



## Relative Efficacy of Graphics and Model Instructional Media on Academic Achievement of Biology Students in Aguata Education Zone

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### Abstract

This paper investigated the relative efficacy of graphics and model instructional media on academic achievement of Biology students in Anambra State. Three research questions and hypotheses guided the study. The sample comprised 210 SS11Biology students. The instrument used for data collection was Biology Achievement Test (BAT). Kuder-Richarson 20 (K-R20) was used to determine internal consistency of BAT and a reliability coefficient of 0.97 was obtained. Mean, Standard deviation and Analysis of Covariate (ANCOVA) were used for data analysis. The results revealed that students taught biology using graphics instructional media performed better than students taught using model; male students performed better than female students when taught using graphics instructional media among others. The study recommended among others that teachers receive appropriate training in the use of graphics in the teaching and learning process.

**Keywords:** Academic achievement, graphics, model and secondary school.

### Introduction

Discovering what exist in the universe and how those things work in the past, today and in the future is done through science. The knowledge obtained from science is based on observation, experimentation, measurement and the formulation of laws to describe these facts in general terms. No country can afford to neglect science at any level of education and hope to thrive in any field of human endeavor because sciences teach one how to think analytically when solving problems. Science is taught in secondary schools as agriculture, biology, chemistry, mathematics, among others. Biology among others is one of subjects taken by both science and art students, thereby making it a subject with vast population.

Biology is defined as the natural science that studies life and living organisms, including their physical make up, chemical composition and molecular interaction, physiological mechanism, growth and evolution. Biology according to Taiwo and Emeke (2014) exposes the students to the world of self knowledge as well as the immediate and distant environment. This statement agrees with Umoke and Nwafor (2014) who defined biology as the study of the inter-relationship between the living organisms and their immediate environment. In addition, Attamah (2016) described biology as a field of study that deals with the study of plants, animal and other living organisms. Biology as a branch of science and the prerequisite subject for many fields of learning contributes immensely to the technological growth of the nation. In Nigeria, the study of biology starts from

Senior Secondary Education. The aims and objectives of biology education includes the following; to prepare students to acquire adequate laboratory and field skills in biology; to acquire meaningful and relevant knowledge to everyday life in matters of personal and community health and agriculture; and to acquire reasonable and functional scientific attitudes (National Policy of Education (NPE) 2013, P.11).

In pursuance of the above stated objectives the contents and context of the curriculum place emphasis on field studies, guided discovery, laboratory techniques and skills along with conceptual thinking. The Nigerian curriculum has been designed not only to help in achieving the stated objectives but also to enhance creativity in learning which involves instructor, learners, and learning resources in the school or in any other appropriate instructional setting(Sani,2014). Some of the problems or gaps which hinder science education which biology is part of it from achieving its set objectives according to Ezeh (2010) include: lack of modern science equipment, poor teaching methods and techniques, lack of qualified and dedicated science teachers, poor attitude of teachers towards using improvised and local materials for teaching. With these problems, students may not understand science which can lead to poor achievement in learning.

Achievement is described as the outcome attained at the end of a given objectives. It is a particular learning setting that is characterized by examination marks, teachers given grades and percentile in academic subjects (Chowdhury and Pati, 2012). The West

African Examination Council (WAEC) Lagos, Nigeria from (2011-2018) stated that the students that sat for biology external examination had percentage passes of: 38.50%, 38.32%, 40.28%, 37.59%, 47.62%, 52.97%, 59.22% and 49.98% respectively (WAEC, 2018). This shows that the percentage of pass for the years retrieved were not satisfactory. This is supported by researchers who noted that student's achievement in biology has not been encouraging (Ezeh, 2010, Ali, Toriman and Gasim, 2014, and Akhigbe and Ogufero, 2019, Onu, Anyaegbunam and Uzoigwe 2020). It becomes paramount to shift to technology integration strategies as a new form of pedagogy.

Instructional media is a broad term which is often replaceable and synonymous with other terms such as educational design and educational technology. Instructional media are tools that an instructor employs to implement instruction and facilitate learning as they help to capture students' attention, stimulate and sustain their interest. Instructional media according to National Teachers' Institute (NTI, 2011) are communication channels through which messages, information, ideas and knowledge are conveyed or disseminated to learners. Instructional media are concrete and non-concrete in nature which the teacher uses in a lesson for teaching (Amali and Adejoh, 2013). It helps in making learning become an enjoyable experience (Akoja and Ali, 2012). In addition, it makes learning more engaging, realistic and appealing (Abdu- Raheem, 2016). Such media according to (Amali and Adejoh, 2013) could be utilized to carry ideas, knowledge, information and messages about what the teacher teaches to the students. Teachers use them as alternative channels of communication to concretize a concept during his or her teaching. It equally helps students to retain knowledge for longer periods (Awolaju, 2015). It makes learning permanent as the students' sense of hearing, sense of sight and sense of touch are all engaged in the learning processes. They are instruments, which assist teachers to make their lessons clear to students. The use of instructional media in the teaching and learning process is highly justified because most subjects that are taught to learner's comprehension depend largely on the use of instructional media (Tolorunleke, Akoji, Enejo and Lawal, 2020). Studies such as (Onasanya and Omosewo, 2011; Adalikwu and Iorkpilgh; 2013 Okpe, 2018) found a positive effect of instructional media on student academic achievement. Therefore, when

adequate instructional media are made available to schools and are used wisely in teaching and learning there could be better academic achievement. An instructional media can either be a three dimensional or two dimensional objects.

A model is a three dimensional object which is used to enhance effective teaching and learning of a particular concept. They are not the real objects but they play the same roles and appear as real objects. They are generally solid object that do not move. Models provide the interior view of the real objects making them larger, smaller or often same size as the object to be presented (Ibe-Bassey, 2000). It also increases the quality of learning by involving more than one sense: sense of hearing, sense of touch and sense of sight as students not only see the different parts of the real objects but they also touch them as they are being taught which increases their understanding and retention of the topic. Uche and Obinna, 2012 stated that models develop creativity and general intellectual ability of the learner. Models are essential in many scientific contexts and constitute one of the main instruments of modern science. They are typically used when it is either impossible or impractical to create experimental conditions in which scientists can directly measure the outcomes. For a model to be effective, it must be rightly labeled to ensure that the correct concepts are formed in the mind of the learner to avoid misconception. Therefore, the introduction of visual – spatial presentation of learning materials can help in the teaching and learning process.

Graphics are visual- spatial materials or instruments which communicate fact clearly through combining of charts, sketches, cartoons, graphs and drawing, words and pictures. They are pictorial representation of data such as computer aided design and manufacture, typesetting, educational and recreational settings (Clark, 2010). Graphics often combine text, illustration, and color which are labeled for clarity as it helps students to learn the various parts of the object labeled which the model does not show. This statement is in accordance with Adalikwu and Iorkpilgh (2013) who stated that graphics communicates facts and ideas clearly through combination of drawings, words and pictures. The importance of graphics cannot be overemphasized; it motivates learners, provides access to instructional content, facilitates greater comprehension, engages learners and captures attention (Inuwa, 2016). Utilization of graphics in teaching creates definitiveness to the materials being studied. Also

engaging the learners in the actual production of graphics visuals offers to students the opportunities for hands- on experience, which is one of the best ways to learn. A well designed graphics may provide the needed structure that allows learners to effectively select, organize and integrate new information (Mayer, 2011). It allows teachers to vary the delivery of lessons and keep students interested in learning (Roberson, 2012). Graphics help to visualize the whole concepts learned and their relationships with each other (Adalikwu and Iorkpilgh, 2013). In a study carried out by Utibe- Abasi (2016) result obtained showed that students in relia experimental group performed better than those in model experimental group. Therefore, this study aims at finding out the relative effectiveness of graphics and model instructional media on academic achievement of biology students. The incorporation of graphics or model in a lesson when combined with oral instruction can facilitate learning among greater number of students be it male or female.

Males and females who are ascribed to a role in the society either socially or culturally is characterized with a term known as gender. Gender is the cultural attributes of both males and females (Akpochofo, 2019). It includes the belief held about the aptitudes and likely behaviors of both women and men. Gender is a vital factor in education, as it influences the interest and academic achievement of students. The issue of gender and academic achievement has a long extended controversial issue. A lot of studies have shown inconclusive results on gender and academic achievement of students. Some studies found a significant effect of gender on student's academic achievement (Ricardo, Svea and Matthias, 2020, Heo and Toomey, 2020, Otutola, 2017; Azman, 2014) while some did not (Akinbadewa, 2020, Akinoso, 2018; Abidoye, 2015; Wonu and Anackwe, 2014). Also Godpower- Echie and Ihenko (2017) concluded that gender does not have significant influence on achievement of integrated science students. Hence studies on gender appear to be contradictory with no precise conclusion. Based on the above assertion of the gender, this study is designed to investigate the efficiency of graphics and models instructional media on students' achievement in biology in respect to gender.

### Statement of the Problem

The act of teaching involves the passing of ideas, skills, beliefs and knowledge from the teacher to the

student (learner). In Nigeria for example studies have shown that spoken words alone in communication of ideas are rigorously ineffective and inefficient in producing the desired outcome, this is because classroom has become a centre for learning which discourages students participation and the stimulation of their senses which can affect achievement in the subject area. In other to overcome the problems of poor performance, teaching and learning of Biology should be done in such as way as to achieve set objectives. Therefore, the use of diverse instructional media has been suggested to help enhance their achievement. There is great demand to shift to technology integration strategies as a new form of pedagogy. Therefore, the problem of this study put in question is: what is the relative effectiveness of graphics and models instructional media on secondary student's achievement in biology?

The study specifically seeks to ascertain the:

1. effect of graphics and model instructional media on students' achievement in biology
2. influence of gender on students' achievement in biology
3. interaction effect of gender and instructional media on student achievement in biology

Based on the purpose of the study the following research questions guided the study:

1. What are the mean achievement scores of students taught biology using graphics and model instructional media
2. What are the mean achievement scores of male and female students in biology?
3. What is the interaction effect of gender and instructional media on student's achievement in biology?

### Hypothesis

The hypothesis was tested at 0.05 level of significance.

1. There is no significant difference in the mean achievement scores of students exposed to models and those taught with graphics instructional media
2. There is no significant difference in the mean achievement score of male and female students in biology
3. There is no significant interaction effect of media and gender on student's achievement in biology

### Methodology.

The study employed a quasi-experimental. The pre-test, post-test design was used. Quasi-experimental design is a resemblance of true experimental design aimed to establish a cause and effect relationship between two or more variables. Unlike a true experiment a quasi experiment does not rely on random assignment, rather subjects are assigned based on non random conditions to the groups. The justification for its usage is that the study involves cause-effect relationship, also since the selection of groups are done non-randomly, quasi experimental is the most suitable (Cohen, Manion and Morrison, 2011). The population of the study comprised of 1,115 SS2 biology students in Aguata Local Government Area of Anambra State. The choice of this area was predicated on the fact that it has the largest number of schools which gives a wider coverage to adopt as the area of study. The sample size was 210 selected from four intact classes in four sampled schools. Purposive sampling was employed to select four co-educational schools because of electricity supply, qualified teachers and also gender since it is a variable in the study. The grouping of the students into experimental was also done through simple random sampling technique. The instrument for the study was a self-designed Biology Achievement Test (BAT). The BAT made up of 30 multiple choice questions, based on the

secondary school biology syllabus on pollination. The BAT was developed from the topic by first constructing the test blue print for the content specified above. The BAT was used to assess the student's achievement in biology. The BAT was subjected to face and content validation by specialist in Science Education and Measurement and Evaluation from the University of Nigeria, Nsukka. For BAT, the reliability coefficient was determined with Kuder-Richardson Formula (K-R20) for internal consistency which yielded 0.94 reliability coefficient. Pre-test was given to both experimental and control groups using Biology Achievement Test. The learning activities or lesson plans on the selected topics were prepared based on Model and graphics instructional media which were used to teach the two experimental groups, using the same length of time (period). The experimental treatment lasted for six weeks for both groups after which post test was administered using BAT. The scripts were marked according to BAT marking scheme and recorded. The reshuffled form of BAT was administered as post-posttest. Mean, Standard deviation and Analysis of Covariance (ANCOVA) were the statistical tools used for analyses of the data collected. The decision rule was that the null hypotheses to be rejected when P-value is less than 0.05, otherwise the hypothesis was not rejected.

## Results

**Table 1: Mean and standard deviation scores on students' achievement in Biology**

Group	N	Pre-test		Post-test		Gain Score
		Mean	SD	Mean	SD	
Graphics	112	14.66	6.91	24.68	2.70	10.02
Model	98	11.56	3.44	14.66	2.98	3.1

The data in Table 1 revealed that students taught Biology using graphics instructional media had mean achievement score of 24.68, standard deviation of 2.70 and a gain score of 10.02, while students taught using

models instructional media had mean achievement score of 14.66, standard deviation of 2.98 and gain score of 3.1.

**Table 2: Mean and Standard Deviation score on influence of gender on students' achievement in Biology**

Gender	N	Pre-test		Post-test		Mean Gain	Gain diff
		Mean	SD	Mean	SD		
Male	98	13.53	6.05	21.03	5.59	7.50	
Female	112	11.75	3.57	18.26	3.40	6.51	0.99

Table 2 showed that male student had a mean achievement score of 13.53 with standard deviation of 6.05 in pre test and a mean achievement score of 21.03 with standard deviation of 5.59 in post-test, while their female counterparts had mean achievement score of

11.75 and standard deviation of 3.57 in pretest and 18.26 with standard deviation of 3.40 in post test. Male students had mean gain score of 7.50 while their female counterparts had mean gain score of 6.51.

**Table 3: Mean and Standard Deviation on interaction effect of media and gender on the mean achievement score of students in Biology?**



Method	Graphics			Models		
	N	Mean	SD	N	Mean	SD
<b>Pretest</b>						
Male	62	14.66	6.91	52	11.56	3.44
Female	50	11.78	3.71	46	11.73	3.48
<b>Posttest</b>						
Male	62	24.69(10.03)	2.70	52	14.65(3.09)	2.98
Female	50	23.96(12.18)	2.75	46	13.59(1.86)	3.58

**Note:** Gain scores are in parentheses

The result in Table 3 revealed that male students taught biology using graphics had higher mean achievement score in pre test and post test of 14.66 and 24.69 respectively while the female counterpart had a pretest and post test of 11.78 and 23.96. For

students taught biology using model instructional media male student had higher mean achievement score of 11.56 in pretest and posttest of 14.65 while the female counterpart had a higher achievement score pretest of 11.73 and posttest of 13.59.

**Table 4: Analysis of covariance of student's mean achievement scores in Biology.**

Sources of Variation	Sum of Squares	DF	Mean Square	F	SIG
Corrected model	5218.382	4	1304.595	148.369	.000
Intercept	7224.426	1	7224.426	821.618	.000
Pretest	96.208	1	96.208	10.941	.001
Gender	21.148	1	21.148	2.405	.123
Media	4358.320	1	4358.320	495.662	.000
Media× Gender	7.078	1	7.078	.805	.371
Error	1626.692	205	7.935		
Total	79444.000	210			
Corrected total	6845.074	209			

Results in Table 4 showed that there is a significant main effect of the instructional media (Models and Graphics) on students achievement in Biology  $f(1,209)495.662$   $p<.000$ . Therefore, the null hypothesis was not accepted. Showing that there was significant difference in the mean achievement scores of students taught biology using graphic and those taught using models.

The result also revealed that there is no significant main effect of gender on students' achievement in Biology  $f(1,209) 2.405$ ,  $p> .123$ . Therefore, the null hypothesis was not rejected it was accepted. Showing that there is no significant difference in the mean achievement scores of male and female students taught biology using graphics and those taught using model.

## Discussion

Students taught using Graphics performed better than their counterparts taught biology using Model instructional media. The observed results could be attributed to the fact that graphics provide the needed structure that allows learners to effectively select, organize and integrate new information or it may be that graphics helps in focusing attention and

motivating learners which are key factors for any successful learning activity through moving symbols or characters. Another reason is that engaging the learners in the actual production of graphics visuals offers to students the opportunities for hands- on experience, which is one of the best ways to learn. This also has a way of improving retention of information due to the link between static and dynamic visuals. The findings of the study are in line with the findings of Mayer (2011), Roberson (2012), Adalikwu and Iorkpilyh (2013) and Inuwa (2016).

Results of this study also showed that the male students performed slightly better than their female counterparts in Biology. This is in line with the findings of Ezeudu and Obi (2013) who opined that male performs better than the female. The study did not support Voyer and Voyer (2014) who opined that female students perform better than the male students. This could be as a result of the instructional media used. The results do not suggest ordinal interaction effect on the mode of method and gender on students' achievement in biology. This was because at all the levels of gender, the mean scores were higher for students with models and graphics. This finding is in



line with the findings of Agomouh (2010), and Miriogu (2012) who found no interaction effect of gender and instructional media. This finding did not support the study of Baser (2006) who noted that gender significantly interacts with the instructional media.

### Conclusion

From the findings of the study, it is concluded that graphics and models have significant effects on students' academic achievement and that graphics is more effective than model in facilitating students academic achievement in biology. Male students performed better than their female counterparts in biology.

### Recommendation

1. Graphic designers should seek to develop subjected laden graphic materials for Biology instructions.
2. Government should assist in funding research works, encourage and sponsor teachers to workshops and conferences. Both State and Local Government should participate fully and actively in the provision of instructional materials for classroom teaching and learning.
3. Parents should assist teachers in the provision of improvised instructional materials for better instructional delivery in schools.
4. Biology teachers should be encouraged to source for instructional materials that can appeal to the senses of the students, encourage their participation which makes learning more meaningful and promotes achievement in biology.

### Reference

- Adalikwu, S.A & Iorkpilgh, I.T. (2013). The influence of instructional materials on academic performance in Biology in senior secondary school. *International Journal of Humanities and Social Studies*, 12(1). 58-73.
- Agomouh, P.C. (2010). Effect of prior knowledge, exploration, discussion, dissatisfaction with prior knowledge and application (PEDDA) and the learning cycle (TLC) constructivist instructional models on students' conceptual change and retention (*An Unpublished PhD thesis*), University of Nigeria, Nsukka.
- Ahmad, N.H. & Ashar, (2015). The role of gender as moderator. *Journal of Asia Business Studies*. 4(3), 4-6.
- Akoja, I.E & Ali, F.A. (2012). The impact of instructional materials on the academic performance of primary school pupils in Makurdi LGA of Benue State. In P.A Eniayeju and P.T. Ortese (Eds). *Contemporary Issues in Education*". Makurdi: Destiny ventures.
- Amali, A. O, & Adejoh, M.J. (2013). *Improving the teaching and learning of Basic Science and Technology through the use of instructional materials and improvisation*. In M.O.
- Attamah, P.N. (2016). Influence of teachers' instructional effectiveness on students' interest and achievement in biology in secondary schools in Udenu Local Government Area of Enugu State. (*Unpublished PGDE thesis*). University of Nigeria, Nsukka.
- Awolaju, B.A. (2015). Instructional materials as correlates of students' academic performance in biology in senior secondary schools in Osun State. *International Journal of Information and Education Technology*, 6(9), 705-709.
- Azman (2014). Constraints and remedies to students' dread for Sciences. *Scientific Journal of Educational Administrators* 3(8) 9-19.
- Baser. M. (2006). Effects of conceptual change and traditional confirmatory simulations on pre-service teachers' understanding of direct current circuits. *Journal of Education and Technology*, 15(2), 367-381.
- Buccheri, G., Gurber, N.A., & Christian, B. (2011). The impact of gender on interest in science topics and the choice of scientific and technical vocations. *International Journal of Science Education*, 33(1), 59-178.
- Cohen, L., Manion, L. & Morrison, K. (2011). *Research Methods in Education 7<sup>th</sup> Edition*. Routledge Taylor & Francis Group, London and New York.
- Egolu, E.O & Igboegwu, E.N. (2013). *Meeting the challenges of MDGS through Chemistry curriculum reforms and implementation in secondary schools in Okechukwu, A. (Ed) STAN 54<sup>th</sup> Annual Conference Proceeding*.
- Ezeh, C.E. (2010). Problems militating against research in business education in selected tertiary institutions in Nigeria. *Business Education Journal*, 7(2), 55-59.



- Ezendu, F.O. & Obi, T.N. (2013). Effect of gender and location on students' achievement in chemistry in secondary schools in Nsukka Local Government Area of Enugu State. *Research on Humanities and Social Sciences*, 3(15). 20-32.
- Godpower- Echie G &Ihenko, S (2017). Influence of gender on interest and academic achievement of students in Integrated Science in Obio/ Akpor of River State. *European Scientific Journal*, 13(10) 272-279.
- Matimbe, R.T(2014). Master of education in educational management: Financial management in education. Harare: Zimbabwe Open University (ZOU)
- Ogah, O.J. (2013). Assessment as a veritable tool for effective teaching and learning. *Journal of Educational and Social Research*. Vol 3(9) 133-137.
- Ogunleye, B.O. (2009). Trends and pathways of Nigerian students WASSCE entry and performance in physics, chemistry and biology. *Annual Journal of Technical University of Na, Bulgaria*, 3(2).
- Onasanya, S.A. &Omosewo, E.O. (2011). Effect of improvised and standard instructional materials in secondary school students' academic performance in Physics in Illorin, Nigeria. *Journal of Scientific Research*, 1:68-76.
- Onu, W. Anyaegbunam, N.J, Uzoigwe, A.U (2020). Improving biology student's interest and achievement through collaborative instructional strategy. *Journal of Education, Society and Behavioral Science* 33(2) 9-20.
- Ricarda, C. I, Svea I. K & Matthias, W (2022). The influence of gender and interest on the use of learning strategies in Biology lesson. *European Journal of Educational Research* 11(1) 587-597.
- Tolorunleke, E.A. Akoji, A, Ibrahim, J.E & Ishaka, M.L (2020). A comparative study of the impact of instructional media in the teaching and learning process in selected schools in kogi state. *Journal of Contemporary Educational Research* 3(1) 1-11.
- Umoke, J.C &Nwafor, C. (2014). Effect of instructional simulation on secondary school Students' achievement in biology. *Journal of Education and Practice*, vol 5.
- Voyer, D., &Voyer, S.D. (2014). Gender differences in scholastic achievement: A meta-analysis. *Psychological Bulletin*, 14(4), 117-122.
- Wonu, N &Anaekwe, E (2014). School effect on students' mathematical achievement in Obio/ Akpor Local Government Area of River State. *International Journal of Educational Development* 4(1) 69- 77.