

COMPUTER GRAPHICS, FLIPPED CLASSROOM INSTRUCTIONAL STRATEGIES AND STUDENTS' PERFORMANCE IN BASIC SCIENCE AND TECHNOLOGY IN AKWA IBOM STATE

¹Umoetuk, Emmanuel, ²Akpan, Anyanime O.
Department of Science Education, Faculty of Education,
Akwa Ibom State University, Ikot Akpaden, Akwa Ibom State

¹Email: enkratilla@gmail.com
Tel: +234-8037444807

²Email: anyanimeakpan@aksu.edu.ng,
Tel.: +234-8023319141



Abstract

The study investigated the effectiveness of computer graphics and flipped classroom instructional strategies on the academic performance of basic science and technology students in Akwa Ibom State, Nigeria. Two research questions and hypotheses guided the study. Quasi experimental research pretest, posttest non-randomized group design was adopted. Population of study comprised all the 7,050 junior senior secondary two (JSS2) students (comprising 3298 boy and 3752 girls) in Uyo Local Government Area of Akwa Ibom State. Multistage sampling technique was used to select 98 JS 2 students for the study. The instrument “Basic Technology Performance Test” was used for data collection, with a reliability coefficient of 0.83. The research questions were answered using mean and standard deviation, while Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance. Results showed that students taught materials and processing in Basic Technology using flipped classroom strategy gained better than those taught using graphic strategy and there was no significant effect of gender on academic performance. It was recommended among others that the use of innovative instructional strategies should be encouraged for teaching of Basic science and technology.

Keywords: Instructional strategies, computer graphic, flipped classroom, basic technology



Introduction

It is generally acknowledged that the survival of a nation scientifically and technologically can only be achieved through science education. Science education plays a vital role in the lives of individuals and the development of nations. Science education is focused on developing students' scientific literacy that will equip them to be rational and participative citizens having societal impact (Akpan, Akpan & Umoh, 2023). The National Policy on Education (Federal Republic of Nigeria (2013) emphasizes that science taught in schools should be such that has meaning, relevance to the needs of the child and society as well as provide the child with opportunity to explore, interact, and interpret certain scientific process in the environment. It was therefore recommended that resources, activity-based, learner-friendly, experiential, and hands-on approach be adopted for teaching.

Basic Science and technology (BST) is a core subject and begins formally in the primary and junior secondary schools, where the foundation is laid for further studies in science and technology. The curriculum has four themes of Basic Science, Basic Technology, Information Technology and Physical/Health Education. The objectives of the BST curriculum amongst

others are to enable learners develop interest in science and technology, as well as apply their scientific and technological knowledge and skills to meet societal needs. Specifically, the revised curriculum addresses and prescribes learning through activities, as well as encouraging innovative teaching and learning approaches and techniques (Akpan & Akpan, 2017). To attain the above objectives, collaborative learning actions and active involvement are essential, and these depend on sound instructional strategies(Oni, 2014, Akpan & Akpan, 2017).).

Over the years, teacher-centred method of teaching, otherwise known as traditional method, is widely used in the classroom and is always central to teaching and learning in schools. John Dewey criticized the academics of his days over a century ago on educational needs to adopt new instructional approaches based on future societal needs (Adeoye, 2020). Several factors have been traced to students' poor performance in Basic Science and technology, such as lack of qualified teachers, lack of instructional materials (Oni, 2014), abstract and difficult nature of some topics and instructional strategies used by lecturers (Samuel, 2017). Among these factors, teachers' method of teaching is viewed to have direct impact on students' academic performance (Akpan & Akpan, 2017). To overcome these problems, there is need for a paradigm shift from traditional methods of teaching to innovative teaching strategies using modern technological devices.

Education in the 21st century is changing, this change requires the adoption an integration of modern approaches, strategies, techniques, and practices to achieve teaching and learning objectives. Fortunately, technology has increasingly grown and infiltrated the classrooms, especially in developed countries; new learning models have emerged that have moved teaching away from the teacher-centered approach to more collaborative (student-centered) learning environment. Example of such teaching strategies include, but are not limited to graphics, simulations, mobile learning, collaborative learning, web-based learning and flipped classroom.

Computer graphics refer to computer technology that deals with the generation of pictures and charts. It the creation, storage, and manipulation of pictures, colours, drawings with the aid of a computer system (Olamigoke, 2018). It is an example of visual teaching resources. It contributes tremendously to teaching and learning process, as it generates more realistic representative virtual messages, unlike verbal messages which are abstract (Okoli & Okeke, 2021). Graphic materials are used in instructions for illustrations and clarity as they are capable of effectively presenting the message for which it is designed. Computer graphics can be in the form of still maps, charts, drawings, pictures, posters, diagrams, computer games, visualization of computer simulations as well as dimensional visual media. The graphic software includes Corel WordPerfect, adobe, photoshop, CorelDRAW, Microsoft paint among others. Computer graphics instructional mode according to Okoli and Okeke, (2021), had significant effect on the interest and achievement scores of students in genetics. Olori, Ogunsanya and Adeola (2022) found that using computer graphics teaching strategy enabled students acquire more learning experiences and upgraded students' achievement than when they are taught by conventional method. Olamigoke (2018) observed that students exposed to computer graphics instructional strategy achieved better and acquired relevant skills than their counterparts who are not exposed to the same teaching strategy.

Flipped classroom according to Itighise and Umanah (2019) is an approach to teaching where the students gain control of the learning process through studying of the course material outside of the class. It is an approach as that which is traditionally done in class is being done at home, and that which is done at home is completed in class. The teacher develops course materials in the form of CDs, audio devices and printed materials and give to the students for review at home before the class is held. This teaching approach encourages active participation in class activities, as well as develop in the students' higher order questioning and critical thinking skills (Aneshie-Otakpa, Andor & Sani, 2021). Itighise and Umanah (2019) concluded that students exposed to flipped classroom instructional model performed better than their

counterparts exposed to conventional method of teaching. Osuafor and George (2023) found that there is a significant difference in the academic achievement of students taught chemistry using flipped classroom via goggle classroom than those taught using lecture method. Flipped classroom was more effective in enhancing attitude of students in chemistry.

Gender disparities have been noticed and reported by various researchers concerning the poor academic achievement of students. Ukpai and Fomsi (2023) found that male students performed better than female students. Also, Olatunde-Aiyedun (2021) stated that males are more likely to take difficult subjects areas and challenging problem-solving situations, while females will prefer simple subjects and less difficult tasks. Likewise, Itighise and Umanah (2019) reported performance of females in science, mathematics and vocational education is below average, when compared to males, and note that there was a significant difference in academic performance of male and female students exposed to flipped classroom in favour of males. Bash, Kurumeh and Samba (2020) found that female students achieve better when the effect of teaching with graphic organizer and experiential learning were compared. Akpan (2022) noted that gender has no effect on students' academic achievement when taught using innovative teaching strategy.

Statement of the Problem

Despite the importance of Basic Science and technology subject to the economy and as the foundation on which other science subjects are founded upon, it is sadly observed that the academic performance of students has declined in examinations with poor grades. The 21st century school students have different and vast learning needs which can no longer be satisfied by the traditional lecture teaching and learning methodologies. Research findings have continually revealed that our classrooms are heavily dominated using traditional lecture method of teaching. These methods emphasize on the procedure of instruction where majority of learners are merely passive listeners, while the teacher plays the role of dispenser of knowledge. It is therefore essential for teachers to embrace innovative instructional strategies. In view of above, it is pertinent to ask, can the use of computer graphics and flipped classroom instructional strategies improve the academic performance of Basic Science and technology students in Akwa Ibom State. Hence, the need for the present study.

Objective of the Study

Generally, the objective of this study was to examine the effectiveness of computer graphics and flipped classroom instructional strategies on academic performance of Basic Science and Technology students. Specifically, the sought to:

1. Determine the mean performance score of students in Basic technology on the concept of materials and processing taught using computer graphic and flipped classroom strategy in Akwa Ibom State.
2. Determine the mean performance score of students in Basic technology on concept of materials and processing taught using computer graphic and flipped classroom strategy in Akwa Ibom State

Research Questions

The study sought to answer the following research questions.

1. What is the mean performance score of students in basic technology on the concept of materials and processing taught using computer graphic and flipped classroom strategy in Akwa Ibom State?

2. What is the mean performance score of students in Basic technology taught the concept of materials and processing using computer graphic and flipped classroom strategy based on gender?

Research Hypotheses

1. There is no significant difference in the mean performance score of students in Basic technology taught the concept of materials and processing using computer graphic and flipped classroom instructional strategies in Akwa Ibom state.
2. There is no significant difference in the mean performance score of male and female students in Basic technology taught the concept of materials and processing using computer graphic and flipped classroom instructional strategies in Akwa Ibom State.

Methodology

Quasi experimental pre-test, post-test experimental groups design was used for this study. The population of the study comprised all 7050, Junior Secondary School II students (JSS 2) from the 13 public secondary schools (3298 males and 3752 females) in Uyo Local Government Area of Akwa Ibom State. Multistage sampling technique was used to select the sample size of 98. JSS2 students were purposively selected for the study as they were already familiar with the subject, unlike JSS 1 who were freshly introduced to the subject or JSS 3 students who are preparing for junior secondary examinations. Two secondary schools were randomly selected from the population of the study. And also, simple random sampling technique was used to pick one intact class in each of the two selected schools. The students were assigned into two groups. Computer graphic strategy group comprised 52 students (21 males and 31 females), while flipped classroom strategy group had 46 students (19 males and 27 females). The instrument "Basic Technology Performance Test" (BTPT) was used for data collection, it contained 40 multiple choice questions with four options containing one correct answer. The instrument was validated by three experts. The reliability of the instrument was established by administering the performance test to 20 students in the population, who were not part of the sample. Test-retest method was used to establish the reliability of the instrument and was done after two weeks interval. A reliability of 0.83 was established using Pearson Product Moment Correlation Coefficient. BTPT was administered to both groups (computer graphic and flipped classroom) as pretest before the commencement of the teaching. The computer graphic instructional group was taught in class with computer simulations, while the flipped classroom group had the videos forwarded to their parents' WhatsApp for the students to view and study at home and return to class for discussion. Same topics and content on materials and processing in Basic Technology were taught the two groups for two weeks. After the treatment, the BTPT was reshuffled and administered again to the students as post-test after four weeks. The scripts were marked, scored and data obtained. Mean scores were used to answer the research questions, while analysis of covariance (ANCOVA) was used in testing the hypotheses at 0.05 level of significance.

Results

The results of the study were presented in line with the research questions and hypotheses below.

Research Question 1: what is the mean performance score of students in basic technology on the concept of materials and processing taught using computer graphic and flipped classroom strategies?

Table 1: Mean and standard deviation of students' pre-test and post-test mean performance scores in Basic Technology on the concept of materials and processing taught using graphic and flipped classroom strategy.

Groups	N	Pre-test		Post-test		Mean Gain
		Mean	SD	Mean	SD	
Graphics	52	10.27	2.77	22.62	4.46	12.35
Flipped classroom	46	11.13	2.90	37.26	5.48	26.13

The result in table 1 indicated pretest-posttest mean differences for students taught with computer graphics animation strategy was 12.35, while their colleagues taught with flipped classroom strategy was 26.13. this means that flipped classroom strategy, had higher gain in performance than students taught with computer graphic classroom strategy.

Research Question 2: What is the mean performance score of students in Basic technology taught the concept of materials and processing using computer graphic and flipped classroom strategy based on gender?

Table 2: Mean and standard deviation of male and female students' pre-test and post-test performance scores on Basic technology on the concept of materials and processing taught using computer graphics and flipped classroom strategy.

Groups	N	Pre-test		Post-test		Mean Gain
		Mean	SD	Mean	SD	
Male	48	10.20	2.90	24.78	6.82	14.58
Female	50	11.17	2.73	34.40	8.06	23.23

The result in table 2 showed that the pretest-posttest mean differences for academic performance of male and female students taught with computer graphic and flipped classroom strategies were 14.58 and 23.23 respectively and the female students gained higher than the male students on the concept taught.

Hypothesis one: There is no significant difference in the mean performance scores of students in Basic technology taught the concept of materials and processing using computer graphic and flipped classroom instructional strategies in Akwa Ibom state.

Table 3: Summary of ANCOVA on the difference in the academic performance of students taught using computer graphics and those taught with flipped classroom strategies.

Source of Variance	Sum of squares	Df	Mean	F	Sig
Corrected model	6484.96 ^a	4	1621.24	135.16	.000
Pre-test (Covariate)	.292	1	.292	.024	.876
Main effect: Strategy	4116.85	1	4116.85	343.22	.000
Error	1115.53	93	12.00		
Corrected total	7600.39	97			

*significant at $p < .05$

The result in table 3 showed that the calculated F-ratio for the effect of instructional strategies is 343.22, while its corresponding probability level of significance is .000. the level of significance is less than .05. With this result, the null hypothesis was rejected, implying that instructional resources (graphic and flipped classroom) used was significant in the academic performance of students.

Hypothesis 2: There is no significant difference in the performance of male and female students in Basic technology taught using computer graphic and flipped classroom instructional strategies.

Table 4: Analysis of Covariance (ANCOVA) of male and female students' post-test performance

With pre-test as covariate						
Source of Variance	Sum of squares	Df	Mean	F	Sig	
Corrected model	6484.96 ^a	4	1621.24	135.16	.000	
Pre-test (Covariate)	.292	1	.292	.024	.876	
Main effect:						
Strategy	4116.85	1	4116.85	343.22	.000	
Gender	1203.21	1	1203.21	100.31	.000	
Error	1115.53	93	12.00			
Corrected total	7600.39	97				

*significant at $p < .05$

The result in Table 4 showed that there is no significant difference in the male and female students' performance ($F = 100.31$; $P = 0.00$) taught using computer graphics and flipped classroom. Since the value of 0.00 obtained is less than 0.05 level of significance, the null hypothesis was retained.

Discussion of Findings

The findings in tables 1 and 3 regarding the effect of graphic and flipped classroom strategies on students' mean performance scores in basic technology indicate that students taught using flipped classroom strategy gained better than those taught using the computer graphics strategy. This can be attributed to the fact that flipped classroom gave the students the opportunity to go over the study material at home again and again prior to the next class session. It allows students to familiarize themselves with the content to be learnt in the next class. This agrees with Osuaia and George (2023); Itighise and Umanah (2019) that flipped classroom provides an archive of teaching resources, increase students' engagement and a shift from passive listening to active learning.

The results of the analysis on the performance of male and female students in Basic technology taught materials and processing using computer graphics and flipped classroom strategies as indicated in tables 2 and 4, show that female students gained better than male students. This can be attributed to the higher level of interest exhibited by female students during the lesson. This agrees with Bash, Kurumeh and Samba (2020) who found that female students achieve better than their male counterparts. This contradicted with Itighise & Umanah (2019) and Olatunde-Aiyedun (2021) that females perform below average in science, mathematics, and vocational education. Nevertheless, the findings of this study on gender suggests that there is no significant difference in the mean performance scores in Basic technology of male and female students taught using computer graphic and flipped classroom

strategy. This agreed with Akpan (2022) who reported that gender had no significant effect on students' performance.

Conclusion

Based on the findings of the study, it was concluded that flipped classroom strategy was most effective in enhancing students' performance and was concluded that the use computer graphic and flipped classroom instructional strategies as innovation in teaching Basic Technology provided the students with firsthand experience and actively involved them in activities during the teaching/learning process. This implies that innovative instructional strategies are significant determinants of learners learning outcomes and that, if students are exposed to the same instructional strategies, irrespective of gender, will perform appropriately.

Recommendations

Based on the findings of the study, the following recommendations were made:

1. The use of flipped classroom and computer graphics instructional strategies should be encouraged in teaching and learning.
2. Teachers should embrace modern, innovative and technology driven methods of teaching since they enhance students' academic performance.
3. Teachers should strive to use knowledge-based resources in teaching Basic Science and Technology concepts as these helps students in the acquisition of science process skills and 21st century learning skills.
4. All students, irrespective of gender should be encouraged to study sciences.

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