Demonstration is the basic method for introducing new skills to the learners (Cyril, 2014). It consists of showing the learner how new skills should be performed. The teacher does the showing while the learner observes. The showing is accompanied by explanation on the part of the teacher of how the skill is demonstrated. Demonstration method of teaching can be used at all levels of education – primary, secondary and tertiary. The method demands certain level of skills, practice and appeals to many senses. It is a good method for introducing new skills, developing understanding and showing appropriate ways of doing things irrespective of gender.

Gender issues in the teaching and learning of biology has remained an inconclusive issue. Some of the factors that are front burners in the issue of gender and science learning is gender stereotyping as well as traditional practice. While some studies showed that certain instructional methods tend to favour male students, others maintain that female students are more favoured. It is pertinent to examine whether an approach to instruction favours male or females so that teachers could make necessary adjustments during lesson to ensure equity both in learning and achievement.

Purpose of the Study

The purpose of this study was to investigate the relative effectiveness of multimedia integrated instruction and demonstration method of teaching on secondary school students' achievements on ecological concepts in Udi Education Zone of Enugu State. Specifically, the study investigated the:

1. mean achievement scores of students taught ecology using multimedia integrated instruction and those taught using demonstration method.
2. mean achievement scores of male and female students in ecology.
3. interaction effect of instructional methods and gender on the achievement of students in ecology.

Research Questions

The following research questions guided the study:

1. What are the mean achievement scores of students taught ecology using multi-media integrated instruction and those taught using demonstration method?
2. What are the mean achievement scores of male and female students in ecology?

Hypotheses

The following hypotheses were tested at 0.05 level of significance.

1. There is no significant difference in the mean achievement scores of students taught ecology using multimedia integrated instruction and those taught using demonstration method.
2. There is no significant difference between the mean achievement scores of male and female students in ecology.
3. There is no interaction effect of instructional methods and gender on the achievement of students in ecology.

Method

The design of the study was quasi-experimental. The pre-test, post-test non-equivalent control group design was used. In the study, intact classes were used. The population of study was made up of 3,054 SS2 biology students in Udi Education Zone of Enugu State. The sample was made up of 105 SS2 Biology students (50 males and 55 females) obtained using a multi-stage sampling procedure. The instrument for data collection was Biology Achievement Test (BAT). The concepts taught cover the following: concepts of ecology and components of ecosystem, population studies, relationship between soil types and water holding effects of soil on vegetation and simple measurement of ecological factor. The instrument was validated by two lecturers and one experienced biology teacher in a secondary school. Their corrections were effected in the final copy of the instrument. The reliability of the instrument was determined using Kuder-Richardson formula 20 (KR-20) after administering same to forty students outside the area of the study. The coefficient of internal consistency obtained was 0.98.In the two co- educational schools chosen for the study, the Experimental Group I was exposed to multimedia integrated instruction while, the Experimental Group II was exposed to demonstration method of teaching. The two groups received the same lesson content. Before the treatment, the regular biology teachers were briefed and used as research assistants. Data relating to the research questions was analysed using mean and standard deviation. The hypotheses were tested at 0.05 alpha level using analysis of covariance (ANCOVA). The choice of ANCOVA was to eliminate the initial group difference among the students. The decision rule was that whenever the null hypothesis was less than 0.05, the null hypothesis was rejected, otherwise, the null hypotheses was not rejected.

Results

Research Questions 1: What are the mean achievement scores of students taught ecology using multi-media integrated instruction and those taught using demonstration method?

Table 1: Pre-test and Post-test Mean achievement Scores of Students taught Ecology using Multimedia Integrated Instruction and Demonstration Method

Source of Variation	N	Pre-test Mean	Pre-test SD	Post-test Mean	Post-test SD	Gain in Mean
MII	51	24.41	8.98	57.94	5.02	33.53
DM	54	26.11	7.31	51.85	5.77	25.74

Table 1 reveals that the students taught ecological concept using multimedia integrated instruction have pre-test mean achievement score of 24.41 with standard deviation of 8.98 and post-test mean achievement score of 57.94, SD of 5.02 with gained mean achievement score of 33.53, while those in the control group taught with demonstration method have pre-test mean score of 26.11, SD of 7.31 and post-test mean score of 51.85, SD of 5.77 with gained mean 25.74.

Research Questions 2: What are the mean achievement scores of male and female students in ecology?

Table 2: Pre-test and Post-test Mean achievement Scores of Male and Female Students in Ecology

Method	Gender	N	Pre-test Mean	Pre-test SD	Post-test Mean	Post-test SD	Gain in Mean
MII	Male	24	24.38	9.24	57.50	5.11	33.12
	Female	27	24.44	8.92	58.33	5.00	33.89
DM	Male	28	27.32	7.39	51.96	5.98	24.64
	Female	26	24.81	7.14	51.73	5.65	26.92

Table 2 reveals that the male students taught ecological concept using multimedia integrated instruction have pre-test mean achievement score of 24.38 with standard deviation of 9.24 and post-test mean achievement score of 57.80, SD of 5.11 with gained mean achievement score of 33.12, while the females have pre-test mean score of 24.44, SD of 8.92 and post-test mean score of 58.33, SD of 5.00 with gained mean 33.89. The male students taught ecological concept using demonstration method have pre-test mean achievement score of 27.32 with standard deviation of 7.39 and post-test mean achievement score of 51.96, SD of

5.98 with gained mean achievement score of 24.64, while the females have pre-test mean score of 24.81, SD of 7.14 and post-test mean score of 51.73, SD of 5.65 with gained mean 26.92

Hypothesis 1: There is no significant difference in the mean achievement scores of students taught ecology using multimedia integrated instruction and those taught using demonstration method.

Table 3: ANCOVA on Main Effects of the Independent Variables on Achievement

Source of variation	SS	Df	MS	F	P-value	P ≤ 0.05
Corrected Model	1417.652[a]	4	354.413	13.745	.000	
Intercept	22716.217	1	22716.217	880.972	.000	
Pre-test	435.541	1	435.541	16.891	.000	
Gender	9.669	1	9.669	.375	.542	NS
Method	1090.036	1	1090.036	42.273	.000	S
Gender * Method	1.104	1	1.104	.043	.836	NS
Error	2578.539	100	25.785			
Total	319425.000	105				
Corrected Total	3996.190	104				

Table 3 also shows that at 0.05 level of significance, 1df numerator and 104 df denominator, the calculated F is 42.273 with P-value of 0.000 which is less than 0.05. Therefore, the null hypothesis is rejected. Thus, there is no significant difference in the mean achievement scores of students taught ecology using multimedia integrated instruction and those taught using demonstration method in favour of multimedia integrated instruction.

Hypothesis 2: There is no significant difference between the mean achievement scores of male and female students in ecology.

Table 3 also shows that at 0.05 level of significance, 1df numerator and 104 df denominator, the calculated F is .375 with P-value of .542 which is greater than 0.05. Therefore, the null hypothesis is not rejected. Thus, there is no significant difference between the mean achievement scores of male and female students in ecology.

Hypothesis 3: There is no significant interaction effect of instructional methods and gender on the achievement of students in ecology.

Table 3 further shows that at 0.05 level of significance, 1df numerator and 104 df denominator, the calculated F is .043 with P-value of .836 which is greater than 0.05. Therefore, the null hypothesis is not rejected. Thus, there is no significant interaction effect of instructional methods and gender on the achievement of students in ecology.

Discussion

The study revealed that multimedia integrated instruction significantly enhanced students' achievement in ecological concepts. This finding can be attributed to the fact the MII tends to engage many senses of the learner. As was observed in the study, the use of MII provided a rich learning experience for the students by engaging both their sense of hearing and that of sight. The use of MII also reduced cognitive load and abstraction inherent in the concepts taught. This made it easy to properly conceptualize what was taught. Another possible explanation for the findings of the study was that MII enabled students to link what was taught to the real world. The use of motion test, graphics and simulation videos gave them first-hand understanding of the concept taught.

The findings of this study is are line with that of Amosa (2014) who reported that students taught using multimedia instruction performed better than their colleagues in the conventional teaching method. The finding of the study is also in line with that of Aminu (2011) who showed that significant differences existed in favour of the multimedia group for students taught with multimedia and lecture method. The finding of the study also supports the view of Danebeth (2013) that multimedia instruction had significant effect on the academic achievement of students more than when traditional method was used.

The study revealed that no significant difference existed between the male and female students in the experimental group taught using multimedia integrated instruction. The observed non-significant difference in the achievement of male and female students in the experimental group could be attributed to the fact that the use of multimedia integrated

instruction equally enhanced the achievement of the male and female students. All the students irrespective of their gender were carried along during the lesson, thus, the uniform performance. Similar observation was made in respect of male and female students in the control group. No significant difference was also found to exist between the achievement of male and female students taught ecological concepts using demonstration method. The finding of the study contradicts that of Oriaklin and Igbudu (2015) that there was gender difference in academic achievement of students.

Conclusion

It can be concluded from the findings of the study that MII is more effective in improving male and female students' achievement in biology more than demonstration method.

Recommendations

The following recommendations are made based on the findings of the study:

1. Seminar, workshops and orientation exercise should be organized by the government and educational agencies to familiarize teachers of biology with the approach of MII.
2. Educational stakeholders should make provision for technological and multimedia facilities that could help biology teachers in the easy use of MII in the real-time classroom.
3. Biology students should be introduced to multimedia database that hold multimedia files on biology related concepts to help them access multimedia files on their own and improve learning.

References

Adegboke, B. A. (2011). Effect of multimedia instruction on senior secondary school students' achievement in physics. *European Journal of Research in Educational Studies, 3*(3), *537- 550.*

Ahmed, M. A. (2008). *Influence of personality factors on biology lecturers' assessment of difficulty levels of genetics concepts in Nigerian colleges of education.* Unpublished doctoral thesis, University of Ilorin, Ilorin, Nigeria.

Ahmed, M. A., & Abimbola, I. O. (2011). Influence of teaching experience and school location on biology teachers' rating of the difficult levels of nutrition concepts in Ilorin, Nigeria. *Journal of Science, Mathematic & Education, 7*(2), 52-61.

Aminu, S. (2015). *Impact of animated media strategy on achievement, retention and interest among secondary school geography students in weather concepts, Kastina state, Nigeria*. (Unpublished Master's Thesis) Ahmadu Bello University, Zaria.

Amosa, I. G. & Akawo, A. Y, Eli, S.G. & Ughovwa, Q. E. (2014). Improving secondary school students' achievement and retention in biology through video- based multimedia instruction. *Journal of Scholarly Teaching*,*9*(4), 78- 91.

Danebeth, T. G. (2013). The effect of multimedia instruction on students learning. *Journal of Education and Practice*, *4*(5),120-124.

Cyril, M.U. (2014). Effects of computer assisted instruction and demonstration method of teaching automobile technology in federal college of education (technical) in North-Eastern Nigeria. *International Journal of Science and Research*, *6*(14), 17-23.

Kareem, L. O. (2003). *Effects of audio-graphic self-instructional packages on senior secondary school students' performance in biology in Ilorin, Nigeria. (*Unpublished PhD thesis) University of Ilorin, Ilorin.

Mayer, R. E. (2005). Cognitive theory of multimedia learning. *The Cambridge Handbook of Multimedia Learning* (pp. 31-48). New York, NY: University of Cambridge.

Mayer, R. E., Dow, G. T., & Mayer, S. (2003). Multimedia learning in an interactive self-explaining environment: What works in the design of agent-based micro worlds? *Journal of Educational Psychology*, *95*, 806-813.

Muller, D. A., Lee, K. J., & Sharma, M. D. (2008). Coherence or interest: Which is most important in online multimedia learning? *Australasian Journal of Educational Technology*, *24*, 211-221.

Oriakhi, U.& Igbudu, U. (2015). Influence of gender on students' academic achievement in government subject in public secondary schools in Oredo local government of Edo state, Nigeria. *Journal of Education and Social Research*, *5*(2). Doi:10.5901/Jesr.2015.v5n2p101.

Starbek, P., Eriavec, M. S., & Peklai, C. (2010). Teaching genetics with multimedia results in better acquisition of knowledge and improvement in comprehension. *Journal of Computer Assisted Learning, 26*(3), 214-224.

Umar, A. A. (2011). Effects of biology practical activities on students' process skill acquisition in Minna, Niger State, Nigeria. *Journal of Science, Mathematic & Education, 7*(2), 118–126

West African Examination Council (2011). *Chief Examiners' reports*, Lagos: WAEC.

West African Examination Council (2016). *Chief Examiners' reports*, Lagos: WAEC.