ASSESSMENT OF FLIPPED CLASSROOM STRATEGIES ON STUDENTS' LEARNING OUTCOMES IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK IN TECHNICAL COLLEGES IN NIGER STATE, NIGERIA

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Abstract

Persistent under-achievement of technical school students in the national examinations has been a concern issue to educational stakeholders. Poor teaching strategies was identified as one of the major causes of the menace. Therefore, there is need to explore flipped classroom strategy on students' learning outcomes in electrical installation and maintenance work (EIMW) in technical colleges in Niger State, Nigeria. The study adopted a quasi-experimental design using pretest, posttest, non-randomised, non-equivalent experimental group design. The research was guided by two research questions with two corresponding null hypotheses tested at 0.05 level of significance. One hundred and seventy five electrical students from three technical Colleges were drawn from six technical colleges. From the three schools, a school was assigned Experimental Group I which uses Flipped Classroom Audio Instructional Strategy (FCSIS, n = 85students), another was assigned Experimental Group II and used Flipped Classroom Text Instructional Strategy (FCTIS, n = 30 students), while the third was assigned Experimental Group III, used Flipped Classroom Video Instructional Strategy (FCVIS, N = 60 students). Electrical Installation and Maintenance Work Achievement Test (EIMWAT) was used for data collection. The instrument was pilot tested and data obtained was analysed using Pearson Product Moment Correlation (PPMC) coefficient and 0.91 reliability coefficient was obtained. Descriptive statistics Mean and Standard Deviation was used to answer the research questions. ANCOVA was used to analysed the hypotheses at 0.05 alpha level. Findings revealed that students taught EIMW using FCVIS achieved better than those taught using FCAIS and FCTIS respectively. The study also revealed that students taught EIMW using FCVIS retained better than their counterparts in FCAIS and FCTIS. It could therefore be concluded that, FCVIS should be encouraged in instruction delivery to enhance students' achievement and retention in EIMW in technical colleges.

Keywords: Flipped classroom, learning outcomes, Achievement, Retention, and Electrical Installation and Maintenance Work

Introduction

Technology advancement is the hallmark of a developed nation, it is also source of pride, power and economics strength to the nation. Application of technology enables nations to provide facilities and infrastructures that improve the quality of life in the modern society. Modern Technology is required for the elevation of nations from consumer nations to producer nations, from developing nations to developed nations. Therefore, modern technology needs to be adopted and nurtured to achieve sustainable national development. Technological advancement can be enhanced and achieved through the delivery of functional and efficient Technical Education amongst others.

Technical Education could be regarded as the factory for the production of the needed technicians and craftsmen as well as skilled artisans who are required to turn the nation's economy around. The National Board for Technical Education (NBTE), (2010) asserted that, Technical Education programmes can increase productivity and significantly improve the

fortunes of the unemployed, thereby reducing poverty and unemployment amongst the youths. Employment creation in Technical areas could be used to arrest the attention of the youth from the streets, and thereby preventing them from social vices which are now prevalence in the country (Biose & Adekola, 2011).

Technical education curricula are offered in Technical Colleges for three years. It is also offered in a wide range of institutions, such as technical institutes, vocational schools, and regular colleges, polytechnics, colleges of technology, and universities. The National Board for Technical Education (NBTE) established and guided by decree No. 9 of January, 1977, has among its objectives as to make recommendations on the national policy necessary for the full development of vocational and technical education for the training of technicians, craftsmen and other middle level manpower (NBTE, 2010). The Board stated that the National Technical Certificate (NTC) and Advanced National Technical Certificate (ANTC) (programmes) curriculum in Electrical Installation and Maintenance Works (EIMW) like many other technical subjects (courses) is aimed at providing training and impart the necessary skills leading to the production of craftsmen, technicians and other skilled personnel who will be enterprising and self-reliant.

Technical college graduates of EIMW are expected to competently render skilled services in (a) Domestic and Industrial Installations work; (b) cable Joint and Battery Charging work; (c) Solid State Devices and Circuits work; and (d) Winding of Electrical Machines work as well as maintenance of Electrical appliances. Appropriate competency in these areas equipped an individual with the necessary knowledge and skills capable of being utilised on its own or as a foundation or pre-requisite knowledge for more advanced work in the same or other fields of study. Each trade when successfully completed can be used for employment purposes (NBTE, 2010). This noble objective is hoped to be achieved largely through technical colleges by providing practical skill training to the students as spelt out in the technical education curricular.

Technical education curriculum emphasises the use of instructional materials and facilities in the teaching and learning of skills, but the present situation in Nigeria unveils the scarcity and inadequate instructional materials in technical and vocational education programmes in many school. Ogbu (2015) observed that, almost hundred percent of classroom teachers do not use films, slides, film strip, overhead projectors, tools, ICT resources, machines and equipment while teaching technical subjects. These problems consequently lead to poor academic achievement and lack of retention. The flipped learning environments are seen as unique opportunities for student learning in tackling these challenges.

The flipped classroom strategy is basically referred to the idea that teaching and explanation would no longer be done in class but at home, leaving what was previously treated as homework to be done in the class time (Lou *et al.,* 2017). At home students participate in preparation work including watching videos, PowerPoint's, and completing readings. After completing the preparation work, students arrive in class ready to start solving problems, analysing text, or investigating solutions. In the flipped classroom, physical presence of the teacher is not necessary during instructional delivery as instructional materials (models) are usually designed, packaged and presented to the students through ICT equipment. Various forms of technology could be used to support the flipped classroom approach (Tanner & Scott, 2015). Most often, flipped classroom instructional method are videos based, but it is opined that other means such as text and audio based instructional media could generate exciting result (Avdic & Åkerblom, 2015). Hence, this study attempts an adoption of three instructional media of audio, text and video packages.

Audio instructional approach can afford the learner to access and acquire sound instruction through a voicing auditory device. In the flipped classroom, the lessons would have been pre-recorded by the teacher and be given to the students to listen to before the class time for discussion later in the class. In the text instructional approach, a well prepared lesson notes (soft or hard copy) on the subject to be taught would be given to the students to study before class time for discussion during the lesson period. In the case of the video instructional approach in flipped classroom, pre-recorded video package on the topics to be taught would be prepared and packaged and later be given to the students to watch at home at any time before the class time, while discussion will be done during class session. One of the benefits of these flipped classroom strategies is opportunity to master the contents of topics as the learners can repeatedly access them over and over. Effectiveness of any instructional strategy is usually measured through students' learning outcome commonly referred to as students' achievement and ability to recall what was learnt at latter date known as retention.

Statement of the Research Problem

Technical Education is very important in the life of any nation. In developing countries like Nigeria, Technical Education at Technical College level has suffered some setback due to lack of Technical materials and equipment. A walk into almost any technical school classroom, one is expected to see variety of Plug-in-devices, instructional media material and other tools that would enhance today's teaching and learning, but this is not the case in Nigeria. Federal Ministry of Education (2008) identified some of the factors responsible for the high failure rate of technical college students in the National Examinations to include poor teaching methods, poor quality of teaching staff, and lack of well-equipped workshop. These challenges persist till date as evidently remarked by the National Business and Technical examinations Board (NABTEB) (2012-2019) Chief Examiner's Reports on Electrical Installation and maintenance Work (EIMW). To this end, several researchers like Gambari and Zubairu (2006), Anunobi (2017), Ellah *et al.* (2019) and Thackaberry (2020) among others, had worked at improving these trends by incorporating modern instructional technology so as to enhance teaching and learning of technical subjects of which are yielding impressive results. But, these painstaking efforts focused more on the Basic Technology at the Junior Secondary School as scanty attempts were made to address these challenges at the Technical College especially on EIMW which is the hub of modern technology. More so, their works were based on traditional classroom, hence, this present study of flipped classroom strategies are student-centred pedagogies and poised to address these gaps.

Flipped classroom instruction is one of the modern student-centred strategies yet to be entrenched in teaching and learning in schools, particularly technical colleges in Nigeria. If at all there is any, it is not known by the researcher as at the time of this study. Most studies available to the researcher on flipped classroom were either carried out in other parts of the world or not related to this study. The previous studies known to the researcher also, did not assess the effectiveness of three instructional media of audio, text and video on students' achievement and retention in a single study as in this present work. In filling these identified gaps therefore, this study focuses on assessment of flipped classroom strategies on students' learning outcomes in electrical installation and maintenance work in technical colleges in Niger State, Nigeria.

Research Questions

The following research questions were raised to guide the study:
(i)   What is the difference in the mean achievement scores of students taught EIMW in

Technical Colleges using flipped classroom strategies (audio, text and video formats)?

(ii)   Will there be difference in the mean retention scores of students in EIMW in Technical Colleges using flipped classroom strategies (audio, text and video formats)?

Research Hypotheses
The following null hypotheses were formulated and tested at 0.05 level of significance:

Ho$_1$:   There is no significant difference in the mean achievement scores of students taught EIMW using flipped classroom strategies (audio, text and video formats) in Technical Colleges.

Ho$_2$:   There is no significant difference in the mean retention scores of students taught EIMW using flipped classroom strategies (audio, text and video formats) in Technical Colleges.

Research Methodology
The research design adopted for this study is a quasi – experimental design. It is specifically, a pre-test, post-test, Non–randomised non-equivalent experimental group design. The design has three levels of treatments namely; Flipped Classroom Audio Instructional Strategy (FCAIS), Flipped Classroom Text Instructional Strategy, (FCTIS) and Flipped Classroom Video Instructional Strategy (FCVIS). The three independent variables used are: Audio, Text and Video Instructional packages, while students' academic achievement and retention were the dependent variables. The research design layout is illustrated in table 1.

Table 1: Research Design Layout

Groups	Pretest	Treatment	Posttest	Retention Test
Experimental Group I	O_1	X_1	O_2	O_3
Experimental Group II	O_1	X_2	O_2	O_3
Experimental Group III	O_1	X_3	O_2	O_3

Key:
O_1 - Pretest;
O_2 - Posttest (Achievement Test);
O_3 - Post-posttest (Retention Test);
X_1 = Flipped Classroom Audio Instructional Strategy (FCAIS) Treatment;
X_2 = Flipped Classroom Text Instructional Strategy (FCTIS) Treatment;
X_3 = Flipped Classroom Video Instructional Strategy (FCVIS) Treatment.

In this study, O_1 was first administered to the three Groups before treatment, while Experimental Group I used X_1, Experimental Group 2 used X_2 and Experimental Group 3 used X_3 as treatment. O_2 was served on three groups after treatment and O_3 was later administered and the Groups. FCAIS, FCTIS, and FCVIS served as the independent variables, while EIMWAT was the dependent variables and used to determine students' achievement, and retention.

Population of the Study
The total population of this study encompassed 2,125 students in all the six State government-owned Technical Colleges in Niger State of 2019 / 2020 Academic Session. The target population of the experimental research study comprised of TC II electrical students of three Technical Colleges purposively drawn from the six technical colleges.

Sample and Sampling Techniques
The sample for this study was made up of all the 175 electrical students of three technical colleges being drawn from the six state government – owned' technical colleges in Niger State. Year two (often referred to as TC II) was used. The purposive sampling techniques was used in this study based on the objectives of this study. The purposive sampling technique was employed to select the three technical colleges used in this study using the following criteria: availability of resources, facility and manpower; proximity of the schools for timely coverage and accessibility; topics covered in this study; and equivalence of the technical colleges in terms of being boarding and equivalent composition. Assigning of the three Government Technical Colleges (GTC) into the various Experimental Groups and allotting of three flipped classroom strategies is done using simple random sampling of balloting. Therefore, GTC, Bida was eventually assigned Experimental Group I for Flipped Classroom Audio Instructional Strategy treatment (FCAIS), GTC, Kontagora was allotted Experimental Group II for Flipped Classroom Text Instructional Strategy treatment (FCTIS) and GTC, Minna emerged as Experimental Group III for Flipped Classroom Video Instructional Strategy treatment (FCVIS) respectively.

Table 2: Distribution of the Selected Sample for the Study

Selected Schools	Educational Zone	Class population		
		Male	Female	Total
G T C Bida	A	84	1	85
G T C, Kontagora	C	30	0	30
G T C, Minna	B	60	0	60
Total Sample Size		174	1	175

Source: Examination of the Schools

Research Instruments
Two research Instruments were used for this study. They are treatment instruments and test instrument. The treatment instruments employed comprised of three flipped classroom instructional strategies tagged: FCAIS, FCTIS, and FCVIS. The test instrument used was EAT which serves as pretest, posttest and retention test after being reshuffled.

Electrical Installation and Maintenance Work Achievement Test (EIMWAT)
Electrical Installation and Maintenance Work Achievement Test (EIMWAT) was developed by the researcher and used in collecting data for the study. The EIMWAT contains two major sections (A & B). Section A required the students demographic data such as name of school, class, admission number and gender, Section B of the EIMWAT comprised of multiple choice objective questions which consist of 50 items with four (4) options (A - D), with one correct answer and three distracters. Students were required to indicate the correct answer by ticking appropriate letter (A - D) that corresponds with the correctly chosen option for each item. The EIMWAT questions generated using the latest guidelines stated in the National Board for Technical Education (NBTE) Curriculum as well as National Business and Technical Examinations Board (NABTEB) syllabus for all classes in Nigerian Technical Colleges. The specifications based on Bloom's taxonomy.

The students were expected to answer all the questions which would predictably evaluate the students at the level of knowledge, comprehension, application, interpretation, analysis and evaluation. One mark was awarded for every correctly answered question and zero for each wrong answer. The maximum obtainable score was 50, while the minimum was zero. The EIMWAT was administered as pretest, posttest and retention test to the groups. The test items were reshuffled after each administration.

Development of Flipped Classroom Strategies
The treatment employed comprised of three flipped classroom Strategies tagged: Flipped Classroom Audio Instructional Strategy (FCAIS) for Experimental Group I, Flipped Classroom Text Instructional Strategy (FCTIS) for Experimental Group II and Flipped Classroom Video Instructional Strategy (FCVIS) for Experimental Group III. The FCAIS, FCTIS and FCVIS treatments were developed and packaged by the researcher with the assistance of cameraman, film editors, sound mixers, Educational Technologists and programmers. All the three instructional packages covered the four topics taught in this study. The module treated is winding of electrical machines based on the latest NBTE Curriculum and NABTEB Syllabus. This includes the following:
(i)   Electrical Tools, Equipment and Instruments used in Winding of Electrical Machines;
(ii)   Statutory Regulations in Electrical Winding Work and General Safety Precautions in Electrical Workshop.
(iii)   Preparation and Interpretation of simple Wave and Lap Winding Drawings
(iv)   Skills for dismantling machines for rewinding them.

In FCAIS, only audio was captured and used as instructional strategy for the Experimental Group I. The FCTIS was administered on Experimental Group II and only Text was employed. The Experimental Group III made use of FCVIS instructional strategy of which video instruction was used. The recording and packaging exercises were carried out by the researcher with assistance of audio recording, films / video recording, sound mixers, films editing experts, programmers and educational technology experts. Various electronic media (Laptop computers, Desktop computer, DVD/ Television sets, Android handset, and M P 3 among others) were used by the students to access the packages depending on availability and students' convenience.

Validation of the Research Instruments
The research Instruments used for this study: treatment and test instrument were validated separately. The treatment which comprises of FCAIS, FCTIS, and FCVIS were validated in three stages (i) Contents Validation by Electrical Technology Experts, (ii) Face Validation by the Programmer and Educational Technology Experts and Field Trial Validation by students.
The test instrument used was which serves as pretest and posttest after being reshuffled. The instrument was assessed based on face and content validations by Electrical Technology Experts The test instrument was critically assessed for clarity, simplicity and appropriateness of the topics, suitability of the content for level of the students, and the extent to which the content covers the topics intended. Their suggestions and comments were used to modify the test instrument.

The Research Instrument was also pilot tested using intact Class II Electrical Installation and Maintenance Work Students of Mamman Kontagora Technical College, Pandogari, Niger State. The test was administered once using split–half method and data obtained was analysed using Pearson Product Moment Correlation (PPMC). Reliability test was used to determine the consistency with which the test measured what it was intended to measure. To determine the reliability of EIMWAT, the scores obtained was analysed using Pearson Product Moment Correlation (PPMC) coefficient and 0.9096 reliability coefficient was obtained which was considered reliable.

Method of Data Collection
Within the first week, the researcher personally visited the schools used for this study to inspect the facilities and equipment, as well seek for the permission of the Authorities concerned to use their schools. The staff and students in all selected schools were informed about the objectives, the modalities and the procedure involve in using the instructional

packages in the lesson presentation. After the approval, the researcher used the second week to train the research assistants, while in the third week a pre – test was administered on the experimental groups using EIMWAT. This was to ascertain the academic equivalence of the students in the groups. For the four consecutive weeks thereafter, treatment were administered on the three groups using the flipped classroom through various electronic media (Laptop computers, Desktop computer, DVD/ Television sets, Android handset, and M P 3 among others) were used by the students to access the packages depending on availability, package type and students' convenience. Immediately after treatment period, EIMWAT was administered to the students in all the groups as the posttest. The posttest items were distributed with the help of research assistants from each school. The students were given 60 minutes to respond to all questions in the test. Four weeks after administering of EIMWAT as posttest, the same EIMWAT was reshuffled and re-administered to the three groups as the retention test. The scores obtained from these pretest, posttest and retention test were recorded, tabulated and subjected to data analysis. The entire study covered a period of 12 weeks.

The data collected from the administration of the EIMWAT at pretest, posttest and retention test were collated, marked and subjected to data analysis. The research questions were answered using Mean and Standard Deviation while the hypotheses were tested using ANCOVA with Statistical Package for Social Sciences (SPSS) version 21. Sidak's post hoc test was used to determine where differences exist among the dependent variables of achievement and retention. The significance of the various statistical analyses was ascertained at 0.05 alpha level of significance. The choice of ANCOVA was to control errors of initial non-equivalent arising from the use of intact classes as subjects for the study. Graphical representations were also used to indicate the mean gain in scores of the students at pretest, posttest and retention tests.

Results

Analyses of Research Questions
The study was guided by two research questions raised in this study. These research questions are answered as follow:

Research Question One: What is the difference in the mean achievement score of students taught Electrical Installation and Maintenance Work using flipped classroom strategies of audio, text and video in Technical Colleges?

In answering the research question one, mean scores of students in the three groups were analysed using mean and standard deviation and the result is as shown in Table 3.

Table 3: Pretest and Posttest Mean Gain Scores of Students taught Electrical Installation and Maintenance Work using flipped classroom strategies of audio, text and video

Group	N	Pretest		Posttest		Mean Gain
		Mean	SD	Mean	SD	
Audio	85	14.05	2.803	41.62	1.697	27.57
Text	30	13.76	3.078	41.33	.935	27.57
Video	60	14.05	2.931	45.47	2.046	31.42

Table 3 shows the Mean and Standard Deviation of the pretest and posttest scores of the students taught Electrical Installation and Maintenance Work in Technical Colleges in Niger State using Flipped Classroom Audio Instructional Strategy (FCAIS), Flipped Classroom Text

Instructional Strategy (FCTIS), and those taught with Flipped Classroom Video Instructional Strategy (FCVIS), The result revealed that the students exposed to the FCAIS had a mean score of 14.05 with standard deviation of 2.803 at pretest and the mean score of 41.62 with standard deviation of 1.697 obtained at posttest. This gives a mean gain of 27.57 for students taught with FCAIS. Similarly, the results also revealed that the students taught using FCTIS have 13.76 as the mean score with 3.078 as the standard deviation at pretest, and 41.33 as the mean score with standard deviation of 0.935 at the posttest. This gives a mean gain of 27.57 for students taught using FCTIS. In the same vein, the results equally revealed that the students taught with FCVIS, had mean score of 14.05 with standard deviation of 2.931 at pretest and 45.47 as mean score with 2.046 standard deviation of 2.046 at posttest. This likewise gives a mean gain of 31.42 for students taught using FCVIS. From the result; it can be deduced that there is difference between the pretest and posttest mean scores which accounted for mean gain Scores for the three groups in favour of the posttest. This implies that students in all the groups achieved better at posttest than pretest. However, students taught using Flipped Classroom Video Instructional Strategy had highest posttest mean score and mean gain score than those in other groups. The graphical representation of the student achievements in various groups is illustrated in Figure 1.
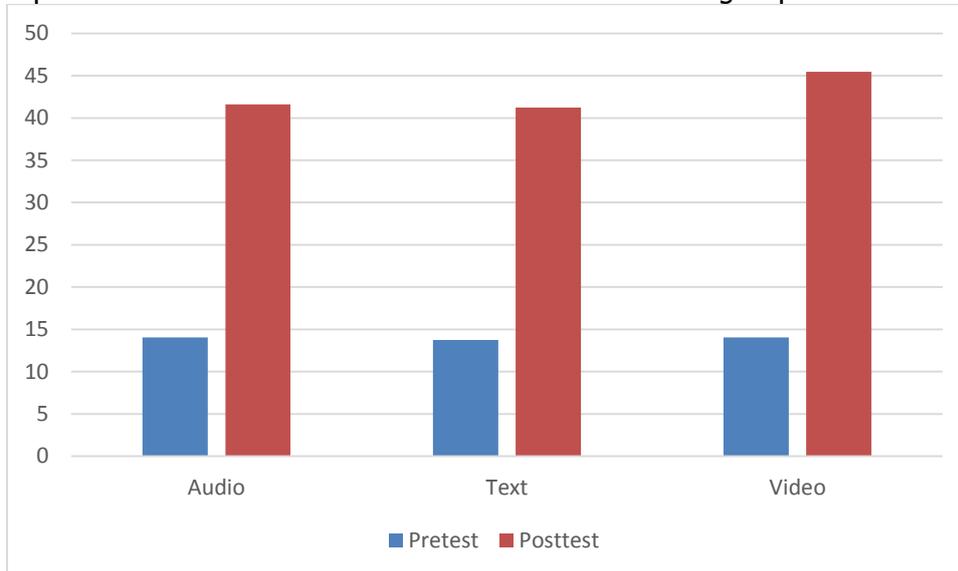

Figure 1: Graphical Illustration of Achievement Scores of Students Taught Electrical Installation and Maintenance Work using flipped classroom strategies of audio, text and video
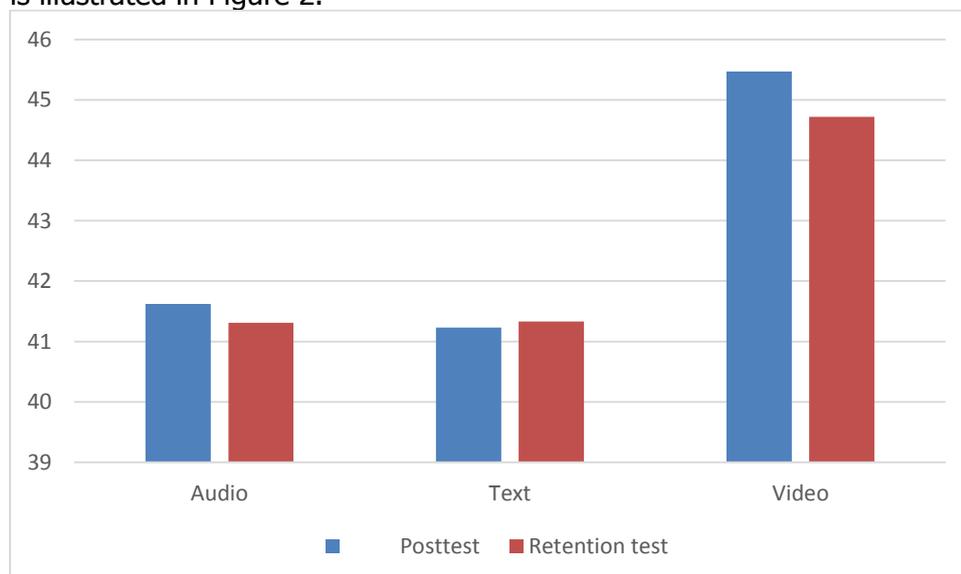
Research Question Two: What is the difference in the retention score of students taught Electrical Installation and Maintenance Work using flipped classroom strategies of audio, text and video in Technical Colleges?

In answering the research question two, the posttest and retention test scores of students in Flipped Classroom strategies (Audio, Text, and Video) were analysed using mean and standard deviation as shown in Table 4.

Table 4: Posttest and Retention Mean Loss Scores of Students taught Electrical Installation and Maintenance Work using flipped classroom strategies of audio, text and video

Group	N	Posttest		Retention		Mean Loss
		Mean	SD	Mean	SD	
Audio	85	41.62	1.697	41.31	1.291	0.31
Text	30	41.33	.935	41.23	.884	0.10
Video	60	45.47	2.046	44.72	1.091	0.75

Table 4 shows the mean and standard deviation of the posttest and retention test scores of the students taught Electrical Installation and Maintenance Work in Technical Colleges in Niger State using FCAIS, FCTIS, and those taught with FCVIS, The result revealed that the students exposed to the FCAIS had a mean score of 41.62 with standard deviation of 1.697 at posttest and the mean score of 41.31 with standard deviation of 1.291 obtained at retention test. This gives a mean loss of 0.31 for students taught with FCAIS. Similarly, the results also revealed that the students taught using FCTIS have 41.33 as the mean score with 0.935 as the standard deviation at posttest, and 41.23 as the mean score with standard deviation of 0.884 at the retention test. This gives a mean loss of 0.10 for students taught using FCTIS. In the same vein, the results equally revealed that the students taught with FCVIS, had mean score of 45.47 with standard deviation of 2.046 at posttest and 44.72 as mean score with standard deviation of 1.091 at retention test. This likewise gives a mean loss of 0.75 for students taught using FCVIS. From the result; it can be deduced that there is difference between the posttest and retention test mean scores which accounted for mean loss scores for the three groups in favour of the posttest. This implies that students in all the groups achieved less at retention test than posttest after four-week of posttest administration. However, students taught using Flipped Classroom Video Instructional Strategy had highest retention mean score, despite their highest mean loss score than those in other groups. The graphical representation of the student achievements in various groups is illustrated in Figure 2.

Figure 2: Graphical Illustration of Retention of Students Taught Electrical Installation and Maintenance Work using flipped classroom strategies of audio, text and video

The following null hypotheses were formulated and tested at 0.05 level of significance:

Hypothesis one
There is no significant difference in the mean achievement scores of students taught Electrical Installation and Maintenance Work using flipped classroom strategies of audio, text and video in Technical Colleges.

In testing hypothesis one, the achievement scores of students exposed to Audio, Text, and Video were analysed using ANCOVA as shown in Table 5.

Table 5: ANCOVA Results of Students Achievement Scores of Students Exposed to Flipped Classroom Strategies (Audio, Text, and Video)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	617.915[a]	3	205.972	68.686	.000
Intercept	28121.063	1	28121.063	9377.623	.000
Pretest	4.411	1	4.411	1.471	.227
Treatment	615.017	2	307.509	102.546	.000*
Error	509.786	171	2.999		
Total	321136.000	174			
Corrected Total	1127.701	173			

*: Significant at $p < 0.05$

Table 5 shows the ANCOVA results of the achievement scores of the three groups taught using FCAIS, FCTIS and FCVIS. From the table, the $F_{(2,171)} = 102.546$, $p < 0.05$. This indicates that there is significant difference in the achievement scores of students in FCAIS, FCTIS, and FCVIS. Hence, hypotheses one is rejected. This reveals that the treatment has effect on the students' academic achievement in the three groups. Moreover, Sidak's post-hoc analysis was done to identify the direction of the difference among the treatment groups as shown in Table 6.

Table 6: Sidak Post-hoc Analysis of Significant Difference on Posttest of Students Exposed to Flipped Classroom Strategies (Audio, Text, and Video)

(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Audio	Text	.39	.367	.641	-.50	1.28
	Video	-3.84*	.292	.000	-4.55	-3.14
Text	Audio	-.39	.367	.641	-1.28	.50
	Video	-4.23*	.387	.000	-5.17	-3.30
Video	Audio	3.84*	.292	.000	3.14	4.55
	Text	4.23*	.387	.000	3.30	5.17

From the Sidak post hoc analysis on posttest of the three groups in Table 6, there was no significant difference in the achievement mean scores of students in the FCAIS group and FCTIS group with mean diff = 0.39, p>0.05 and upper bound of 1.28. There was statistically significant difference in the achievement mean score of students in the FCAIS group and FCVIS group with mean difference of 3.84, p<0.05 and upper bound of 4.55 in favour of students in FCVIS group. Similarly, there was statistically significant difference in the achievement mean score of students in the FCTIS group and FCVIS group with mean

difference of 4.23, p<0.05   and upper bound of 5.17 also in favour of students in FCVIS group. This implies that students taught Electrical Installation and Maintenance Work using Flipped Classroom Video Instructional Strategy (FCVIS) achieved better than those taught with Flipped Classroom Audio Instructional Strategy (FCAIS) and Flipped Classroom Text Instructional Strategy (FCTIS).

Hypothesis Two
There is no significant difference in the mean retention scores of students taught Electrical Installation and Maintenance Work using flipped classroom strategies of audio, text and video in Technical Colleges.

In testing hypothesis two, the retention achievement scores of students exposed to Audio, Text, and Video were analysed using ANCOVA as shown in Table 7.

Table 7: ANCOVA Results of Students Retention Scores in Audio, Text and Video Flipped Classroom Strategies

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	484.966[a]	3	161.655	135.033	.000
Intercept	295.180	1	295.180	246.567	.000
Posttest	28.183	1	28.183	23.542	.000
Treatment	111.986	2	55.993	46.772	.000*
Error	204.714	170	1.197		
Total	316486.000	175			
Corrected Total	689.680	174			

*: significant at p < 0.05

Table 7 shows the ANCOVA results of the retention scores of students taught Electrical Installation and Maintenance Work using flipped classroom strategies of audio, text and video in Technical Colleges. From the table, there is significant difference in the retention mean scores of the students in FCAIS, FCTIS and FCVIS groups at 0.05 level of significance, $F_{(1,171)} = 46.772$, $p < 0.05$. This indicates that there is significant difference in the retention mean scores of students taught Electrical Installation and Maintenance Work using FCAIS, FCTIS and FCVIS. Hence, hypothesis two is rejected. Moreover, Sidak's post-hoc analysis was done to determine the direction of the difference among the three groups and the result is shown in Table 8.

Table 8: Sidak Post-hoc Analysis of Significant Difference on Retention of Students Taught Using Audio, Text and Video Flipped Classroom Strategies

(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
Audio	Text	-.03	.247	.999	-.62	.57
	Video	-3.41*	.196	.000	-3.88	-2.94
Text	Audio	.03	.247	.999	-.57	.62
	Video	-3.38*	.260	.000	-4.01	-2.76
Video	Audio	3.41*	.196	.000	2.94	3.88
	Text	3.38*	.260	.000	2.76	4.01

Table 8 shows the Sidak post hoc analysis on retention of students taught Electrical Installation and Maintenance Work using FCAIS, FCTIS and FCVIS. From the Table, there was no significant difference established between the mean retention scores of FCAIS and FCTIS because the mean difference of 0.03, (p>0.05) with an upper bound of 0.57 was obtained. However, there was statistically significant difference in the mean retention scores of FCAIS and FCVIS with mean difference of 3.41, p<0.05 with upper bound of 3.88 in favour of FCVIS. Similarly, there was statistically significant difference in the mean retention scores of FCTIS and FCVIS with mean difference of 3.38, p<0.05 with upper bound of 4.01. This implies that students taught Electrical Installation and Maintenance Work using Flipped Classroom Video Instructional Strategy (FCVIS) retained better than those taught with Flipped Classroom Audio Instructional Strategy (FCAIS) and Flipped Classroom Text Instructional Strategy (FCTIS).

Discussion
One of the findings of this study revealed that students taught Electrical Installation and Maintenance Work using Flipped Classroom Video Instructional Strategy (FCVIS) achieved better than those taught using Flipped Classroom Audio Instructional Strategy (FCAIS) and Flipped Classroom Text Instructional Strategy (FCTIS). This finding is in accord with Gambari *et al.* (2016) who found that there were significant differences in the mean achievement scores of students taught using Text Only (TO), Text with Narration (TN), Text with Animation (TA), and Text, Animation with Narration (TAN) in favour of those in TAN Video Type Instructional package group. Similarly, these findings agreed with the findings of Dahlgvist (2000) who reported that a picture is better than (a sound) words, an animation is better than a still picture and sound is better than silence. This was also supported by Gambari, Falode, Yaki, Anyanwu and Olatunji (2014) who reported that performance of students taught geometry with Animated Graphics with Narration and Text performed better than their counterparts in other modes of multimedia instruction. The results of this study likewise supported the findings of Gambari, Yaki, Gana and Ughovwa (2014) who reported that students in Text with Animation with Narration (TAN) multimedia instruction group performed better than their counterparts in the conventional teaching method. This finding also agreed with the findings of Adegoke (2010) who found that students in the animation + on-screen text + narration (video) perform better than those in animation + on-screen text, animation + narration (audio) and text only group.

The findings of this study equally concurs with that of Karbalaei *et al.* (2016) who found audio-picture (video) instruction is more effective than text-picture instruction in facilitating immediate L2 vocabulary achievement and retention. The study also agrees with Bal-Gezegin (2014) who found that using video was more effective than using audio, though agreed that exposure to different kinds of materials such as spoken language, printed text or visual information all convey the same message, the way they are comprehended as input can vary from context to context and from student to student. This finding is in agreement with that of Heo and Choi (2014), who found that student who watched has positive relationship with academic achievement than those did not. In addition, the result of this findings is also in line with the results of Sulaiman *et al* (2917) who concluded that, the majority of the students performed better in video media as compared to audio only.

However, the findings of this study contradicts that of Gambari *et al.* (2014), whose results findings showed that there was no statistically significant difference among the achievement of three experimental groups of Animation + Narration (audio); Animation + On-screen Text (text); Animation + Narration + On-screen Text (video) experimental groups, but agreed that students under multimedia instruction performed better than their colleagues in the conventional teaching method.

The findings of this present study also contradict that of Yeh and Wang (2003) whose study compared the effectiveness of text instruction, text-picture instruction, and text - picture-audio instruction, whose analysis of their 82 participants' performance on the posttests indicated that the text-picture instruction was the most effective for vocabulary learning, and the text-picture-audio (video) instruction was the least effective. The finding from this study also revealed that students taught Electrical Installation and Maintenance Work using Flipped Classroom Video Instructional Strategy (FCVIS) retained better than those taught with Flipped Classroom Audio Instructional Strategy (FCAIS) and Flipped Classroom Text Instructional Strategy (FCTIS). The findings of this study is in agreement with that of Gambari et al (2014) who found that that there is significant difference in retention score of students taught biology with video-based multimedia instructional packages in which those in animation + narration + on-screen text (video) groups had better retention than their colleagues in animation + on-screen text and conventional teaching method. These results agreed with the findings of Gambari and Zubairu (2008) and Achebe (2008); Moreno and Mayer (2000); Tabbers *et al.* (2004); and Starbek *et al.* (2010), who found that students taught genetics with multimedia acquired better knowledge, retention, and improved comprehension skills than other groups.

Conclusion

The design, development and utilisation of flipped classroom instructional models for teaching Electrical Installation and Maintenance Work in Technical colleges have recorded significant landmark as noteworthy achievement were substantiated in academic achievement and retention of students who used the packages. This has thus, generated excitement. It could therefore, be concluded that:

(i)   The use of flipped classroom instructional strategies of audio, text and video in teaching Electrical Installation and Maintenance Work in technical colleges were effective, but, the flipped classroom video strategy was more effective compared to the other two of flipped classroom audio strategy and flipped classroom text strategy.

(ii)   Students' ability to retain what was learned after certain period of time was influenced by the nature of instructional media and strategies employed for teaching and learning. Therefore, students taught Electrical Installation and Maintenance Work using Flipped Classroom Video Instructional Strategy (FCVIS) retain better than those taught with Flipped Classroom Audio Instructional Strategy (FCAIS) and Flipped Classroom Text Instructional Strategy (FCTIS).

Recommendations

In line with the findings of the research, the following recommendations were made:

(i)   Flipped classroom instructional strategies, particularly, Flipped Classroom Video Instructional Strategy (FCVIS should be used for teaching Electrical Installation and Maintenance Work at Technical Colleges. This will enable the students to learn at any location they want, at their convenient time and repeatedly before coming to the class and participate actively during the class period. This could eliminate the problem of poor achievement that is due to attention deficit, poor teaching strategies and over-populated classes.

(ii)   Students should be exposed to the use of Flipped Classroom with video package media to enhance their academic achievement and retention in order to improve their ability level. This will increase students' retentive memory and consequently achieve better at National Technical Certificate examination and for future application of the acquired knowledge.

(iii)   The use of Flipped Classroom Strategies are students – centred and learners' friendly pedagogies, therefore, flipped classroom should be encouraged in the instruction delivery to enhance students achievement and retention in Electrical Installation at technical college level.

(iv)   Inclusion and use of flipped classroom instruction and other modern technology driven strategies in teacher education should be encouraged by the stakeholders. This will help in producing teachers who will help the shift from teacher-centred to student-centred approach of learning to enable students take charge of their learning and gather experiences that can help them achieve and retain what have been learnt.

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