



## Assessing Effectiveness of Animated Instructional Media on Academic Performance and Retention of Genetics Concepts

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### ABSTRACT

The present study was carried out to assess the effectiveness of animated instructional media on academic performance and retention of genetic concepts among senior secondary school on biology students in Sokoto State. Adopted through Quasi Experimental design involving pre-test, post-test and post-posttest on two equivalent groups as experimental and control, the population on the study was 10148 SS III Biology students. In this regard, four intact classes were chosen with sample size of 238 SSIII students. Genetic Concept Performance and Retention Test (GCPRRT) was the instrument used for data collection. Animated Instruction Media was used as instructional material to teach the experimental group while demonstration method was used to teach the control group. Independent sample t-test was used to test the four (4) hypotheses formulated in the study. The results obtained in this line of research revealed that there was a significant difference in the academic performance and retention ability between students taught using Animated Instructional Material and those taught using demonstration method. It was therefore recommended for other senior secondary school teachers to harness the considerable benefits of technology, particularly animations, in teaching genetics and other related concepts.

**Keywords:** *animated, media, academic performance, retention.*

### INTRODUCTION

There is persistently poor performance in science subjects in secondary school certificate examination, and this leads to the assumption that most science teachers in Nigerian secondary schools do not make use of the varied forms of teaching method with innovations in teaching and learning of science. Whereas the world is now becoming dynamic in terms of technological development, an instructional system supported by technology will be meaningful for teaching and learning of science.

Genetics is one of the topics under the theme continuity of life taught in biology at Senior Secondary School level in Nigerian schools. It is the study of genes, genetic variation and heredity in living organisms. It attempts to explain the mechanism and basis for both similarities and differences between related individuals and also explain the phenomenon of evolution and cyto-differentiations (Aggarwal, 2008). Genetics gives the basis for which characteristics are or traits are transferred from parents to offspring and from generation to generation. Like other sciences, the study of genetics has produced an insight to new challenges as well as solution to human problems

for example, treatment of diseases, plant and animal breeding, applications of genetics in crime detection, establishment of paternity where there is dispute etc.

Educational system in Nigeria has undergone series of changes for the purpose of development among which are changes in theory and practice of education demanding the use of technology (Imhanyehor, 2021; Anyika et al., 2021; Usman & Chinyere, 2021). According to Bello (2014), recent advances in pedagogy, organization and presentation using technologies have changed the structure of educational systems of the society. A way to which an educational system can use these is the integration of technology in the teaching strategies or methods which are numerous ranging from the traditional to modern methods of teaching. Science educators have used different methods of teaching such as the lecture method, problem solving method, guided discovery, laboratory method, field trip, simulation, games, computer animations, concept mapping among others. However, there are marked differences in some respect among these methods.

Therefore, there is need to look into science teaching methods to enhance students' performance. Morakinyo in Bello (2014) has attributed the fallen level of academic performance to teachers' non-use of verbal reinforcement and visual materials in strategies in the course of instruction.

There is persistent poor performance in science subjects in secondary school certificate examination leading to the assumption that most science teachers in Nigeria secondary schools do not make use of the varied forms of teaching method in teaching and learning of science (Bello, 2014) as evidence by record of performance from WAEC chief examiners' report. The ineffectiveness of these strategies in teaching science is one of the major contribution to the performance of students hence the need to reconsider innovative and new methods of instruction in science.

An instructional system supported by technology will be meaningful for learning in the 21<sup>st</sup> century like the use of computer technologies in teaching and learning such as computer aided learning, computer-based training, computer assisted instruction, interactive computer video disc, multimedia, Animated Instructional Material etc (Rajaram, 2021; Hamutoglu et al., 2021).

Animated Instructional Material is a form of animated instructional method that involves the use of computer animation, graphics and cartoons in classroom instruction (Salisu, 2015; Antó et al., 2021; Yulianti et al., 2021; Abu Bakar et al., 2021; Williams, 2020). It involves the use of drawings, cartoons and other graphical materials to create motion pictures. Thomas and Israel (2014), sees animation teaching as a device that has the features of both audio and visual presentations that are used in teaching and learning process for effective dissemination of knowledge (Kim et al., 2021; Капинова et al., 2020; Yan, 2021).

The use of animation helps in teaching and learning, the retention of the knowledge is also important and put into account because it is only when the concepts learned are stored and recalled thereafter that the performance can improve (Yan, 2021; Krishnan, 2021).

Retention is the ability to store what has been learned by an individual and able to recall what has been stored thereafter. Retention plays a vital role in what the teacher does, it determines the time teachers spend in reviewing lesson from the days or week. According to Bichi (2002) retention is ability to retain and later remember information or knowledge gained after learning in to memory.

A number of studies were reviewed based on the influence of animation in teaching and learning. Scholars (Versky, Morrison & Bétrancourt, 2002; Stith, 2004 & Barak, Ashkar, & Dori, 2010) narrate that when a capable and enthusiastic teacher presents animation systematically, it provides a valuable way to communicate dynamic and complex sequences of events more effectively to students. Animation method as an important tool for science education was further

supported by studies (for example, Hoffler & Leutner 2007; Tayo, 2012; Thomas & Israel, 2014), who proves that animated images transform abstract idea into concrete images, thus improving the students' performance, understanding, and attention.

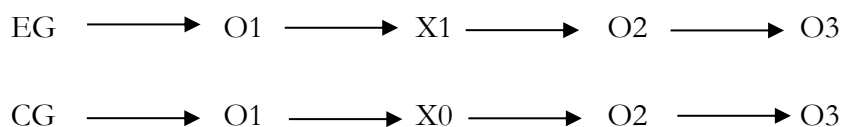
In the study of Gambari, Yaki, Gana & Ughovwa (2014) which examined the effects of video-based multimedia instruction on secondary school students' performance and retention in biology in Nigeria. The results showed that there was no statistically significant difference among the experimental groups. Generally, students under multimedia instruction performed better than their colleagues in the conventional teaching method. However, students in conventional teaching method had better retention than other groups. Ayodele (2009) investigated the effect of computer assisted instruction (CAI) and gender as they predict student academic performance in biology concepts. Findings revealed that majority of boys performed better when they use computer assisted instruction than the girls in school.

As well, Bello (2014) investigated the effect of computer aided instructional package (CAIPAG) on performance, attitude and retention of genetic concepts among secondary school students in Niger state. The result indicated that students who received instruction with CAIPAG outperformed those students who received instruction with CLM and higher retention and positive attitude. The findings also revealed that there is no significant difference in performance, attitude and retention between male and female students. It was recommended that teachers should use computer as instructional package in order to improve students' performance, attitude and retention.

One of the main problems facing Nigeria Secondary Schools is relative decline in academic performance of students especially in Sciences (Enohuen, 2015). Secondary Schools in Sokoto state were no exception. There was also a similar concern expressed on student performance and retention in genetic concepts in Sokoto Metropolis. This was evidenced by a report from WAEC Chief Examiner from 2012 to 2019. The report indicates that many students from Sokoto Metropolis failed to answer questions on genetics, and those who attempted the questions relatively performed poorly, this is as a result of not retaining the concept of genetics taught earlier. The main purpose of this research would be to assess the effect of Animated Instructional media on academic performance and retention of genetic concepts. In a more specific term, the research answered the following questions. What is the difference in academic performance of students taught genetics concepts using Animated Instructional Media (AIM) and those taught with Demonstration Method? And what is the effect of AIM on the retention of learned concepts in genetics?

## **METHODOLOGY**

The present study adopted Quasi Experimental research design which involves pre-test, post-test and post-posttest on two equivalent groups designated as experimental and control (Antó et al., 2021;Gopalan et al., 2020). This design is suitable for adoption to approximate conditions of true experiment in situations that do not permit the control and manipulation of all relevant variables (Kpolovie 2010). The design is illustrated below:



The population of the study comprises of all SSIII students in Public Senior Secondary Schools offering Biology spread across Sokoto State. There are 10148, SS III Biology students in Senior Secondary Schools in Sokoto State. The choice of using this population was justified by the

fact that, they have undergone longer years of secondary school education than those below them. Likewise, genetics concepts are taught from SSI –SSIII so the choice of SSIII was to assess whether the genetics concept taught along these years (SSI-SSII) was retained by the student up to the third year of their senior secondary school. The population include both male and female students of age-range 15-21 years and covers all major tribes in Nigeria.

Four schools were selected from three local government in Sokoto State using stratified sampling to determine the sample size for the study consisting of 1504 students. To determine the sample size for the study, four intact classes was used one from each school. The four classes were grouped into two classes for experimental group and the other two for control group. These intact classes were used on the assumption that random selection of students would distort the school timetable.

The research instrument used for the study were Genetic Concept Performance & Retention Test (GCPRT) was validated by science education specialist in Sokoto State University and a Biology teacher in Sultan Bello Secondary School, who is marking Biology in both WAEC and NECO. They examined the items on the instrument and made necessary corrections. The reliability of the instrument GCPRT which contain 20 questions was administered to an intact class containing 20 Biology students from Government Day Secondary School, Mabera, Sokoto, for pilot test in order to determine the reliability of the instrument.

Given an interval of 4 weeks after the instrument was first administered, the instrument was re-administered to the same group of students. The results of the tests were subjected to Pearson Product Moment Correlation Coefficient analysis, which yielded a coefficient of 0.81. Descriptive and inferential statistics will be used in analyzing the data. The descriptive statistical tools to be used include Frequency Count and Percentages in describing the demographic data of the, while mean and standard deviation will be used in answering the research question by describing mathematical expectation or average and dispersion of the data. Inferential statistic i.e. independent T-test will be used in testing the null hypotheses.

## RESULT AND DISCUSSION

This section addressed the research questions and hypotheses earlier raised in the study.

### **Difference in academic performance of students taught genetics concepts using Animated Instructional Media (AIM) and those taught with Demonstration Method**

Post test data of the experimental and control groups were subjected to descriptive statistics. Mean and standard deviation were computed and used to draw Table 1.

**Table 1. Difference in academic performance between AIM and DM**

	Category	N	Mean	Std. Deviation	Std. Error Mean
Posttest	Exp	125	54.77	9.837	0.803
	Ctrl	113	39.73	9.976	0.998

Source: Research Field Study 2021

Table 1 showed the difference in academic performance of students taught genetics concepts using Animated Instructional Media (AIM) and those taught with Demonstration Method (DM). Inspection of the mean scores indicates that participants taught with Animated Instructional Material had a mean score of  $54.77 \pm 9.83$  compared with mean score of  $39.73 \pm$

9.97 from participants taught with DM. This suggested the fact that Animated Instructional Media is important for improving student academic success in genetics than conventional demonstration method, even though scores of the two groups deviated with the same magnitude.

### Effect of AIM on the retention of learned concepts in genetics

Post-post test data of the experimental and control groups were subjected to descriptive statistics, mean and standard deviation were computed and used to draw Table 2.

**Table 2. Difference in retention ability between AIM and DM**

	Category	N	Mean	Std. Deviation	Std. Error Mean
Post Posttest	Exp	125	51.41	8.805	0.719
	Ctrl	113	29.43	8.655	0.866

Source: Researcher’s Field Study 2021

Table 5 showed the difference in retention of students taught genetics concepts using Animated Media (AIM) and those taught with Demonstration Method (DM). Inspection of the mean scores indicated that participants taught with Animated Instructional Material had a mean retention score of  $51.41 \pm 8.80$  against the retention score of  $29.43 \pm 8.65$  from participants taught with demonstration method. This huge difference in retention scores between the two groups suggested the fact that Animated Instructional Media is important for improving student retention of genetics concepts than conventional demonstration method.

### Testing the Null hypotheses

This section tested the research hypotheses predicted earlier in the study.

H<sub>0</sub>1: There is no significant difference in academic performance of students taught genetics concepts using Animated Instructional Media (AIM) and those taught using demonstration method (DM).

To test H<sub>0</sub>1, post test data of the experimental and control groups were subjected to t- test statistics. t- and p values were computed and used to draw Table 3.

**Table 3. Significant difference in academic performance between AIM and DM**

	Category	N	Mean	Std. Deviation	T	p-value	Decision
Posttest	Exp	125	54.77	9.837	11.774	0.000	H <sub>0</sub> 1 Rejected
	Ctrl	113	39.73	9.976			

Source: Research Field Study 2021

$\alpha=0.05$

Table 3 showed significant difference in academic performance of students taught genetics concepts using Animated Instructional Media and those taught using demonstration method. Results presented in the table indicated that there was a statistical significant difference in academic performance of students taught genetics concepts using and those taught using demonstration method ( $t = 11.77$ ;  $p\text{-value} = 0.00$ ). Based on this result, the research hypothesis was therefore rejected, implying that students taught with Animated Instructional Material differ significantly in performance scores from those taught using conventional demonstration method.

H<sub>02</sub>: There is no significant difference in retention of students taught genetics concepts using Animated Instructional Material (AIM) and those taught using demonstration method (DM).

To test H<sub>02</sub>, post -post test data between experimental and control groups were subjected to t-test statistics. t and p-values were computed and used to draw Table 4.

**Table 4. Significant difference in retention ability between AIM and DM**

	Category	N	Mean	Std. Deviation	T	p-value	Decision
Posttest	Exp	125	51.41	8.805	19.471	0.000	H <sub>01</sub> Rejected
	Ctrl	113	29.43	8.655			

Source: Research Field Study 2021

$\alpha=0.05$

Table 4 showed significant difference in retention ability of students taught genetics concepts using Animated Instructional Material and those taught using demonstration method. Results presented in the table indicated that there was a statistical significant difference in retention ability of students taught genetics concepts and those taught using demonstration method (t = 19.47; p-value = 0.00). Based on this result, the research hypothesis was therefore rejected, implying that students taught with Animated Instructional Material differ significantly in their retention ability from those taught using conventional demonstration method.

## Discussion

This study assessed the effectiveness of Animated Instructional Material on academic performance and retention of genetics concepts among senior secondary school students in Sokoto metropolis. Finding of this study indicated that students taught using animations performed better in genetics than their counterparts taught with a conventional strategy. The submission was based on the fact that most animations have sensory appeal, and as such, could be used to meet diverse learning needs of students. By using animations, some abstract genetics concepts could be demonstrated in a manner that reduces abstract imagination of students. In addition to motivational elements of computer technologies, animated media ignites students' brain, captures and sustains students' attention, and increases their chances of engagement in classroom activities. The significance of Animated Instructional Material is supported by Aremu and Abiodun (2010) whose comparison between animation and demonstration method showed that computer animation was effective in improving students' academic performance than demonstration method. Contrary to this, a study on effects of video-based multimedia instruction on academic performance by Gambari, Yaki, Gana and Ughovwa (2014) showed no significant difference between students taught using multimedia instruction and those taught with conventional lecture method.

Secondly, the finding revealed a difference in the retention ability of students taught using Animated Instructional Material and those taught using conventional demonstration method. This suggested the fact that animated packages are significant for students in retaining genetics concepts than conventional demonstration method. Although intelligent quotient play important role on student retention ability, however, when students learn through animation, what they learn previously tends stay longer in their long term memory and tends to reflect in their brain recursively. They stand a chance of retrieving information from their schema in quicker fashion than it would be when they were taught using conventional methods. This is due to the fact that computer technology itself has the potential of improving student retention capability by exposing learners to visual and auditory reality. In support of this view, study conducted by O'Day (2007) on effect of computer animation on students' attitude and retention indicated that students prefer

having animations because it leads to long-term memory retention than simple graphics. However, study by Gambari, Yaki, Gana and Ughovwa (2014) affirmed that students taught by conventional teaching method had better retention than other groups. This finding could be limited by inability to enforce intervention fidelity by the authors.

## **CONCLUSION**

Based on results obtained in this line of research, it is therefore argued that teaching is a complex activity that requires sound results. However, these results predominantly depend on effective approach and strategy. Such obvious premise is to say that what was learned depends on how it was taught and the associated tools. The current research disclosed that Animated Instructional Material was significant for students in terms of performance and retention of genetics concepts. Based on such obvious result, the study concludes that Animated Instructional Material was especially important for improving student educational success in an inclusive setting. The research suggests that in order to improve the students' academic performance, secondary school teachers should harness the potential benefits of technology, particularly animations, in teaching genetics and other related concepts in biology. The government should provide animated media to secondary schools across the state, to be used as instructional material in teaching and learning concepts, as this would enhance the retention ability of students. Biology teachers should not be gender bias in the use of animations while teaching. Biology teachers should not use animations in preference to a particular gender group over another. This can be conducted by providing inclusiveness during adoption and utilization of Animated Instructional Material. Governmental and Non-governmental agencies can also assist by creating awareness to the general public on the use and effectiveness of Animated Instructional Material in teaching genetic concepts in biology. Such awareness could be created by organizing workshops, seminars, conferences periodically and in-service training of Biology teachers. However, such awareness should be gender sensitive.

## **REFERENCES**

- Abu Bakar, M. H., Ya'cob, S. N., Mohd Bajury, M. S., & Wan Rosli, W. R. (2021). Copyright Concerns for Educators: Online Learning Post Pandemic Effect. *Malaysian Journal of Social Sciences and Humanities (MJSSH)*, 6(10).
- Adegboye, M.C., Bello, G., & Isaac, O.A. (2018). Conceptions of the Nature of Biology Teachers in Ilorin, Kwara State, Nigeria. *MOJES: Malaysian Online Journal of Educational Science*. 5(3), 1-12.
- Aggarwal, J.C. (2008). *Essentials of Educational Psychology*. Delhi. VKAS Publishing House pvt ltd. 287-292.
- Antó, J. M., Martí, J. L., Casals, J., Bou-Habib, P., Casal, P., Fleurbaey, M., Frumkin, H., Jiménez-Morales, M., Jordana, J., Lancelotti, C., Llavador, H., Mélon, L., Solé, R., Subirada, F., & Williams, A. (2021). The Planetary Wellbeing Initiative: Pursuing the Sustainable Development Goals in Higher Education. *Sustainability (Switzerland)*, 13(6).
- Anyika, V. O., Anikelechi, I. G., & Thobejane, T. D. (2021). The Impact of Covid-19 on Nigerian Education System. *Journal of Intellectual Disability - Diagnosis and Treatment*, 9(2).
- Gopalan, M., Rosinger, K., & Ahn, J. Bin. (2020). Use of Quasi-Experimental Research Designs in Education Research: Growth, Promise, and Challenges. *Review of Research in Education*, 44(1).

- Aremu, A, & Abiodun, S. (2010). Computer Animation and Academic Performance of Nigerian Senior Secondary Schools Students in Biology. *Journal of the Research Centre for Educational Technology (RCET)*. 6(2), 148 - 161
- Ayodele, E. A. (2009). Effective Improvisation in Primary Science. Teachers' Association of Nigeria (STAN) , *41st Annual Conference Proceedings*, 339 – 341.
- Bamidele, E.E & Yoade, F.B. (2017). Effects of Modes of Computer Animation Instructional Packages on Students' Achievement in Osun State Secondary Schools Biology. *International Journal of Innovation and Research in Education Sciences*, 4(4), 2349-5219.
- Barak, M., Ashkar, T, & Dori, Y.J (2010). Teaching Science via Animated Movies; its Effect on Students Learning Outcomes and Motivation. *Proceedings of the Chais Conference on Instructional Technologies Research. The Open University of Israel*.
- Bello., M. R. (2014). Effect of Computer Aided Instruction Package on Performance, Attitude and Retention of Genetics Concepts Among Secondary School Students in Niger State, Nigeria A Thesis Submitted to Postgraduate School Usmanu Danfodiyo University Sokoto.
- Bichi, S.S. (2002). Effects of Problem Solving Strategy and Enriched Curriculum on Secondary School Student's Performance in Evolution Concepts. *Journal of Department of Education A.B.U Zaria, Nigeria*, 3(1), 132-137.
- Enohuen, V. O. (2015). Effect of Instructional Materials on Achievement and Retention of Biology Concepts among Secondary School in Delta State, Nigeria. A thesis submitted to the Department of Science Education, Ahmadu Bello University Zaria, Kaduna Nigeria.
- Federal Government of Nigeria (2013). Revised National Policy on Education. Lagos Press.
- Ifeobu, H. N. (2014). Evaluation of the Implementation of National Curriculum for Secondary School Biology in Anambra State, Nigeria. A Doctorial Thesis Submitted to the University of Nigeria, Nsuka, Enugu State.
- Gambari, A.I., Yaki, A.A., Gana, E.S & Ughouwa, E.Q. (2014). Improving Secondary School Students' Achievement and Retention in Biology through Video-based Multimedia Instructions. *Journal of Scholarly Teaching*, Vol 9.
- Hamutoglu, N. B., Unveren-Bilgic, E. N., Salar, H. C., & Şahin, Y. L. (2021). The Effect of E-Learning Experience on Readiness, Attitude, and Self-Control/ Self-Management. *Journal of Information Technology Education: Innovations in Practice*, 20.
- Imhanyehor, G. O. J. (2021). Digital Literacy and Primary Educational System in Nigeria. *Journal of Public Administration, Finance and Law*, 20.
- Kim, H., Lee, E. C., Seo, Y., Im, D. H., & Lee, I. K. (2021). Character Detection in Animated Movies Using Multi-Style Adaptation and Visual Attention. *IEEE Transactions on Multimedia*, 23.
- Krishnan, N. (2021). A Hemodialysis Curriculum for Nephrology Fellows Using A Blended Learning Approach: Best of Both Worlds? *Journal of Nephrology*, 34(5).
- Kpolovic, J.P. (2010). Advance Research Methods: New Owerri: Springfield Publishers Ltd.
- O'Day, D.H (2007). Animated Cell Biology: A Quick and Easy Method for Making Effective High Quality Teaching Animations. *CBElifesci.educ*.5. 255-263.
- Rajaram, K. (2021). Learning Interventions: Collaborative Learning, Critical Thinking and Assessing Participation Real-Time. In *Evidence-Based Teaching for the 21st Century Classroom and Beyond*.



- Ramalingam, S.T (2010). *Modern Biology for Senior Secondary Schools*. African Publishers plc, Book house trust, P.M.B 1639, Onitsha, Nigeria. ISBN: 978-978-175-530-9.
- Salisu, A. (2015). *Impact of Animated Media Strategy on Achievement, Retention and Interest among Secondary School Geography Students in Western Concepts , Katsina State, Nigeria*. A PhD Thesis Submitted to the School of Postgraduate Studies, Ahmadu Bello University, Zaria.
- Thomas, O.O. & Israel, O.O. (2014). Effectiveness of Animation and Multimedia Teaching on Students Performance in Science Subjects. *British Journal of Education, Society and Behavioral Science*, 4 (2).
- Versky, B., Morrison, J. B., & Bétrancourt, M. (2002). Animation: Can it Facilitate? *International Journal of Human-Computer Studies*, 57(4), 247-262
- Usman, Y. D., & Chinyere, M. G. (2021). Quality Assurance in Nigeria's Education System: Prospect and Challenges. *EduLine: Journal of Education and Learning Innovation*, 1(2).
- Williams, W. R. (2020). Examining Studio Ghibli's Animated Films: A Study of Students' Viewing Paths and Creative Projects. *Journal of Adolescent and Adult Literacy*, 63(6).
- Yan, B. (2021). Problems and Countermeasures in the Process of Applying Multimedia Technology in Basketball Teaching. *Wireless Communications and Mobile Computing*, 2021.
- Yulianti, E., Zhafirah, N. N., & Hidayat, N. (2021). Exploring Guided Inquiry Learning with PhET Simulation to Train Junior High School Students Think Critically. *Berkala Ilmiah Pendidikan Fisika*, 9(1).
- Карпова, С. И., Муродходжаева, Н. С., Цаплина, О. В., & Каитов, А. П. (2020). The Pedagogical Potential of Animation in The Education of Preschool and Primary School Children. *Tomsk State Pedagogical University Bulletin*, 6(212).