



KWASU INTERNATIONAL JOURNAL OF ARTS AND SCIENCE EDUCATION

ISSN: 0795-820X (ONLINE)

Journal homepage

IMPACTS OF MULTIMEDIA INSTRUCTIONAL STRATEGY ON STUDENTS' CONCEPTUAL UNDERSTANDING OF GENETICS IN SECONDARY SCHOOLS IN ILORIN, NIGERIA

Abdulrahim, Basira J.

School of Sciences, Kwara State College of Education,
abdulrahimbisira25@gmail.com

ARTICLE INFO

Article History

Received on 13 February 2025

Accepted on July, 2025

Keywords: Multimedia, Instructional strategy, Conceptual Understanding, Genetic, Secondary School

ABSTRACT

The purpose of this study was to examine the impacts of multimedia instructional strategies on students' conceptual understanding of genetics in biology. A quasi-experimental design was employed for the research. The study population comprised all students studying biology in public secondary schools within Ilorin, Kwara State, Nigeria, during the 2024 academic year. Through purposive sampling, co-educational public secondary schools in Ilorin were selected. The sample consisted of intact classes totalling 94 biology students. The experimental group received instruction using a multimedia instructional strategy (MIS), whereas the control group was taught using the traditional teacher-centred approach. The study utilised multimedia resources (videos with audio on genetics), structured lesson plans, and a researcher-developed assessment tool titled the Genetics Achievement Test (GAT). Experts confirmed the instrument's content validity, and its reliability was established with a Pearson Product-Moment Correlation, yielding a coefficient of 0.77. Data were analysed using descriptive statistics such as mean and standard deviation, along with inferential statistics using the t-test at a 0.05 level of significance. The findings revealed a statistically significant difference in achievement between students exposed to MIS and those taught with conventional methods, in favour of the experimental group. These results suggest that multimedia instructional strategies significantly enhance students' conceptual understanding of genetics. Therefore, it is recommended that biology educators integrate MIS into their teaching practices to enhance students' understanding of genetic concepts and improve their overall academic performance.

Introduction

Biology is a science subject taught at senior secondary school levels in Nigeria. It is perceived as the most popular of the three natural science disciplines amongst secondary school students in Nigeria (Jibril *et al.*, 2015). According to Adewale *et al.* (2016) biology subject is regarded as the simplest and easiest science subject that usually attracts the widest enrolment among Nigerian students at the Senior School Certificate Examinations. Genetics concept is the study of how living organisms transfer traits like observable or detectable characteristics from generation to generation (Armstrong and Wilkinson 2020). It is an important aspect of human development and a discipline in biology that is difficult to teach and learn, thereby promoting rote learning of the concept (Jibril, 2024 & Abimbola, 1998). Therefore, the need for conceptual understanding of genetics is very important, and teachers need to employ methods will aid critical thinking and more conceptual understanding of genetics. Science educators have continued to place emphasis on teaching and learning strategies that can facilitate critical conceptual understandings in the sciences that can improve academic achievement in the 21st century (Abdulrahim *et al.*, 2018). Thus, the study focused on the impacts of using multimedia as a medium of instruction in genetics.

Multimedia strategy presents learning through the use of pictures and words. For instance, learning involving the use of PowerPoint presentations, a pre-recorded lecture or reading a physics textbook. (University of Buffalo, 2025). According to Mayer (2011), Multimedia instruction refers to a learning environment that combines visuals and text to enhance understanding. It includes resources like textbooks, videos, narrated slide presentations, online animations, and educational computer games designed to support effective learning. This strategy is based on three principles of cognitive science as dual channels, limited capacity, and active processing; five cognitive processes of learning such as selecting words and pictures, organizing words and pictures, and integrating); and five representations learning as external representations, sensory copies in sensory memory, images,sounds in working memory, pictorial and verbal models in working memory, and knowledge in long-term memory. According to Ye (2024) multimedia teaching in the primary school classroom plays a pivotal role in enhancing the educational experience for young learners. The study further highlighted some impact of multimedia resources (such as interactive digital content, videos, animations, etc.) on learners as enhancing comprehension, engagement in critical thinking and creating interactive learning environments, fostering intellectual development.

Several studies have been conducted on the effectiveness of multimedia strategy in teaching and learning, among which are Ayodeji (2021), Akinbadewa (2020; Akinbadewa and Sofowora, 2020; Alamina and Otuturu, 2019). In addition, recent studies on multimedia were reviewed in this study:

Kasa et al. (2024) conducted a study on the effects of multimedia and dynamic classroom integrated instruction (DCII) on students' academic achievement in respiration and photosynthesis. The study employed a non-equivalent, quasi-experimental design. A total of 94 secondary school students were sampled for the study. Data were collected using biology achievement tests, classroom observations, and focus group discussions. The data were analysed using paired and independent sample t-tests, repeated measure analysis of variance, and thematic analysis. The results revealed a statistically significant difference in biology achievement between the experimental group. It was concluded that multimedia creates a more active learning environment, simplifies complex content and enhances students' achievement. In the same vein, Okoli et al. (2024) studied the effect of using multimedia on the achievement of upper basic education students in Basic Science in secondary schools in Anambra state. The study adopted a quasi-experimental research design. The sample comprised. Of 79 Seventy-nine (37 control and 42 experimental) upper basic.9 students from the 19 co-educational schools in Awka Education Zone. The instrument used for data collection was an Achievement Test (BSAT) of 40 multiple-choice questions. Mean and standard deviation were used to answer the research questions, while Analysis of covariance was used to test the hypotheses at a 0.05 level of significance. The findings revealed that. there was a significant difference in the students' academic achievement in Basic Science when taught using multimedia.

Earlier, Onuigwe et al. (2023) studied the effect of multimedia instructional packages on secondary school students' academic performance in Chemistry. The design adopted for this study was a quasi-experimental type of a pretest-posttest nonequivalent control group design. The population of the study comprised 2,109 SS1 students (1,027 males and 1,082 females) in public secondary schools in Enugu Education Zone of Enugu State. The sample for this study comprised 415 SS1 students drawn using a multistage sampling procedure. Data were collected with a researcher-designed test titled "Chemistry Performance Test (CPT) . Mean and standard deviation were used to answer the research questions, and Analysis of Covariance (ANCOVA) was used to test the hypotheses. The findings of the study revealed that students exposed to a multimedia instructional package performed better than those taught using a conventional teaching method.

Kiat et al. (2020) examined the effectiveness of multimedia-based learning on the academic achievement of science subjects. The study was a descriptive design. The sample involved 40 junior high school students in Malaysia. The sample was divided into two groups (control and experiment). The data collected were analysed using a t-test. The results of the analysis revealed that the experimental group performed better than the control group. Therefore, there was a significant difference between traditional teaching and multimedia teaching. The study concluded that the use of multimedia in learning enables students to learn at their own pace and helps students to develop a better understanding of science. Similarly, Khan et al.(2020) examined the effect of multimedia instructions on the academic performance of secondary and higher secondary school students in Bangladesh. A sample size of 600 secondary and higher secondary school students was involved. Data was collected from copies of questionnaires. The data collected were analysed using a two-stage structural equations modelling approach. The study results revealed that organised class lectures of multimedia instruction have a direct positive relationship with the academic performance of secondary and higher secondary students. Also, In study conducted by Igbibo et al.(2019) on multimedia instructional packages and students' academic performance in biology. A quasi-experimental design was employed for the study. The population comprised all senior secondary two biology students in Obio Local Government Area in Rivers State. Apurposive sampling was used to select 100 students in two intact classes for the study. A 30-item cell division performance test was used to collect and the data collected were analysed using a t-test. Findings from the study revealed that a multimedia instructional package significantly enhanced the academic performance of students in cell division.

Based on these backdrops, this study investigated the effect of multimedia on the Genetics concept in biology. This is because it has been reported by teachers and students to be one of the difficult biology topics in secondary schools in Kwara State over the years (Abimbola,1998 &Jibril, Bello &Ayinde, 2021). Researchers have employed different strategies to aid the teaching of this concept to maximise meaningful learning, conceptual understanding, eliminate misconceptions as well as improve the academic achievements of senior school students.

Research Questions

The following research question was answered in this study:

1. Is there a difference in the achievement of students taught genetics using multimedia and those taught with the conventional method?

Research Hypothesis

The following null hypothesis would be tested in this study:

1. There are no statistically significant differences in the achievement of students taught genetics using multimedia and conventional methods

Methodology

The study was a Quasi-experimental study of a non-equivalent, on-randomized pretest; posttest control group design. The sample comprised 94 students from intact classes from two co-educational public secondary schools in Ilorin city. A purposive sampling technique was used to select the schools for the study. The Senior School two (SSII) Biology students were the target population. The target population were not preparing for WASSCE. Instruments employed for the study was a researcher-designed Genetics Achievement Test (GAT). The Research instruments were given to three experienced Biology teachers and two Biology educators from the Department of Science Education, University of Ilorin, Nigeria for face and content validity. Also, the draft of the PTG was given to an expert in the field of measurement and evaluation for the standard of the items. Reliability of the instrument was determined using the test-retest method with a week's interval on the students of a non-participating school. A reliability index of 0.77 was obtained using Pearson's product-moment correlation coefficient.

The researcher sought permission to conduct the study in the sampled schools by presenting an introductory letter to the Principals of the selected schools for consideration. With permission, the researcher was introduced to the Biology teachers of the schools for familiarity and arrangements were made for the study to take place. The researcher and Biology teachers, who were the Research assistants, distributed the consent forms to the students. The form was given to each student to be completed and returned to the Research assistants of each school. These consent forms were given to seek students' consent to participate in the study. The copies of the collected consent forms were returned to the Researcher. Then, pretests were administered to the participating students in both experimental and control groups before the commencement of the teaching. The experimental group was taught using a multimedia strategy on genetics, and the control group with a conventional method. A posttest was administered to all the groups at the end of the lessons.

Data Analysis and Results

The research question was answered with a mean, and the research hypotheses were tested at a 0.05 level of significance

Research Question 1: Is there differences in the achievement of students taught genetics using a multimedia strategy and those taught with a conventional method

Table 1: Mean for the experimental and control groups

Group	N	X
Experimental group	40	66.30
Control	54	45.41

The result from Table 1 revealed the mean scores for the experimental and the control group. The result revealed that the experimental group had an approximate mean score of 66.30 and the control group had an approximate mean of 45.41. The result shows that the experimental group has a higher mean score than the control group students after the treatment. Thus, multimedia strategy improves students' understanding of concepts in genetics as reflected in their scores in achievement in GAT.

Hypothesis 1: There is no statistical significant differences in the achievement of students taught genetics using multimedia strategy and the conventional method

Table 2: t-test of Post-test Scores of Experimental and Control Groups

Group	Mean	Std. Deviation	t-value	t-cal	Decision
Experimental	66.30	9.27	10.78	1.98	Sig.
Control	45.41	10.50			

Table 2 reveals that the mean achievement scores of the students in the experimental group were higher than those of the control that did not experience any form of treatment. The difference is therefore accounted for by the treatment on the experimental group ($t\text{-cal} = 10.78$, $t\text{-tab} = 1.98$) computed at a 0.05 level of significance. This means that there was a difference between the experimental and control groups, as the $t\text{-value}$ 10.78 was greater than the $t\text{-tab}$ 1.98. Hypothesis one is hereby rejected, which means that there was a significant difference in the achievement of students that exposed to multimedia instruction and those of the conventional method. This means that the experimental group performed better than the control group in GAT.

Discussion of Findings

This study revealed that multimedia strategy has a positive impact on students' performance in GAT, i.e. the approach improves students' conceptual understanding of the genetic concept as reflected from their performances in the GAT. Hypothesis one was rejected because there was a significant difference in the achievement of students taught with MIS. This is in favour of the MIS group. This finding was in line with the results of studies conducted by Kasa et al. (2024); Onuigwe et al. (2023), and Kiat et al. (2020), that students taught using a multimedia instructional approach had better academic achievement than the control group. Previous research also revealed that the use of multimedia can increase conceptual knowledge and eliminate misconceptions (Lihan & Oruc, 2016; Akinbadewa & Sofowora, 2020). Multimedia approach improves students-teacher interactions and communication as well as aids students' attention and curiosity during the teaching and learning process.

Conclusion

1. Multimedia Instructional Approach aids more conceptual understanding and better achievement of senior school students in genetics.
2. Multimedia instructional approach improves students' learning, active interactions and curiosity

Recommendations

The following recommendations were made based on the findings

1. Teachers in senior secondary schools should incorporate multimedia instructional strategies when teaching genetic concepts.
2. Training workshops should be organised to equip educators with the necessary skills for effectively using multimedia tools in their instructional practices.

References

- Akinbade, B. O. (2020). The effect of multimedia instructional packages on students' academic achievement in Biology. *International Online Journal of Education and Teaching (IOJET)*, 7(4), 1266-1281. <http://iojet.org/index.php/IOJET/article/view/880>.
- Akinbadewa, B. O. & Sofowora, O. A. (2020). Effectiveness of multimedia instructional learning packages in enhancing secondary school students' attitude towards biology. *International Journal on Studies in Education*, 2(2), 119-133.
- Alamina, J. I. & Otoru, F. G. (2019). Effects of multimedia instructional package on students' academic performance in biology in senior secondary schools in Rivers state. *Rivers State University Journal of Education (RSUJOE)*, 22(182), 74-83. www.rsujoe.com.
- Ayodeji, J. E. (2021). Effects of multimedia instructional strategy on senior school students' performance and retention in mathematics. *Anatolian Journal of Education*, 6(2), 193-206.
- Jibril, B. A. (2024). Use of 5E Learning-cycle and Concept-mapping Strategies for Improving Students' Performance in Genetics in Secondary Schools in Kwara State, Nigeria. *Journal of Science and Science Education*, 5(1), 1-9.
- Kassa, M. W., Azene, M. K., Menstie, S. M. & Fered, M. W. (2024). Effect of using multimedia and dynamic classroom integrated instruction on grade II students. *Heliyon*, 10(18). <https://doi.org/10.1016/j.heliyon.2024.e37315>.
- Khan, A. G., Shetu, S. H., Islam, M. N. & Moudud-Ul-Huq, S. (2020). Multimedia instructions and academic performance of students: an empirical study of a developing country. *International Journal of Smart Education and Urban Society*, 11(1), 22-35.
- Kiat, T. Y., Jumintono, Kriswanto, E. S., Sugiri, Handayani, E., Angyarini, Y. & Rofik, M. (2020). The effectiveness of multimedia learning on academic achievement in the reproduction of science topic. *Universal Journal of Educational Research*, 9(8), 3625-3629. <http://www.hirpub.org>.
- Lihan, G. O. & Oruc, S. (2016). *Effects of the use of multimedia on students' performance: a case study of social studies class*. <https://www.eric.ed.gov>
- Mayer, R. E. (2011). *Applying the science of learning to multimedia instruction*. Psychology of learning and motivation. Sciencedirect.
- Okoli, J. N. & Adesun, G. A. (2024). Effect of using multimedia in teaching on achievement of upper basic education students in basic science in Anambra state. *UNIZIK Journal of Education and Policy Studies (UNIJERS)*, 16(5), <https://unijerps.org/index.php/unijerps/article/view/582>.
- Onuigwe, B. U. & Egolum, E. (2023). Effectiveness of multimedia instructional package on secondary school students' academic performance in chemistry. *UNIZIK Journal of STM Education*, 6(1), 119-130.
- University at Buffalo (2025). *Multimedia learning*. Buffalo.edu/catt/teach/develop/theory/multimedia-learning.html.
- Ye, X. (2024). The application of multimedia teaching in primary school classroom. *Reseachgate.net*. <https://www.researchgate.net>