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EFFECT OF COMPUTER SIMULATION ON STUDENT ACADEMIC ACHIEVEMENT AND RETENTION IN MECHANICAL ENGINEERING CRAFT PRACTICE IN TECHNICAL COLLEGES IN KANO STATE, NIGERIA

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Abstract

The purpose of the study was to find out the effect of computer Simulation on students' Academic Achievement and Retention in MECPT in Technical Colleges in Kano State. The study will adopt quasi-experimental pre-test, post-test non-equivalent control group research design. The population of the study comprised of 128 NTC II Students. Purposive sampling technique was use for the study based on availability of professionally qualified staff, computer facilities for teaching, regular electricity supply and availability of teachers willing to participate as research assistance. The instrument use for data collection was achievement and retention test developed by the researchers tagged: "Mechanical Engineering Craft Practice Trade Achievement and Retention Test" (MECPTART) constructed with five point rating scale which was subjected to validation by two experts. The validated instrument was tested for internal consistency and reliability. The reliability coefficient of the instrument was 0.74. The study was guided by four research questions. The data collected for the study were analyzed using mean scores and standard deviation to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance. The pre-test and post-test scores were used for data analyses using Statistical Package for the Social Sciences (SPSS). The study revealed that high achievers in the experimental group had higher mean gain than academic achievement than high achievers in the control group. Also low achievers in the experimental group gained more than low achievers in the control group.

Keywords: Technical Colleges, Computer simulation, Achievement and Retention

INTRODUCTION

Technical Colleges according to National Policy on Education (NPE) are to provide trained manpower in the applied sciences, technology and commerce, particularly at sub-professional

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level, to give introductory studies to some professionals like engineering and other technologies, training, which impart the necessary skills to individuals who can also be self-reliant. Federal Republic of Nigeria (FRN, 2014). Mechanical Engineering Craft Practice Trade (MECPT) is one of the trades found in technical colleges, which is aimed at training and imparting necessary skills leading to the training of craftsmen who will be self-reliant and enterprising in job areas, such as Metal fitting, Machining, Welding, Fabrication, etc. National Board of Technical Education (NBTE, 2008). Furthermore mechanical Engineering Craft Practice Trade (MECPT) is one of the several recognized fields of engineering that start from the practice of machines, an art of trial and error to the application of scientific method in research, design and production (Crawford, 2010). It is a branch of engineering which deals with machines and mechanized processes, particularly concerned with power generation, transmission, utilization of tools and equipment (Atsumbe, Okoro, & Ogwo, 2012). MECPT students are awarded with the National Technical Certificate (NTC) after successful passing of all the relevant modules of the course. This qualifies them to secure employment either at the end of the whole course or after completing one or more modules, set up their own business and become self-employed and be able to employ others; pursue further education in advanced craft/technical programme in post-secondary (tertiary) technical institutions such as polytechnics or colleges of education (technical) and universities (FRN, 2013).

Teaching method refers to the general principles and management strategies used for classroom instruction Enemali (2006). An effective teaching method is believed to be a source of critical thinking or inspirational disposition on the part of the students (Yinusa, 2014). That is, teaching method utilized by technical teachers in teaching technical trades must also improve in line with the changing needs of the contemporary society. Therefore, a good teaching method for teaching in technical colleges must possess certain qualities capable of bringing out the innovations and making the lesson student-centered activity. Okoye (2010) outlined the following as characteristics of teaching methods:

1. It should progress from simple activities to the more complex tasks.
2. It should possess qualities capable of arousing the interest and enthusiasm for active participation of the students.
3. It should be flexible to accommodate individual differences of the learners.
4. It should be structured in such a way that will satisfy the basic needs of the students.
5. It should be motivating for achievement without boredom.
6. It should link classroom activities with real life activities.
7. It should be able to put into action all five senses (hearing, seeing, feeling, testing and touching) for effective retention of knowledge and transfer of skills acquired.

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Computer assisted instruction is a new teaching and learning strategy in which the topics to be taught is carefully planned, written and programmed in a computer which could be run at the same time in several computer units and it allows each students to one computer terminal, the instructions are programmed in a computer disc (CD), which could be played in either audio or video system for the student to learn the programmed at his/her leisure time and at his/her own Sani (2011). Computer Assisted Instruction (CAI) is a program of instruction or package presented as computer software for instructional purpose, is the most interesting degree on how information between the users and the machine is facilitated by colorful and attractive machine inter-phase, it provides the learner with different backgrounds and characteristics, and also a learner-centered and activity oriented Olawale (2013). CAI is an instruction or learning activity that involves the use of a computer system, including any of the hardware, software, network and telecommunication efforts, for the primary use of learning.

Computer simulations promote student interest and foster retention of information, and offers opportunities for affective and behavioral learning (Gambar & Yusuf 2014). Computer simulation is the process of using a computer to imitate the operation of a real world process or facility according to appropriately developed assumptions taking the form of logical, statistical or mathematical relationships which are developed into a model. There are number of computer simulations software programmes relevant to Mechanical Technology, computer simulations enhanced students' active involvement in the learning process, and facilitated their practice, computer simulation helped students to meet their learning objectives or goals (Maxwell & Halliru 2016). (Mchaney, 2009). Computer technology has been widely used in education for more than forty years. More specifically, computer simulation as an instructional technology has been commonly used in education (Reid, Zhang & Chen, 2003). Computer simulations enable students to have opportunity to receive supplemental contact with the variables tested in real experiences or dangerous ones. Students can be active during the simulated experiments by identifying the study problem, writing in their notebooks their hypotheses, planning and performing the simulated experiments, gathering results, collecting data in their notebooks, plotting these data back in the computer, and using the data for drawing tables and graphs.

Academic achievement describes a measure or level of success in relation to a task or job**;** especially learning that has been carried out (Umar 2015). Academic achievement is the extent to which a student, teacher or institution has achieved their educational goals, the quality of knowledge, skills, attitudes and values acquired in the cognitive, affective and psychomotor domains of educational objectives for necessary self-confidence, self-reliance, effective citizenship, responsiveness to opportunities and challenges of life, the quality of students' learning outcomes is undoubtedly dependent on teachers' knowledge, skills and competencies

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in instructional task performance (Cyril, 2015). Achievement is students' present performance level or academic skill; it is the criterion used to measure students' success in their studies, making it crucial to understand the factors responsible for determining, predicting, mediating, or causing variance in academic achievement and retention (Ahmad & Bruinsma, 2006)

Retention is the ability to reproduce the learnt concept when the need arises (Demirel, 2004). However, students' retention could be retained through the use of an appropriate instructional material like computer assisted instruction and computer simulation package in teaching. Retention is the degree of competence to which an acquired knowledge or skills is retained through the passage of time. It is the maintenance of the content of learned behaviors (Adams, Karhtaus & Rehak 2011). Therefore retention in other words is skills relative to a criterion. Given that there is obviously a relationship between the acquisition of skill and knowledge and their retention over time. However retention is influence by number of factors that include among others student attributes (his/her cognition), the media through which learning is taking place (learning style), the method used to conduct teaching (teaching method) (Adams, Karhtaus & Rehak (2011). A good memory and retention lead to meaningful learning leading to production of a series of changes within the entire cognitive structure, modifying existing concepts, and forming new linkages between concepts. If there is no sufficient effective instruction, there can be no retention. Therefore, it is against this background that, the researcher intends to find out the comparative effect of computer assisted instruction (CAI) on students' academic achievement and retention in mechanical engineering craft practice trade in technical colleges in north western Nigeria

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Statement of the Problem

Mechanical Engineering Craft Practice Trade (MECPT) is one of the trades offered by technical college students in Nigeria. In spite of the huge investment by successive government on technical college programme aimed at improving the image, academic achievement and retention of technical college students, in MECPT is still poor National Business and Technical Education Board (NABTEB) (2005- 2013) Chief Examiner reports indicate high percentage failure rate by MECPT students. The (Federal Ministry of Education FME 2012) has observed that some of the factors responsible for the high failure rate of technical college students in the NABTEB examinations include poor quality of teaching methodologies in technical colleges Bakare (2019). The learning outcome of every student majorly depends on the type of teaching methods, teaching strategies, and instructional techniques or approaches employed by the teacher during instruction Sonola (2017).

The traditional teaching methods such as demonstration, lecture and discussion methods adopted for teaching in technical colleges by technical teachers are termed to be teacher

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centered instead of students centered and these methods of teaching technical subjects according to the author, discourage creativity and disallow students from thinking beyond what is presented to them by their teachers. Campbell and Campbell (2019) also explained that traditional method of teaching does not adequately equip teachers with contemporary views of students' intelligence and their vast learning capabilities.

Therefore, there is need for a change of method and technique in the teaching of MECPT, so as to enable the students of technical college acquire adequate knowledge and skills for the world of work, hence, the problem of the study is designed to find the effect of computer assisted instruction on student academic achievements and retention in MECP in technical colleges in northwest Nigeria.

Purpose of the Study

The Purpose of this Study is to determine the effect of Computer Simulation, with Traditional Instructional Method (DTM) on students' Academic Achievement and Retention in MECPT in Technical Colleges in Kano state Nigeria. Specifically, the study sought to:

1. Determine the Mean academic achievement scores of students taught MECPT with CAI and those taught with DTM in technical colleges in Kano state.
2. Determine the Mean retention scores of students taught MECPT with CAI and those taught with DTM in technical colleges in Kano state.
3. Determine the Mean achievement scores of high and low achieving students taught MECPT with CAI in technical colleges in Kano state.
4. Determine the Mean retention scores of high and low-achieving students taught auto-mechanics with CAI in technical colleges in Kano state.

Research Questions

Research Questions The following research questions guided the study

1. What are the mean academic achievement scores of students taught MECPT trade using CAI and those taught using DTM in technical colleges in Kano state?
2. What are the mean retention scores of students taught MECPT using CAI and those taught using DTM in technical colleges in Kano state?
3. What are the Mean achievement scores of high and low achieving students taught MECPT with CAI in technical colleges in Kano state?
4. What are the Mean retention scores of high and low-achieving students taught MECPT with CAI in technical colleges in Kano state?

Hypotheses

The following null hypotheses were tested and will be tested at 0.05 level of significance.

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1. There is no significant difference between the mean academic achievement scores of technical college students taught MECPT with CAI and those taught using demonstration method in technical colleges in Kano state.
2. There is no significant difference between the mean retention mean scores of technical college students taught trade with CAI and those taught MECPT with demonstration method in technical colleges in Kano state.

Significance of the Study

The findings of the study will help MECPT teachers to give students task in hierarchical order. It will help teachers to move from simple to complex task. Since learning new knowledge largely depends on what is already known, otherwise, the result will encourage teachers more to use either computer assisted instructions in presenting lessons to students, this will also help teachers to differ their instructional approaches, develop creative skills and help in making their lesson interesting as well, to cope with the present situation and the challenges of the future.

Scope of the study

The study was delimited to curriculum content of year two (NTC II) modules in MECPT Drilling operation as accredited by NBTE for technical colleges in Nigeria. The study is also delimited to use of CAI (computer simulation) as teaching methods focusing on academic achievement and retention of NTC II students in technical colleges in Kano state Nigeria

METHODOLOGY

This study adopts quasi-experimental pre-test, post-test non-equivalent control group research design. Quasi experimental design investigate possible cause and effect as well as relationship between two or more variables by the application of treatment which cannot be resolve by description or observation (Abdullahi, Ojulari & Jadas, 2015). The design requires a pretest to be conducted on all the students before they are separated into control and experimental groups respectively. This informs the use of this research design

The study was carried out in Kano state of Nigeria. The geographical region of the state is located between latitude 11^{o} 59'47" N and longitudes 8^{0} 31'0" E of the Greenwich Meridian (World Atlas Map, 2015). Kano state shares borders with Katsina state to the north-west, Jigawa state to the north-east, Bauchi state to the south-east and Kaduna state to the south-west.

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The target population of this study was 128 students of the entire NTCII MECPT students of 2022/2023 session in selected technical colleges with adequate ICT facilities in the study area used as both experimental and control group.

A purposive sampling technique was adopted to select three (3) Technical Colleges out of (5) accredited technical colleges in the study area . NTC II intact classes were used for the research exercise. MECPT students in each intact class constitute the sample used for the study. The intact class selected in each of the technical colleges chosen for the study serve as either experimental or control group. The intact class was assigned to treatment condition. The study considers three technical colleges, namely: Government Technical College Kano, Government Technical College Ungogo and Government Technical College Bagauda.

The instrument use for data collection was achievement and retention test developed by the researcher tagged: "Mechanical Engineering Craft Practice Trade Achievement and Retention Test" (MECPTART). The MECPTART consist of forty multiple choice items with four options (A, B, C, and D) drawn from the topics that taught which include Drilling operations, Measuring and Marking Out Tools, Properties of Materials and Rivet and Riveting Process from the modules in MECPT as contained in the National Business and Technical Examination Board (NABTEB, 2007) syllabus. A pretest administered in order to ascertain the entry behavior of the students in MECPT. The same instrument was used as posttest instrument but the question numbering and their alternative responses was rearranged to avoid memorization of the answers by students.

The instrument undergoes face validation only by Five (5) experts: three (3) from the department of technology education, Modibbo Adama University of Technology, Yola, Adamawa state; two (2) from Mechanical Engineering Craft Practice Trade in Technical Colleges in Kano State. These experts assess both the instrument and the marking scheme in relation to the curriculum contents for year two (NTC II) MECPT in technical colleges. Their observations and corrections were used to modify the instrument and the marking scheme.

To establish the reliability of the instrument, the instrument was trial tested on NTC II Mechanical Engineering Craft Practice Trade students of government science and technical college Ringim, in Jigawa state which is not part of the study area. This is to enable the researcher to determine the workability of the instrument. The test re-test method was used to determine the reliability of the instrument. In order words, the same test with the same

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content and structure was administered twice within an interval of two weeks. Kurder-Richardson (K-R) 21 method of calculating internal consistency of the test item used to determine the internal consistency of the instrument.

Experimental Procedure The researcher select topics to include Drilling operations (drilling large hole), Measuring and Marking Out Tools, Properties of Materials and Rivet and Riveting Process from the modules in Mechanical Engineering Craft Practice Trade skills under Engineering Trades as listed in the National Business and Technical Examination Board (NABTEB 2007) syllabus.

Each selected technical college have the experimental and the control groups. This is to ensure that, the data collected are valid and homogeneous. This was done in such a way that disrupting the school activities and interference would be avoided. The researcher with the help of three research assistants (whom the researcher had trained) administers a pretest to the intact classes on the first day before the lesson commences. Thereafter, the students were randomly assigned into the experimental and control groups after which the trained research assistants will commence proper teaching using the prepared lesson plans as a guide. The experimental group taught using computer assisted instructions instructional approaches and the control group was taught using conventional teaching method.

The researchers prepare lesson plans for the teaching of the module set out for the study. The lesson plans prepared from the module of NABTEB, 2007. The researcher takes into consideration the age, class of the students, duration, and the specific objective of the lesson topics in preparing the lesson plans. Lesson plans will be prepared for the computer assisted instruction (computer simulation and conventional teaching method). After the treatment of the experimental groups, the researcher administer a posttest to both experimental and control groups using the same question for pretest but now reshuffled. The regular Mechanical Engineering Craft Practice Trade teachers (trained by the researcher) were used.

The data for this study was collected by the researcher with the help of trained research assistants that are MECPT Teachers from the selected technical colleges in the study area through administering the pretest, treatment and posttest. The researcher and the assistance there after mark the script and the scores generated was used as data for the study.

The achievement test, that is, pretest was administered on the students in MECPT. The scores will be kept by the researcher pending the outcome of the treatment. The same instrument used as post-test (Retention Test) instrument but the question numbering will be

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rearranged to avoid memorization of the answer by students. Also, the answer scripts or scores of the pre-test was not be made known to the students. The scores obtained from both groups was compared to determine if there is any significant difference in the performance of the two groups.

The data collected from pretest and posttest was analyzed using Mean and Standard deviation to answer research questions. **While analysis of covariance (ANCOVA) was used to test the null hypotheses at 0.05 level of significance.** Any group with higher mean in the achievement test irrespective of the closeness in the mean value was taken to perform better and the method used in teaching them also be considered better. The decision rule for testing the hypothesis is that, if the p-value is less than 0.05, the null hypotheses was rejected. Alternatively if the p-value is greater than or equal to 0.05, the null hypothesis was accepted. All the analysis was carried out using Statistical Package for Social Sciences (SPSS) version 26.

Results

Table 1 Pretest and Post-test mean academic achievement scores of students taught MECPT trade using CAI and those taught using DTM in technical colleges in Kano state?

Groups	No	**Pre-test** Mean	SD	Post-test Mean	SD	Gain in mean
Experimental	29	24.61	2.49	35.53	5.37	10.841
Control	27	23.84	2.91	33.33	11.53	9.50

Table 1 show that the post-test mean score of experimental group is 35.53 is higher than post-test mean score is 33.33. There is a slight difference in the mean of 2.20 in favour of high achieving students.

Table 2 Mean Retention scores of students taught MECPT using CAI and those taught using DTM in technical colleges in Kano state?

Group	No	Post-test Mean	SD	Gain in Mean
Low Achievers CAI	20	41.8	3.69	4.24
Low Achievers DTM	27	37.45	4.79	

D/M –Difference in Mean

Table 2 shows that the mean retention score of experimental group is 41.69 and the control group is 37.45 with a difference of 4.24 in favour of the low achievers taught with CAI had better retention than low achievers taught with DTM.

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Table 3 Mean achievement scores of high and low achieving students taught MECPT with CAI in technical colleges in Kano state?

Group	No	Pre-test mean	SD	Post-test mean	SD	Gain mean
High Achievers CAI	29	24.69	2.49	35.53	5.35	10.84
Low Achievers CAI	24	23.83	2.19	33.33	11.55	10.50

Table 3 shows that mean cognitive achievement scores of experimental group of high achievers posttest is 35.53 while that of the control group low achievers mean posttest scores is 33.33. The gain in mean of high achievers is 10.84 and 10.50 for low achievers taught with CAI.

Table 4 Mean retention scores of high and low-achieving students taught MECPT with CAI in technical colleges in Kano state?

Group	**No**	**Post-test mean**	**SD**
High achievers	29	41.84	4.069
Low achievers	27	37.79	4.999

Table 4 shows the posttest mean retention scores of high achievers is (M=41.84) and low achiever is (M=37.79). This implies that the high achievers retained better than the low achievers in the treatment. It implies that the use of CAI positively enhanced the retention ability of both the high and low achievers respectively.

Table 5 ANCOVA for Differences in mean Cognitive Achievement scores of high and low achieving Students taught MECPT with CAI

Source	**Type III Sume of square**	**DF**	**Mean square**	**F**	**P-value**
Corrected model	470.062	2	235.301	3.384	0.38
Intercept	719.144	1	719.144	10.353	0.02
Post-test	155.618	1	155.618	2.240	1.38
Achievers	32.342	1	32.342	466	497
Error	6807.107	46	69.460		
Total	119655.000	49			
Corrected total	7277.168	48			

R Squared = .065 (Adjusted R Squared = .046)

Table 5 shows that the posttest mean cognitive achievement of high and low achieving students in the experimental is $F(1, 100) = 0.497$, $p > 0.05$. This means that there was no significant

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difference in the mean achievement scores of high and low achieving students in experimental group. Therefore, the null hypothesis was rejected.

TABLE 6 ANCOVA Summary for Differences in Mean Retention Scores of High and Low-achieving Students taught MECPT with CAI

Source	Type III Sume of square	DF	Mean square	F	P-value
Corrected model	698.637	2	349.319	762	470
Intercept	91.271	1	2044.174	44.590	0.000
Post-test	602.735	1	91271	0.199	0.657
Achievers	44954.195	1	602.735	1.34	0.254
Error	1663525.000	46	458.716		
Total	45652.832	49			
Corrected total		48			

R Squared = .065 (Adjusted R Squared = .046)

Table 6 shows that the posttest mean retention scores of high and low achieving students in the experimental is $F(1, 100) = 0.254$, $p > 0.05$. This means that there was no significant difference in the mean retention scores of high and low achieving students in experimental. Therefore, the null hypothesis was rejected.

Discussion

Findings of the study revealed that high achievers had higher mean academic achievement in both experimental and control groups in the posttest while high achievers in experimental group gained more than high achievers in the control group. The finding is in agreement with that of Nwosu (2009), Bayrak and Bayram, (2010) which reported that experimental group taught with CBI achieved better then the control group taught with L/DTM. Finding further showed that the high achievers in the experimental group had the higher mean retention score than those in the control group. This finding agrees with that of Okoye (2010) and Okoye (2018) which reported that higher achiever taught with CBI performed better than the high achievers in the taught with L/DTM. The study revealed that high achievers in the experimental group had higher mean gain than academic achievement than high achievers in the control group. Also low achievers in the experimental group gained more than low achievers in the control group. This finding supports the findings of olawale (2013) that high and low achievers in the experimental group achieved better than their conterparts in the control group The results showed that both achievers in the experimental group had greater retention scores than those in the control group. This result is in agreement with the findings of Nwanne and Agommuoh

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(2017) which reported that the mean retention scores of students taught with CBI achieved more than those taught with L/DTM. Furthermore, findings of the study revealed that there was no significant difference in the mean academic achievement scores of high and low achieving students in the experimental and control groups. This finding disagrees with Oyenuga (2016) which found a significant between mean retention scores of students taught with computer simulation technique and those taught with L/DMT in favour of the experimental group.

Conclusion

Based on the findings of this study. It could therefore be concluded that CBI is not only an innovative teaching method, but could also enable teachers effectively deliver their lessons to enable students assimilate the instruction in order to enhance their cognitive achievement in auto-mechanics in technical colleges. Also, the findings revealed an appreciable improvement in the performance of students taught auto-mechanics using computer-assisted gadgets as well as the comparison between the achievement of high and low-achievers.

Recommendations

Based on the findings of this study, the following recommendations were made: 1. Teachers should ensure constant and effective utilization of CAI for instruction in trade and trade related subjects/courses in technical colleges, secondary and vocational schools to enhance achievement and retention ability of students 2. School administration should provide opportunities for in–service training programmes for auto mechanics trade teachers in order to equip them with competencies needed in the use of CAI for instruction. 3. Government should provide Technical colleges with computers and internet facilities to enable students maximize the benefits of CAI.

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