International Journal of Innovative Information Systems & Technology Research 11(3):72-83, July-Sept, 2023

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Effects of Computer-Assisted and Programmed Instruction on NCE Students Learning Outcomes in Educational Technology in Colleges of Education in Northeast, Nigeria

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ABSTRACT
In Nigeria's education system, the establishment of a Centre for Educational Technology (CET) is a compulsory requirement for any college of education to survive accreditation. The primary function of the CET as enshrined in the National Commission for Colleges of Education (NCCE, 2020) Minimum Standard is to among other things regulate the training of NCE teachers for the award of Nigeria Certificate in Education (NCE). Since then, attention has been focused on identifying appropriate strategies for imparting knowledge, attitude and skills to different categories of citizens including those outside the school system. These include instructional strategies which allow active involvement of learners, give them opportunity to get information on their on their finger tips and consequently enhance their learning outcomes as against the didactic conventional lecture method. This study therefore; investigated the effects of computer-assisted and programmed instructions on NCE students' learning outcome in Educational Technology in some selected colleges of education in the Northeast zone of Nigeria. The study adopted a pre-test, post-test, control group quasi experimental design with a 3 x 3 x 2 factorial matrix. Two hundred and eighty one (281) NCE students from six purposively selected Colleges of Education in the Northeast participated in the study. Seven null hypotheses were generated and tested at 0.05 level of significance. A questionnaire called Computer and Programmed Instruction Attitude Scale Test (Carpast) was used for the study. Computer and Programmed Instruction Attitude Scale Test (Carpast) got a reliability coefficient of r = .826. Data collected were analyzed using Analysis of Covariance (ANCOVA) and Scheffe's post-hoc analysis while graphs were used for illustration. The findings showed significant main effect of treatment on the NCE students Educational Technology skills ($F_{(2,262)}$ = 26.176; P<.05). The NCE students were exposed to the computer-assisted instructional strategy and obtained the highest adjusted post-test mean score ($\bar{x}$ = 26.80), followed by the computer programmed instructional group ($\bar{x}$ = 24.24) while the control group obtained the lowest mean score ($\bar{x}$ = 23.77). The NCE students with high learning outcome had the highest adjusted post-test Educational Technology attitude score ($\bar{x}$ = 127.73) than those of medium learning outcome ($\bar{x}$ = 121.02) and low learning outcome ($\bar{x}$ = 114.77) respectively. In conclusion, both the Computer-Assisted and Computer Programmed Instructional strategies are more effective compared to the conventional lecture method. It was therefore recommended that Programmed Instruction should be adopted in our Colleges of Education giving more preference to the Computer assisted programmed instruction.
Keywords: Computer-Assisted instructional strategy, learning outcomes, Programmed Instruction

INTRODUCTION

The integration of Information Communication Technology (ICT) in the teaching industry brought about a lot of dynamics in the teaching industry which in turn gave a new outlook on the face of pedagogy in the information age. In Nigeria, the National Commission for Colleges of Education (NCCE) in its

Minimum Standard for all colleges of education (NCCE, 2020) has developed a conceptual framework for the proper adaptation and integration of ICT in its implementation framework to guide all stakeholders. In education general education, these innovations could be realizable through Educational Technology, Micro Teaching Theory and Practicum. The core concepts in spear-heading this revolutionary approach to teaching are Computer/Programmed Instruction (PI), Computer Assisted Instruction (CAI) and other computer mediated teaching and learning processes that may enhance students learning outcomes. If the culture of media-based instruction is imbibed by learners and teachers, then learning on the other hand becomes a fun (Akinpelu, 2006). The CET in each College of Education houses three courses, namely: Micro Teaching Theory, Micro Teaching Practicum and Educational Technology. Micro-teaching is a compressed teaching situation in terms of class size, duration, content and the skills to be acquired and practiced (Abimbade, 1997). It exposes the student teachers to the basic pedagogical knowledge capable of providing the trainees with appropriate level of competence needed in the classroom as a teacher. Abifarin (2004) described micro-teaching as a laboratory procedure which is aimed at simplifying the complexities of regular teaching-learning processes. It is a process that has been used to raise the level of teacher's competencies under controlled laboratory settings where frequent practice sessions and evaluation are easily effected.

Programmed Instruction is a self-paced self-administered instruction prepared in a logical sequence, which can be in text or machine form. It is a shift from teacher centred-instruction and places the learner at the center of the learning process with full and active participation (Ezike, 2005). The teacher only serves as a facilitator, guiding the interaction of the learners with the programmed material. Thus, learners fish out information on their own. Furthermore, this strategy encourages critical thinking in learners and accommodate learners of different intellectual abilities to learn at their own pace which is a gap created by conventional method.

Ajiboye (1996) found self-learning programme (a textual programmed instruction) to be very effective in enhancing the cognitive learning outcomes of junior secondary students in population education. Sex has no effect on achievement and attitude. He suggested the need for researches in self-learning (Computer programmed Instruction) in areas such as environmental education. Okwudilieya (1996) recommended the use of computer programmed instruction in Teacher Education. Eguabor and Betiku (1997) found that undergraduates were favourably disposed to the use of self-learning mode of instruction (computer programmed instruction) and noted that it would be beneficial to them. They therefore, recommended its use in our institutions. Balogun and Abimbade (2002) also recommended the use of programmed text in our classrooms.

Olagunju (1996) advocated for more research work on computer education in Educational Technology in Nigerian Colleges of Education to ensure compatibility of computer-based instructions in our socio-cultural setting, particularly in Educational Technology and in science curriculum. Akinsanya (2003) noted that computer provides some methods of teaching and learning of sciences. It serves as a support to teaching. It can be used to help individuals learn at their own pace. For example, computer can be used through Programmed Learning System (PLS) or Computer Assisted Instruction (CAI). In his study, Fajola (2000) found computer-based instructional strategies to have positive significant effects on the achievement of pre-service teachers and also their attitude towards computer instruction. He suggested that computer systems should be used to present learning materials to pre-service teachers. He inferred that the positive attitude of the pre-service teachers towards the use of computer in presenting learning materials to them most probably enhanced their performance in the subject matter.

Learning Outcome refers to NCE students' achievement in the selected Educational Technology concepts and skills as measured by the Educational Technology Achievement Test (ETAT) and Educational Technology Knowledge Scale (ETKS) respectively. Therefore, the present study is using computer-based and programmed instruction to enhance the teaching of Educational Technology concepts to NCE teachers in Colleges of Education. The study also sets out to investigate the potency of computer-based and programmed instruction in enhancing the acquisition of Educational Technology knowledge and skills of NCE teachers.

Statement of the Problem: The major purpose of the study is to investigate the effects of computer-assisted and programmed instruction on NCE students learning outcomes in Educational Technology in some selected colleges of education in the Northeast zone. The establishment of a Centre for Educational Technology (CET) is a compulsory requirement for any college of education to survive accreditation in the Nigerian education system. The primary function of the CET as enshrined in the National Commission for Colleges of Education (NCCE, 2020) Minimum Standard is to among other things regulate the training of NCE teachers for the award of Nigeria Certificate in Education (NCE). In the minimum standard, the time allotted for practical in Educational Technology is quite inadequate which inhibits the students from acquiring the requisite skills that will enable them operate teaching equipment. Consequently, this study is an attempt to provide the students with self-spaced computer programmed instruction that will provide ample opportunities for them to practice using their leisure time. It will also assist the students to reduce phobia associated with using some of these gadgets.

Objectives of the Study: The major purpose of the study is to investigate the effects of computer-assisted and programmed instruction on NCE students learning outcomes in Educational Technology in some selected colleges of education in the Northeast zone. Specifically, the study sought to:

1. Determine the main effect of treatment on NCE students' knowledge in Educational Technology Concepts;
2. Determine the main effect of learning outcome on NCE students' knowledge in Educational Technology;
3. Determine the main effect of projection techniques on NCE students' knowledge in Educational Technology;
4. Determine the significant interaction effect of treatment and students learning outcome on NCE students' knowledge in Educational Technology;
5. Determine the interaction effect of projection techniques and learning outcomes on NCE students in the acquisition of Educational Technology Concepts.
6. Ascertain any significant difference on students learning outcome between the Experimental and Control groups in operating Digital Light Processing Projector.

Research Questions:

1. Is there any significant main effect on students learning outcome in operating overhead projector?
2. Is there any significant effect of slide projector operation on students learning outcome in Educational Technology
3. Is there any significant interaction effect of treatment on students learning outcome in using projection techniques?
4. What is the interaction effect of treatment on students learning outcome in using programmed instruction?
5. What is the interaction effect on students learning outcome in using computer assisted instruction?
6. Is there any significant difference on students learning outcome between the Experimental and Control groups in operating Digital Light Processing (DLP) Projector?

Hypotheses

The study was guided by the following null hypotheses tested at 0.05 level of significance:

HO_1 There is no significant main effect of treatment in operating Educational Technology gadgets on students' attitude towards Educational Technology Practical.

HO_2 There is no significant main effect of students learning outcome in operating overhead projector

HO_3 There is no significant main effect of students learning outcome in operating Slide projector

HO_4 There is no significant interaction effect of treatment on students learning outcome in using projection techniques

HO_5 There is no significant interaction effect of treatment on students learning outcome in using programmed and computer instruction.

HO_6 There is no significant interaction effect on students learning outcome in operating Digital Light Processing (DLP) Projector.

Significance of the Study

The study will be relevant to NCCE in the review of the minimum standards for NCE programmes in Educational Technology. It will also assist NCE students in enhancing their manipulative skills in the operation of Educational Technology gadgets. Similarly, prospective teachers and in-service teachers will also find this study relevant in upgrading their pedagogical disposition.

Scope of the Study: The study was conducted in six (6) colleges of education from the Northeast zone which were purposively selected. These colleges of education are: FCE (Tech.) Potiskum, Yobe State, FCE (Tech.) Gombe, Sir Kashim Ibrahim College of Education (Maiduguri), FCE Yola, Umar Suleiman College of Education (Gashua) and Aminu Saleh College of Education, (Azare).

LITERATURE REVIEW

The theoretical framework of the study majorly descends on the theories of programmed instructions. Programmed Instruction derived basically from the stimulus – response theory of the behaviourist psychology and Getsalt cognitive psychology. Contributors included Pressey (1915), Skinner in 1920s, 1930s up to 1950s and Crowder in 1950s. Stimulus – Response Theory: The linear programmed instruction is based on Skinner's S-R theory. The theory says that in any unit of activity there is a situation or stimulus(S) which affects the individuals and there is a Response (R). A stimulus becomes connected with its response by the S-R bond so that on future occasions a repetition of the stimulus will produce the response. Where the probability that R will follow S is high, then the S-R bond is said to be strong (Balogun & Abimbade, 2002).

Gagne's behaviourist theory of Learning Hierarchy and Bruner's cognitive theory of learning by discovery: The present work (both the textual and computer-assisted programmed Instruction) adopted the branching programmed instruction model which was introduced by Norman Crowder in the 1950s.

The branching mode is based on the behaviourist's theory of learning hierarchy propounded by Gagne (1965) and cognitive theory of learning by discovery of Bruner (1960) (a cognitive Gestalist). For Gagne, a student can acquire any piece of knowledge if he/she possesses certain prerequisite pieces of knowledge which in turn have their own prerequisite pieces of knowledge. The programmed material (text and computer-based) applied this theory by arranging the contents sequentially and hierarchically for the purpose of instruction. Thus, learners can move from simple to complex items in the programme.

Bruner's theory is hinged on learning by discovery. In the context of this theory, discovery is used as all forms of obtaining knowledge for oneself by use of one's mental processes (Abdulahi, 1982; Ifamuyiwa, 2005). Bruner identified two forms of discovery (i) when the new content is compatible with what is in the existing structure of knowledge in which case the new content is easily assimilated and (ii) when the new content is not compatible and hence the learner first restructures the cognitive frame-work so as to accommodate the new content.

According to David and Sorell (1995), mastery learning became revived in the form of programmed instruction in the late 1950s with the aim of providing students with instructional material text which would make them to learn at their own rate and receive constant feedback on the level of mastery. Computer Assisted instruction was first used in education and training during the 1950s (Seattler, 1990). He also noted that early work was done by IBM and such people as a Gordon Pask and Moore, but CAI grew rapidly in 1960s. Gordon Pask was the first to systematically apply cybernetics principles to education with the introduction of 'adaptive teaching systems' in England in 1953.

There are four major groups of programmes used for programmed instruction:

Linear Programme -This is usually traced to the Harvard behavioural psychologist Skinner. In a linear programme the frames are short. The sequence is said to be linear because all the learners follow only one path. Skinner's involvement can be traced to his 1954 famous professional address, "The science of learning and the Art of learning". The Linear programme was actually propounded by Skinner in 1966. It is based on Operant conditioning theory of Skinner (1953, 1968). That is, the students are expected to make an active response at the 'end' of each frame. The confirmation of correct answer and correction of

wrong answers is to serve as reinforcement. Skinner suggested that teachers or schools should function in much the same way shaping the behaviour of learners by presenting sequences of stimuli and responses as well as reinforcement.

Adaptive or Branching Programming-This was introduced by Norman Crowder in 1959. Here, frames are lengthier than the linear programmes. Furthermore, the learner chooses an answer from a multiple-option format and the sequence of frames followed by the learner is determined by the response given. To skinner 'learning' results from making the correct response (Overt response) while Crowder believed that 'learning' results from the realignment of the user's knowledge structure, and that the response is simply a means of controlling the programme or machine.

Adjunct Programming- A third type of programme that has been identified in literature is Adjunct programme (Alcorn, 1970). Adjunct programme, was introduced by Sidney Pressey as early as 1915 in his efforts at the Ohio State University to build a simple machine for testing comprehension of materials that had been taught. These crude machines presented multiple choice questions to users while providing immediate knowledge of their results. In a way, the adjunct programmes are supplementary to regular instructional method. They are not an integral part of the teaching process. Mathetic Programming-Abmibade (1999) explained this to be a retrogressive chaining technique which reverses the order in the teaching of a given process. According to him the basis for this type of progrmming is that the closer the learner is to the reinforcement in the learning process, the more effective such reinforcement becomes. In mathetic programme the feedback (i.e reinforcement) completes the task being learnt.

Learning outcomes-According to Basow (1991), prescribes the a change in behavioural pattern as a result being exposed to a particular learning activity which the learner is prompted with; in an instructional process

Types of Computer-based Instruction-Abimbade and Egunjobi (2003) defined computer-based instruction as instructions that are computer-oriented. The computer helps the teacher in managing the educational process (Kehinde, 2004). There are two major types of computer-based instruction which are: Computer-Assisted Instruction (CAI) and Computer-Managed Instruction (CMI)

Computer-Assisted Instruction (CAI): In CAI, computer delivers instruction through the following modes:Tutorial (used in this study), Drill and Practice, Simulation, Games and Utility/Problem Solving.

Computer-Managed Instruction (CMI)-In CMI the computer is made to help the teacher to administer and guide the instructional process: This can be in form of grade book spreadsheets, test item bank.

Tutorial mode of Computer-Assisted Instruction-Tutorials are one of the most effective Instructional strategies (Cronin and Cronin, 1992). In their simplest form, they are similar to textbooks, interspersed with predetermined questions and responses. The basic components of a tutorial programme are: Tutorial mode of Computer-Assisted Instruction-Tutorials are one of the most effective Instructional strategies (Cronin and Cronin, 1992). In their simplest form, they are similar to textbooks, interspersed with predetermined questions and responses.

Consequently, the study is anchored on Gagne's behaviourist theory of Learning Hierarchy and Bruner's cognitive theory of learning by discovery: The present work (both the textual and computer-assisted programmed Instruction) adopted the branching programmed instruction model which was introduced by Norman Crowder.

RESEARCH METHODOLOGY

Research Design: This study adopted a pretest, posttest control group quasi experimental design. The schematized diagram for the design is as presented below:

O_1 X_1 O_2 --------- E_1 (Experimental group 1)
O_3 X_2 O_4 --------- E_2 (Experimental group 2)
O_5 X_3 O_6 --------- Control, Where:

O_1, O_3, O_5, are the pretest scores for the Experimental groups 1, 2, and Control respectively.
0_2, O_4, O_6, are the posttest scores for the Experimental groups 1, 2 and Control respectively.
X_1 is for the Experimental Treatment of Computer-Assisted Programmed Instruction
X_2 is the Experimental Treatment of Textual Programmed Instruction.

Population of the Study: The target population for the study were NCE II students drawn from six Colleges of Education from the northeast zone of Nigeria Comprising FCE (Tech.) Potiskum, Yobe State, FCE (Tech.) Gombe, Sir Kashim Ibrahim College of Education (Maiduguri), FCE Yola, Umar Suleiman College of Education (Gashua) and Aminu Saleh College of Education, (Azare). Two hundred and eighty one (281) students constituted the population out of nine hundred and fifty five (955) students.

Sampling Technique: Purposive sampling technique was employed to obtain the population of the study. Consequently, Two hundred and eighty one (281) students constituted the population out of nine hundred and fifty five (955) students.

Research Instrument: A questionnaire called Computer and Programmed Instruction Attitude Scale Test (Carpast) was used for the study. Computer and Programmed Instruction Attitude Scale Test (Carpast) got a reliability coefficient of r = .826 . The questionnaires were administered with the help of trained research assistants.

Reliability and Validation of Research Instrument: The research instrument goes through various stages of validation processes. To establish the face and content validity of the instruments; copies of each of the instruments were submitted to experts in the field of Educational Technology and evaluation that ascertained the suitability of the instruments in terms of language presentation, clarity and applicability to the various respondents were determined. Modifications were made where necessary and Cronbach Co-efficient alpha was used to determine the interval consistency and reliability of each item and the entire instruments for the attitude scales. The Formula for Cronbach alpha is = $\frac{n\ (1 - vi)}{n-1}$ vt. Where n_o = number of items on the instrument, Vi = number of variance in the item, Vt = variance of total score on the test. Items having negative correlation were removed in order to improve upon the internal consistency of the attitude scale.

Research Procedure: The researcher engaged the services of research assistants who were trained for two weeks and given adequate orientation before the commencement of the programme. Similarly, the researcher liaised with the authorities of the six institutions of learning to obtain necessary permissions before the commencement of the programme.

Data Analysis: Data collected from the study was analyzed using both descriptive and inferential strategies. For descriptive statistics; mean, standard deviation for both experimental and control groups were used. The Analysis of Covariance (ANCOVA) was used in testing the hypotheses and differences among the groups, using pretest scores as covariates. The Multiple Classification Analysis (MCA) also be used to find out how each group performed, the t-test and Schefft multiple range test was used where there are significant differences to determine the source of significance. All hypotheses were tested at $P<.05$ level of significance.

RESULTS AND DISCUSSIONS

The results obtained in this study was presentation based on the six research questions formulated for the study as follows:

Research Question one: *Is there any significant main effect on students learning outcome in operating overhead projector?*

Table 1: Summary of 3x3x2 Analysis of Covariance (ANCOVA) on students learning outcome in operating overhead projector?

Source of Variance	Hierarchical Method				
	Sum of Squares	**Df**	**Mean Square**	**F**	**Sig. of F**
Covariates Pretest	5856.144	1	5856.144	510.298	.000
Main Effects (COMBINED)	1033.158	5	206.632	18.006	.000
Treatment	600.719	2	300.360	26.173	.000*
Academic Ability	431.642	2	215.821	18.806	.000*
Gender	.798	1	.798	.069	.792
2-Way Interactions (Combined)	118.538	8	14.817	1.291	.248
Treatment X learning outcome	23.410	4	5.853	.510	.728
Treatment X Overhead Projector	96.845	2	48.422	4.219	.016*
Interaction effect	.500	2	.250	.022	.978
Treatment X learning outcome X overhead Projector	56.464	4	14.116	1.230	.298

* Significant at p <0.05

Table 1 reveals a significant effect of treatment on NCE students learning outcome ($F_{(2,262)} = 26.173$; P<.05). This means that the Experimental post-test Educational Technology knowledge is significantly different across the two treatment groups. Based on this result, H_o 1(a) is hereby rejected.

Research Question two: *Is there any significant effect of slide projector operation on students learning outcome in Educational Technology?*

Table 2 presents the multiple classification analysis of the performance of the various groups in the operation of Slide Projector.

Table 2: Multiple Classification Analysis of Post-test on operation of Slide Projector and students learning outcome Grand mean = 25.00

Treatment & Category	N	Unadjusted Mean	Adjusted for Covariates	Unadjusted Deviation	Eta	Adjusted Deviation	Beta
TREATMENT							
Slide Projector	103	25.23	26.80	.22		1.79	
	74	26.01	24.24	1.01		-.76	
	104	24.05	23.77	-.94	.131	-1.24	.230
Performance							
Outcome	120	21.18	23.38	-3.82		-1.62	
	100	26.37	25.74	1.36		.73	
Low	61	30.27	26.99	5.27	.601	1.98	.246
Medium							

Table 2 shows that the NCE students who were exposed to the operation of Slide Projector obtained the highest adjusted post-test mean score (x = 26.80; standard deviation = 1.79), followed by those taught using the Textual Programmed Instruction (x = 24.24, standard deviation = -.76) while the control group obtained the lowest mean score (x = 23.77; standard deviation = -1.24). This implies that the operation of Slide projector was more effective in fostering NCE student's acquisition of skill than the conventional strategies.

Research Question Three: *Is there any significant interaction effect of treatment on students learning outcome in using projection techniques?*

Table 3: Scheffé's Post-hoc Analysis of interaction effect of treatment on students learning outcome in using Projection Techniques

			Treatment		
Treatment	**N**	**Mean**	**1. Computer Assisted**	**2. Textual**	**3. Control Assisted**
Computer Assisted	103	26.80		*	*
2. Textual	74	24.24	*		
3. Control	104	23.77	*		

From table 3 above, there are significant differences between the Computer Assisted Programmed Instruction (x = 26.80) and those in the projection techniques (x = 24.24). Also, the pair of Computer Assisted Programmed Instruction group and the control group (x = 23.77) also differs significantly. These two pairs contributed to the significant treatment effect while only the pair of projection techniques Instruction and control groups did not differ significantly in learning outcome. This pair therefore did not contribute to the significant treatment effect earlier obtained.

Research Question four: *What is the interaction effect of treatment on students learning outcome in using programmed instruction?*

Table 4: Summary of ANCOVA of Students' Learning Outcome Post-Test Experimental and Control groups' using Programmed Instruction.

	Hierarchical Method				
Source of Variance	**Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**
Covariates PRETEST	3292.782	1	3292.782	18.246	.000
Main Effects (Combined)	14015.216	5	2803.043	15.532	.000
Treatment	7804.452	2	3902.226	21.623	.000*
Programmed Instruction	6092.404	2	3046.202	16.880	.000*
	118.360	1	118.360	.656	.419
2-Way Interactions (Combined)	12136.744	8	1517.093	8.407	.000
Programmed Instruction and Students Learning Outcome	10784.337	4	2696.084	14.940	.000*
	288.805	2	144.402	.800	.450
	646.568	2	323.284	1.791	.169

** Significant at P < .05*

Table 12 shows that there is a significant effect of treatment on the pre-service teachers' environmental attitude ($F_{(2,262)} = 21.623$; P <.05). This means that the post-test environmental attitude scores of the two experimental and control groups are significantly different at p<.05. Hence, hypothesis 1b is rejected.

Research Question 5: *What is the interaction effect on students learning outcome in using computer assisted instruction?*

Table 5: Multiple Classification Analysis of Post -Test computer assisted instruction Scores by Treatment and Students Learning Outcome

Grand mean = 119.80

Treatment & Category	N	Unadjusted Mean	Adjusted for Factors and Covariates	Unadjusted Deviation	Eta	Adjusted Deviation	Beta
TREATMENT							
Computer Assisted	103	123.45	124.81	3.64	.270	5.01	.311
Textual	74	122.95	122.10	3.14		2.29	
Control	104	113.96	113.21	-5.84		-6.59	
Students Learning Outcome							
low	120	114.53	114.77	-5.27		-5.04	
Medium	100	120.08	121.02	.27	.348	1.21	.301
High	61	129.73	127.73	9.93		7.92	
R = .473							
R squared = .223							

From Table 5 above, the Computer Assisted Programme Instructional group obtained the highest learning outcome score (x = 124.81, standard deviation = 5.01), followed by the Textual Programmed Instructional group (x = 122.10, standard deviation = 2.29) and then the control group.

Research Question 6: *Is there any significant difference on students learning outcome between the Experimental and Control groups in operating Digital Light Processing (DLP) Projector?*

Table 6: Scheffé Post-hoc Test of learning outcome by Treatment using Digital light Processing Projector

		Treatment		
Treatment	**Mean**	**DLP**	**Experimental**	**Control Assisted**
Digital light processing projector	124.81			*
Experimental	122.10			*
Control	113.21	*	*	

** Pairs of groups significantly different at P < .05*

Table 6 above shows that the significant effect of treatment on learning outcome of NCE students is due to the significant difference between the pairs of Using Digital light processing projector group (x = 124.81) and the conventional group (x = 113.21) as well as between the pairs of Textual Programmed Instructional group (x = 122.10) and the conventional group. Only the pair of Computer Assisted Programmed Instruction Group and Textual Programmed Instructional Group did not differ significantly in learning outcome scores and did not contribute to the significant treatment effect on learning outcome.

Summary of Findings

Treatment had significant effects on both learning outcome and attitude of the NCE students. In each case, the NCE students' who were taught using the computer-assisted and text-assisted programmed instruction performed better than those taught with the conventional method. There were also significant effects of Academic Ability on NCE student's environmental knowledge and attitude in Educational Technology. The NCE students with high learning outcome obtained the highest environmental knowledge in the operation Educational Technology gadgets.

Hypothesis 1 revealed that the 3-way interaction effect of treatment on operation of overhead projector and learning outcome on NCE students' knowledge is significant at $p < 0.05$. Hypothesis 2 shows that there is no significant interaction effect of treatment on learning outcome and operation of slide Projector

on NCE students attitude ($F_{(4,262)} = 1.097$; P>.05. Therefore, hypothesis is not rejected. Hypothesis 3 shows that the interaction effect of learning outcome and gender on environmental knowledge is not significant ($F_{(2,262)} = 0.22$; P>.05). Hence, hypothesis 6a is not rejected. Hypothesis 4 shows that there is no significant interaction effect of Programmed Instruction and learning outcome on NCE students attitude in both experimental and control groups($F_{(2,262)} = 1.791$; $P < .05$). Hypothesis is therefore not rejected. Hypothesis 5 revealed that the 3-way interaction effect of treatment on computer assisted instruction and learning outcome on NCE students' knowledge is not significant ($F_{(4,262)} = 1.230$; P>.05). Hence, the hypothesis is not rejected. Hypothesis 6 shows that there is no significant interaction effect of treatment on learning outcome and Digital Processing Projector on NCE students attitude ($F_{(4,262)} = 1.097$; $P < .05$. Therefore, hypothesis is not rejected.

CONCLUSION

From the foregoing, it is clear that there have been past researches (both within and outside Nigeria) which investigated the effect of Instructional strategies on learning outcomes, the interaction effect of academic ability with instructional strategies and the ultimate effects on learning outcomes in Educational Technology. Some have shown significant effect of academic ability and gender on learning outcomes while some did not establish this assertion. Thus, there is need for further work to establish the appropriate strategies for both male and female students with different ability levels. The past studies on the use of programmed instruction did not focus on the moderating effects of academic ability and gender with the use of Programmed Instruction on Educational Technology learning outcomes in colleges of education; a gap which this study attempted to fill. The present study, therefore, used computer-assisted and Textual Programmed Instructional modes taking into consideration the NCE students' learning ability and the effects on their learning outcomes in Educational Technology concepts in Nigerian colleges of education.

RECOMMENDATIONS

Based on the findings of the study, the following were recommended:

1. There is need for the colleges of education in the study area to imbibe the culture of media-based instruction to enhance students' skills in handling Educational Technology gadgets
2. Most of the colleges in the study area need to be equipped with the state of the art equipment to enable them discharge their function effectively
3. More competent personnel need to be employed to man some equipment
4. There is paucity of funds for the procurement ICT consumables in most of the colleges
5. ICT friendly environment should be created to help lecturers in performing their assigned duties.

ACKNOWLEDGEMENTS

The entire study was sponsored by TetFund Abuja with Project Number: **TETF/DR & D/CE/FCE/POTISKUM/IBR/2023/VOL.1**

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