

## IMPACT OF DIGITAL GRAPHICS ON SECONDARY SCHOOL BIOLOGY STUDENTS' RETENTION ON THE CONCEPT OF POLLUTION IN AGAIE METROPOLIS OF NIGER STATE

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### Abstract

*This study examined the impact of digital graphics (charts showing land, water and air pollution) on secondary school Biology students' retention on the concept of pollution in Agaie Metropolis of Niger State. Quasi experimental design was adopted for the study. A total of 120 Secondary School I (SSI) Biology students from two senior secondary schools (67 Experimental group and 53 Control group) formed the sample of the study. The schools were randomly assigned to experimental and control groups and intact classes were used in each of the schools. The instrument used for data collection was the Biology Retention Test (BRT) which was developed by the researchers and validated by Biology lecturers in the Department of Biological Science, Federal University of Technology, Minna. The instrument was also pilot tested and reliability coefficient of 0.86 was obtained using Pearson Product Moment Correlation Coefficient formula. Two research questions were raised to guide the study. Also, two null hypotheses were formulated and tested at 0.05 significant level. The result revealed a significant difference in the mean retention score of students taught using digital graphics and those taught using conventional lecture method. It also revealed no significant difference between the mean retention scores of male and female students taught using digital graphics. Based on these findings, it was concluded that the use of digital graphics is more effective in improving students' retention in Biology than the conventional lecture method. It is therefore recommended among others that Government should provide adequate and relevant digital graphics for the meaningful teaching and learning at secondary school level of our educational system.*

**Key words:** Achievement, Biology, Chart, Digital Graphic, Students and Pollution.

### Introduction

Science is a methodical approach of acquiring, understanding and interpreting knowledge for growth and development of both individual and the nation as a whole (Abakkour, 2012 & Awofobaju, 2006). The National Policy on Education stated that science subjects constitute part of the core subjects at the Secondary School Level. The study of science is important as the knowledge of science is used for improving and changing attitudes and skills, improving the process of storing knowledge about an individual and its environment. Science has always been seen as the backbone of technological advancement therefore, its role in the modern world cannot be overemphasized (Lorence, 2006). Other importance of the knowledge of science includes; manufacturing and production of medicine, computer, mobile phones, air craft, space satellite, television amongst others. The major branches of science comprised of Biology, Physics, Chemistry and Mathematics (Abakkor, 2012).

Biology, as a core science subject, is basically concerned with the study of living organisms. It deals with the study of life, evolution of living organisms, the study of the structures and functions of living organisms and the processes by which they interact with each other as well as with their environment. Biology studies how the world is structured, how it functions and what these functions are all about, how it develops, how living things came into existence, and how they react to one another and with their environment (Alice, (2007). It is central to many science related courses like medicine, pharmacy, biochemistry, nursing, agriculture etc. This is why researchers and curriculum planners pay much attention to biology as an important science subject in the school curriculum (Koroka, Ezenwa, Wushishi & Omalu (2015).

Despite the importance of Biology to individual and national development, the study of Biology especially at secondary school level is faced with numerous problems as a result of which the students' performance in Biology has been bellow expectation (WAEC, 2011, 2012 & 2013). Abdullahi (2003) reported that, one of the major factors hindering effective teaching and learning of science (especially Biology) in Nigeria is lack of human and material resources. Other problems includes; lack of teacher training and retraining facilities, the curriculum content, poor curriculum implementation and evaluation, lack of relevant instructional materials, large classroom sizes and lack of adequate laboratory equipment. Other researchers revealed that teachers' instructional strategies are unproductive and as such, students find many topics difficult to understand (Koroka & Ezenwa, 2009 and WAEC, 2013). Many Biology teachers employed several methods in teaching to achieve meaningful learning and understanding by the students (Zenbari & Blume, 2009). For instance, Ifeakor (2005) emphasized the use of commercially produced computer assisted instructional package to teach Biology.

Others ascertained that, students' poor achievement in Biology can be attributed to lack of qualified teachers to handle Biology (Maishinkafa, 2010 & Abakkour, 2012). According to them, most teachers employed the use of conventional lecture method which is a classroom-based method characterised by lectures and instructions by the teacher which make it to be a teacher-centred method of instruction. This teacher-centred method of instruction emphasizes on learning through the teacher's guidance whereby the teacher always talk to the students instead of encouraging them to interact and actively participate in teaching and learning process. In most classes, students are subjected to rote learning, where they depend on memorization without understanding the subject. This method makes students to become passive rather than active learners (Abdullahi, 2003; Lawal, 2006; Maishinkafa, 2010 & Udousoro, 2011).

However, various efforts have been made by researchers and science educators to come up with instructional strategies that will promote effective teaching, learning and understanding of Biology concepts as well as improving students' achievement but all proved unsatisfactory as shown in table 1.

**Table1: Performance of Nigerian Biology Students at WASSCE, 2008-2013**

| YEAR | TOTAL   | (A1 – C6) PASS  | (D7 – E8) PASS  | FAILURE         |
|------|---------|-----------------|-----------------|-----------------|
| 2008 | 1005894 | 298555 (29.68%) | 326092 (32.41%) | 348890 (34.68%) |
| 2009 | 1051557 | 375850 (35.74%) | 313827 (29.84%) | 338491 (32.18%) |
| 2010 | 1137131 | 559854 (49.23%) | 292317(25.70%)  | 284960 (72.96%) |
| 2011 | 1238163 | 413211 (33.27%) | 397353(32.09%)  | 402148 (32.47%) |
| 2012 | 418423  | 185949 (44.44%) | 114697(27.41%)  | 110417 (26.38%) |
| 2013 | 468546  | 204725 (43.69%) | 114020(24.33%)  | 119260 (25.45%) |

Source: WAEC, 2013

Table 1 shows the percentage of students that passed Biology at the Senior School Certificate Examination (SSCE) conducted by the West African Examination Council (WAEC). As indicated in table 1, the number of students that passed Biology at credit level (A1-C6) was consistently less than 50% for a period of six years (2008 - 2013).

Therefore, it is necessary to look into the current methods of teaching Biology in order to obtain a suitable strategy that would lead to effective teaching and learning of Biology. One of the strategies considered by this research study is the use of Digital Graphics. This study therefore, aimed at investigating the impact of digital graphics (charts showing land, water and air pollution) on secondary school Biology students' retention of the concept of pollution. The study also investigated the impact of digital graphic on gender retention ability among the students.

### Aim and Objectives of the Study

The aim of this study was to investigate the impact of digital graphics (charts showing land, water and air pollution) on secondary school Biology students' retention of the concept of pollution. Specifically, the study attempted to achieve the following objectives:

- to determine the impact of digital graphics (charts showing land, water and air pollution) on secondary school Biology students' retention of the concept of pollution

- ii. to determine the gender influence of digital graphics (charts showing land, water and air pollution) on secondary school Biology students' retention of the concept of pollution.

### Research Questions

The following research questions were raised to guide the study:

- i. Will there be any differences between the mean retention scores of students taught the concept of Pollution in Biology using digital graphics and those taught with conventional method?
- ii. Will there be any differences between the mean retention scores of male and female students taught the concept of Pollution in Biology using digital graphics?

### Research Hypotheses

The following null hypotheses were formulated and tested at 0.05 significant level

**HO :** There is no significant difference in the retention scores of secondary school Biology students taught the concept of Pollution using digital graphics and those taught without digital graphics.

**HO<sub>2</sub>:** There is no significant difference in the retention scores of male and female students taught the concept of Pollution using digital graphics.

### Methodology

The research design adopted for this research was a Quasi experimental design (Non-equivalent, Non-randomized, Experimental - Control group design). The experimental group students were taught the concept of pollution in Biology using digital graphics (chart showing land, water and air pollution) while the control group students were taught the same concept using conventional lecture method.

**Table 2: Research Design Format**

| Group              | Pretest        | Treatment | Retention test |
|--------------------|----------------|-----------|----------------|
| Experimental Group | O <sub>1</sub> | X         | O <sub>2</sub> |
| Control Group      | O <sub>3</sub> | C         | O <sub>4</sub> |

Where:

O<sub>1</sub> & O<sub>3</sub>=Pretest, O<sub>2</sub> & O<sub>4</sub>= Retention test, X – Treatment and C – Conventional Method

The target population comprises of 495 (male = 231 and female = 264) Senior Secondary School One (SSI) Biology students in two Niger State Government owned co-educational secondary schools in Agaie Metropolis while the sample population comprises of 120 Senior Secondary School One (SSI) Biology students.

Two schools were purposively selected for the study. This is because there are only two government owned co-educational schools in Agaie Metropolis. The selected schools were randomly assigned into experimental and control groups. From the selected schools, two intact classes were also randomly selected for the study.

The instruments used for the study were the treatment and test instruments.

**Treatment Instrument:** This was the digital graphics (charts showing land, water and air pollution). The concept of pollution was drawn as chart in form of concept map by the researchers in collaboration with an expert in instructional development. The charts were drawn by strictly following the SSI curriculum.

**Test Instrument:** This was Biology Retention Test (BRT) test items on pollution. It consisted of (20) multiple choice test items on pollution with four options (A - D) but only one of them is correct. The test items used covered all the topical areas of pollution in accordance with the SSI syllabus and they were drawn (adapted) from the West African Examination Council (WAEC) past question papers. The above instruments were both validated by three Biology teachers to determine their appropriateness before being used for the study. The retention test questions were the reshuffled pretest and posttest questions.

Reliability of the instrument was determined at Day secondary school Lapai using 20 students (male = 10 and female = 10). Day secondary school Lapai was used because there are only two co-educational secondary schools in Agaie and Lapai is not too far from Agaie. Test-retest method was used to collect two sets of data during pilot test. The two set scores were analyzed using Pearson product moment correlation coefficient formula and  $r = 0.86$  was obtained.

After the researchers were granted permission to use the selected schools and also introduced to both Biology teachers and students of the schools, they administered the Pretest question on both groups to determine their entry behaviour. The experimental group students were taught the concept of pollution in Biology using digital graphics (charts showing land, water and air pollution) while the control group students were taught the same concept using conventional lecture method. After the treatment which lasted for three weeks, a week revision was held after which the posttest was administered on them. The retention test was administered on the students two weeks later after posttest. The research study lasted for nine weeks.

The pretest, posttest and retention test scores were analyzed using mean, standard deviation and t-test statistics. Statistical Package for Social Sciences (SPSS) 20.0 version was used to analyze the data obtained. Data analyzed were used to answer the research questions and also test the hypotheses.

## Results and Discussion

**Table 3: t-test Analysis of Pretest Scores of Experimental and Control Groups**

| Group              | N  | df  | -<br>X | SD   | t cal               | P-value |
|--------------------|----|-----|--------|------|---------------------|---------|
| Experimental Group | 67 | 118 | 8.43   | 3.09 | 0.918 <sup>NS</sup> | 0.360   |
| Control Group      | 53 |     | 7.93   | 2.99 |                     |         |

NS: Not significant at  $p > 0.05$

Table 3 shows summary of t-test comparisons between the mean retention scores of control and experimental groups in the pretest. The result indicated that there was no significant difference in the mean retention mean scores of the two group ( $t = 0.918$ ,  $df = 118$ ,  $p > 0.05$ ). Hence it can be concluded that both experimental and control groups were at equal level on their prior knowledge on the concept of pollution in biology before the treatment.

**H<sub>0</sub>** . There is no significant difference in the retention mean scores of secondary school Biology students taught the concept of Pollution using digital graphics and those taught without digital graphics.

**Table 4: Summary of t-Test Analysis of Retention Score of Experimental and Control Groups**

| Group              | N  | df  | -<br>X | SD   | t-cal  | P-value |
|--------------------|----|-----|--------|------|--------|---------|
| Experimental group | 67 | 118 | 15.38  | 1.92 | 20.294 | 0.000   |
| Control group      | 53 |     | 8.15   | 2.10 |        |         |

\*Significant at  $p > 0.05$  alpha level

Table 4 shows the t-test comparisons between the retention score of students taught the concept of pollution in Biology with digital graphics and those taught using conventional lecture method. The mean score and standard deviation of the experimental group are 15.38 and 1.92; while that of the control group are 8.15 and 2.10 respectively ( $t = 20.294$ ,  $df = 118$ ,  $p > 0.05$ ). This result indicated a significant difference in the retention mean score of the experimental and control groups. The null hypothesis one is therefore rejected as a significant difference was observed in favour of experimental group.

**HO<sub>2</sub>.** There is no significant difference in the retention mean scores of male and female students taught the concept of Pollution using digital graphics.

**Table 5: Summary of t-Test Analysis of Retention Scores of Male and Female in the Experimental Group**

| Group  | N  | Df | $\bar{X}$ | SD   | t-cal | P-value |
|--------|----|----|-----------|------|-------|---------|
| Male   | 29 | 65 | 12.20     | 4.13 | 0.492 | 0.624   |
| Female | 38 |    | 11.84     | 4.17 |       |         |

NS= Not significant at  $p > 0.05$  alpha level

Table 5 shows t-test comparisons between the retention scores of male and female students taught using digital graphics. The mean score and standard deviation of the male students are 12.20 and 4.13 while those of the female students are 11.84 and 4.17 respectively ( $t = 0.492$ ,  $df = 65$ ,  $p > 0.05$ ). This result does not indicate any significant difference in the retention scores of male and female students taught using digital graphics. Hence the null hypothesis two stated above is not rejected.

### Findings of the Study

The following were the findings of the study:

- (I) Digital graphics used has significantly improved Biology students' achievement on the concept of pollution. This is because the experimental group students exposed to digital graphics achieved better than the control group students.
- (ii) Male and female students exposed to digital graphics achieved equivalently on the concept of pollution. This implies that the digital graphics (charts showing land, water and air pollution) improved the achievement of both male and female students equally.

### Discussion

The pretest scores in table 3 shows that the experimental group had a mean score of 8.43 and standard deviation of 3.09 and control group had a mean score of 7.93 and standard deviation of 2.99 respectively. This result reveals that the two groups are equivalent on the basis of their prior knowledge on the concept of pollution in Biology before the treatment because the p-value is greater than the alpha level of significance ( $p = 0.918$  greater than 0.05 alpha level).

The result of the t-test as shown in table 4 reveals a t-value of 8.630 and a p-value of 0.000 which is less than 0.05 alpha level of significance. The results in table 4 therefore, shows that the experimental group performed better than the control group. This means that the use of digital graphics has enhanced the retention ability of the experimental group students on the concept of pollution in Biology. This result was in line with the findings of Aiyede, 2008 and Akubulo, 2004 who also attested to the efficacy of digital graphics (instructional materials) in facilitating meaningful learning. Koroka, Ezenwa, Wushishi and Omalu (2015) also reported a significant improvement retention ability of the experimental group students using concept mapping techniques on students as an instructional material (digital graphics). Alice (2007) reported that effective utilization of digital instructional material promote effective teaching and meaningful learning.

The t-test as shown in table 5 revealed a t-value of 1.116 and p-value of 0.269 which is greater than the 0.05 alpha level of significance. Therefore, there is no significant difference in the retention scores of male and female Biology students exposed to digital graphic. This means that digital graphics is gender friendly. This finding is in line with those of Eze (2008) and Koroka, Ezenwa, Wushishi and Omalu (2015) who also found no significant difference in the performance of male and female students that were exposed to Computer Assisted Instruction.



## Conclusion

The results revealed that students exposed to digital graphics in Biology retained better than those exposed to conventional lecture method. The results also revealed that digital graphics is gender friendly. This implies that exposing students to digital graphics instructional strategy enhanced better retention of the concept of pollution.

## Recommendations

In view of the findings of this research study, the following recommendations were made: I

- (i). Teachers especially in Biology should be sent on in- service training on how to effectively use digital graphics as an instructional strategy during teaching.
- (ii). Government and School administrators should support and give necessary encouragement to teachers for effective utilization of digital graphics as an instructional strategy during teaching, most especially that it is observed to be gender friendly.

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