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Effects of Computer Tutorial and Simulation Techniques on Achievement of Electrical Installation Students in Technical Colleges in Osun State, Nigeria

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Abstract: *The study investigated the impact of computer tutorials and simulation techniques on the achievement of electrical installation students in technical colleges in Osun State. A quasi-experimental pre-test and post-test three-group design was adopted for the study, comprising two experimental groups and one control group. The population targeted in the study consisted of 210 electrical installation students from nine technical colleges in Osun State. A sample of 81 students was selected through a multistage sampling procedure, involving purposive sampling of technical colleges from different senatorial districts and intact classes within these colleges. Three research instruments were used: the Electrical Installation Performance Test (EIPT), the Computer Tutorial Package (CTP), and the Instructional Simulation Package (ISP). Reliability was established through a test-retest method with a reliability coefficient value of 0.837. The experimental procedure consisted of pre-treatment, treatment, and post-treatment stages. Data were analyzed using descriptive and inferential statistics, with hypotheses tested through One-way ANOVA, ANCOVA, and t-tests at a 0.05 significance level. The analysis revealed that prior to treatment, there was no significant difference in the performance mean scores of students using computer tutorials, simulation techniques, and conventional methods in electrical installation. However, after treatment, significant differences emerged among these methods. Additionally, significant differences were observed in student performance before and after treatment across the different methods. The use of computer tutorials, and simulation technique enhanced better performance of students in electrical installation than the conventional method with simulation technique being the most effective strategy. It was recommended among others that the use of computer tutorials and simulation technique should be encouraged in electrical installation class in technical colleges so as to enhance better academic performance of students in electrical installation.*

Keywords: Computer Tutorial, Simulation Technique, Electrical Installation, Students, Technical Colleges

INTRODUCTION

A technical college is a specialised educational institution that provides general education and scientific courses with vocational and modular programs. Umunadi (2013) asserts that the principal objectives of technical college education are to familiarise students with key sectors of production in industry and commerce, to impart skills and practical competencies in the use of tools and materials, and to equip students with theoretical knowledge and general work habits. Technical Colleges educate students in the vocational skills essential for various employment sectors. It offers technical and vocational training for numerous occupations, including woodwork, metalwork, mechanical engineering, electrical installation, radio and television technology, refrigeration, carpentry and joinery, furniture making, baking, metal fabrication, tailoring, dressmaking, typing, shorthand, accounting, spinning, weaving, dyeing and bleaching, vocational agriculture, agricultural machinery operation, and home economics (Umunadi, 2013).

Consequently, technology is essential for national development. Nigeria must develop a cadre of scientists and technicians with the critical and highly valued skills necessary for the enhancement of technological capabilities. The Federal Republic of Nigeria (2014) asserts that technical schools are essential for acquiring technical expertise necessary for technological advancement. The principal vocational institutions in Nigeria that provide technical education are referred to as Technical Colleges. The phrase "technical education" denotes the components of the educational process that encompass, alongside general education, the examination of technologies and associated sciences, as well as the attainment of practical skills, attitudes, comprehension, and knowledge pertinent to professions across diverse economic and social sectors (Federal Republic of Nigeria, 2014).

Electrical Installation is a vocational topic offered at the National Technical Certificate (NTC) level by Technical Colleges. This topic aims to provide its recipients with the knowledge and skills required for artisan-level Electrical Installation and Maintenance. The Federal Government of Nigeria (2004) states in the National Policy on Education that the rationale for the creation of the National Technical Certificate (NTC) program is to equip Technical College students with the requisite knowledge and skills to produce craftsmen and other skilled professionals capable of fulfilling vacancies at the craft level in Nigeria's industrial and business sectors. The NTC program aims to educate students to become artisans and other skilled professionals, hence facilitating the development of such persons. The National Board for Technical Education (NBTE) and the National Business and Technical Education Board (NABTEB) both accredit and evaluate Technical Colleges offering Electrical Installation programs.

Recent research (Moodley & Gaigher, 2019; Uwizeyimana, et al, 2018; Yuliati et al, 2018) indicate that electrical installation is often seen as a difficult topic for both educators and

learners. Moodley and Gaigher (2019) posited that the theoretical aspect of electrical installation is seen as abstract due to its reliance on symbolic representations, absence of tangible examples, and need for advanced mathematical manipulation and visualisation. Furthermore, they said that this facet of electrical installation requires a significant degree of mathematical proficiency. Teaching students to construct these concepts from the ground up may prove to be a formidable endeavour. Nonetheless, it is the teacher's obligation to explore various strategies to facilitate student comprehension of these complex concepts.

Recent study indicates that some students possess significant misconceptions and insufficient information about electrical installations and electricity, which adversely affects their academic performance (Ramnarain & Moosa, 2017; Yuliati et al., 2018). These misunderstandings and insufficient comprehension lead to the student's inadequate academic performance. The problem of insufficient academic performance is not limited to Technical Colleges. Okoth et al. (2018) discovered that students in secondary schools had inadequate understanding of physics, resulting in low academic performance in the subject. Dzana (2012) identified many variables that led to the deterioration of student academic performance in electrical installation. The issues were an absence of scientific labs, insufficient and substandard textbooks, students' views of science topics as challenging, student apathy, and an inadequate allocation of time for practical instruction.

Subpar academic performance may be attributed to several factors, including the insufficient information possessed by educators and the interpersonal interactions among pupils, as previously noted. The subpar academic performance is partly due to the pedagogical approaches of teachers, who lack the necessary teaching tactics for imparting knowledge in electrical installation to their pupils. Lectures, enquiries, elucidations, dialogues, role-playing, demonstrations, and observations are but a few methods used by educators to facilitate students' acquisition of information and skills (Ilojeme, 2013). Teachers may use several additional strategies. Within the framework of electrical installation training at technical institutions, some of the aforementioned teaching methodologies are used. These instructional strategies are sometimes termed traditional or conventional teaching methods. The traditional teaching style prioritises the teacher's position as the active participant in the educational process, in contrast to the learner's function as a passive participant.

As the industrial era transitions to the information era, global technical advancement escalates. The age of information technology has enhanced technical education and several facets of human existence. Education benefits significantly from incorporation into the contemporary, information-abundant digital landscape. Nigeria's education system is continually enhancing its resources by modernising various components to keep pace with evolving technical advancements in regional, national, and global contexts. Modernisation may be accomplished

by the use of contemporary instructional aids and technology, such as computers, projectors, whiteboards, CD-ROMs, televisions, and the internet (Yusuf, 2009).

Educators and learners now possess an unprecedented array of choices for instruction and acquisition of knowledge. There has been a continuous influx of advancements in pedagogical tactics and educational technology in schools. The increasing use of computers in classrooms has resulted in a transition from conventional to innovative educational practices. Educators started the implementation of new pedagogical innovations in their classrooms. Computer tutorials are being implemented via Computer Aided Instructions (CAI) in electrical installations courses at the National Technical Certificate (NTC) level at the Vocational Training Centre, with the use of computer simulation for instruction (Roschelle & DiGiano, 2014). This study examines the use of ICTs, such as computer tutorials and simulations, in educational environments. These strategies can facilitate the instruction of electrical installation without requiring the teacher to possess extensive programming expertise; rather, they necessitate a basic understanding of prevalent information and communication technologies (ICTs) such as Microsoft Word, PowerPoint, and the ability to operate software applications. Secondly, it is an easily available and complimentary software package.

Computer Tutorial is an innovative pedagogical method wherein lessons are carefully designed, documented, and programmed into a Tutorial that can be executed concurrently on multiple computer units, enabling each student to access identical instruction simultaneously through their computer terminals (Adedoja & Fakokunde, 2015). The student may study programming at their own speed using a computer disc that holds the instructions, which can be revisited using an audio or visual system. This not only offers formative feedback on multiple-choice questions but also enhances engagement by customising material for each student (Bayrak & Bayram, 2010). Students using a computer-based lesson may assimilate more material during the same duration as their conventionally instructed counterparts.

Ilojeme (2013) defines computer-assisted instruction as an automated pedagogical approach in which a computer is used to provide an instructional program to learners via an interactive process. This method is classified as computer-based instruction (CAI). The pace of computer-assisted education is dictated by the students, and the software generally does not progress until all skills being taught have been fully grasped by the learners. Emphasis is placed on learner participation and practical experience. Okorieocha (2010) asserts that a crucial feature of CAI is its capacity to tailor training to meet the specific needs of the learner. Ilojeeme (2013) identifies five kinds of computer-assisted instruction: simulations, games, problem-solving exercises, and tutorials. The Tutorial mode of computer-assisted education employs any computer program to provide content to an individual student or a small group, regardless of temporal and spatial constraints (Hardback, et al, 2017). This may be accomplished irrespective of the learner's geographical location.

Alabi and Lasisi (2015) define simulation as a portrayal of a system's behaviour or features using an alternative medium, particularly a computer developed for this specific purpose. Krulik (2010) posits that simulation serves as a sort of mimicry, whereby functioning replicas or representations of machines are created for the purpose of demonstration or exploration of challenges, while accurately portraying real or hypothetical occurrences. Simulation enables students to modify parameters or variables and see the resultant effects on the simulation (Krulik, 2010). Simulations are instruments that facilitate learning by enabling students to practise and illustrate ideas in a secure, regulated environment. It assists students in identifying the factors affecting a system and forecasting its behaviour. It has the capacity to bring ideas into the classroom that would otherwise be unattainable owing to their elevated cost, significant risk, high abstractness, considerable difficulty, or variable frequency of occurrence.

In the simulation mode of computer-assisted education, the computer generates a very realistic environment (Ilojeme, 2013). It is used in circumstances when in-person education would be unfeasible. CAI's simulation mode may be used to assess students' knowledge and instructional comprehension. Agrahari and Singh (2013) asserts that via the simulation mode of Computer-Assisted Instruction (CAI), students acquire information by applying it in a context that replicates real-world scenarios. The objective of an educational simulation is to provide students with the necessary tools to explore, manoeuvre, and comprehend a system or environment in a manner unattainable by direct experience alone. To simulate is to intentionally enact a situation or technique.

The integration of the computer tutorial package and simulation approach into the teaching and learning process, particularly in electrical installation, might potentially transform the classroom setting into a more collaborative, active, and dynamic space. This research aims to analyse this matter. The purpose of the study was to examine the effects of computer tutorials and simulation techniques on the achievement of electrical installation students in technical colleges in Osun State. The study specifically determined the difference between the pre-test and post-test mean scores of students taught electrical principles with computer tutorial, simulation technique, and those taught with conventional method.

The below research question was raised to guide the study:

1. What is the difference in the pre-test and post-test mean scores of students among the experimental and control groups?

The following null hypotheses were generated for this study:

1. There is no significant difference in the performance mean scores of students exposed to computer tutorials, simulation techniques, and conventional methods before treatment in electrical installation.

2. There is no significant difference in the performance mean scores of students exposed to computer tutorials, simulation techniques, and conventional methods after treatment in electrical installation.
3. There is no significant difference in the performance mean scores of students exposed to computer tutorials, simulation techniques, and conventional methods before and after treatment in electrical installation.

Research Methods

This study adopted a quasi-experimental pre-test and post-test three-group design (two experimental groups and one control group). This design allowed the researcher to determine whether the treatment had a significant impact on the outcome variable which is academic performance.

The pattern of the experimental design was shown below:

Experimental group (E_1):	O_1	X_1	O_2
Experimental group (E_2):	O_3	X_2	O_4
Control group(C):	O_5	C	O_6

Where

Observations before treatment	⟶	O_1, O_3, O_5
Observations after treatment	⟶	O_2, O_4, O_6
Treatment via Computer Tutorial	⟶	X_1
Treatment via Simulation Technique	⟶	X_2
Conventional Strategy	⟶	C

The targeted population for the study wass 210 students. This consisted of all electrical installation students in technical colleges in Osun State. There were Nine Technical colleges in Osun State, Nigeria. The sample for the study was 81 students. This consisted of an intact class size of electrical installation students in three technical colleges in Osun State. One of the groups was be used for the Control group which is the conventional method (19), the second group was used for the Experimental group one which is the Computer Tutorial Technique (37), and the third group was the last group will be Experimental group two which is Computer Simulation Technique (25). The sample was selected through a multistage sampling procedure. In stage

one; one Local Government Area where a technical college is situated was selected from each of the three Senatorial Districts in Osun State using a purposive sampling technique. In stage two, one technical college was selected from each of the Local Government areas through a purposive sampling technique. In stage three, one intact class of electrical installation students in each of the three technical colleges was used for the study.

Three instruments were used for this study, which are Electrical Installation Performance Test (EIPT), Computer Tutorial Package (CTP), and Instructional Simulation Package (ISP). The Electrical Installation Performance Test (EIPT) was self-designed. The instrument contained two sections; Section A consisted of bio-data of respondents while Section B consisted of subjective items adapted from NABTEB past questions. The contents of the objective items were based on the concepts taught during the treatment. EIPT was used for both the pre-test and post-test with the test questions reshuffled for the post-test to prevent the effect of test familiarity. The Computer Tutorial Package (CTP) was an adjunct instructional and interactive package. It contained twelve lessons structured in units; each unit lasted for 45 minutes. The package was developed by the researcher with the aid of a program developer. The Instructional Simulation Package (ISP) was an adjunct instructional and interactive package. It contained twelve lessons structured in units; each unit lasted for 45 minutes. The package was developed by the researcher with the aid of a program developer.

The face and content validity of the Electrical Installation Performance Test was ensured by experts in Tests and Measurement, and Technical Education. The face and content validity were ensured by these professionals and the researcher's supervisor to assess the wording and structuring of the test items. For the face validity, experts indicated that the items and the build-up of the instrument are of high face validity and acceptability to what it claims to measure. Furthermore, experts determined the items in terms of simplicity and clarity to ensure that all the words that could confuse respondents were discarded. The experts also affirmed that the instruments were capable of eliciting responses from the respondents. The experts also indicated that the items in the instruments adequately measured the trait and the subject matter it was designed to measure, thereby confirming its content validity. The reliability of the instrument (EIPT) was determined through the test re-test method. The instrument was administered twice to 20 respondents outside the sampled area within an interval of two weeks. To ascertain the reliability of the instrument, data collected were tested using Pearson's Product Moment Correlation statistics to determine the reliability of instrument which yielded a reliability coefficient value of 0.837

The study was carried out in three stages: Pre-treatment Stage, Treatment Stage, and Post-Treatment Stage. The data collected for this study were analyzed using descriptive and inferential statistics. The research question was answered using means and standard deviation. Hypotheses 1 and 2 were tested using One-way ANOVA, while hypothesis 3 was tested using

Analysis of Covariance (ANCOVA). All the hypotheses were tested at 0.05 level of significance.

RESULTS

Research Question 1: What is the difference in the pre-test and post-test mean scores of students among the experimental and control groups?

Table 1: Mean and standard deviation of pre-test and post-test scores of students in experimental and control groups

Strategies	**Test**	**N**	**Mean**	**S.D**	**Mean Diff.**
Computer Tutorials	Pre-test	37	23.97	3.83	**45.92**
	Post-test		69.89	9.05	
Simulation Technique	Pre-test	25	23.80	2.97	**49.08**
	Post-test		72.88	10.33	
Conventional	Pre-test	19	23.58	3.70	**16.16**
	Post-test		39.74	7.87	
Total		**81**			

Table 1 revealed that pre-test performance mean scores of students exposed to computer tutorials was 23.97 while simulation technique was 23.80 while conventional method was 23.58 with their corresponding standard deviations as 3.83, 2.97 and 3.70 respectively in electrical installation. The post-test performance mean scores of students exposed to computer tutorials, simulation technique and conventional method was 69.89, 72.88, and 39.74 with their corresponding standard deviations as 9.05, 10.33, and 7.87 respectively in electrical installation. The mean difference in each of the strategy (computer tutorials and simulation technique) was found to be 45.92, and 49.08 respectively while that of the conventional method group was found to be 16.16.

This implied that the use of computer tutorials and simulation technique had significant effects on the performance of students in electrical installation before and after treatments which was depicted in figure i.

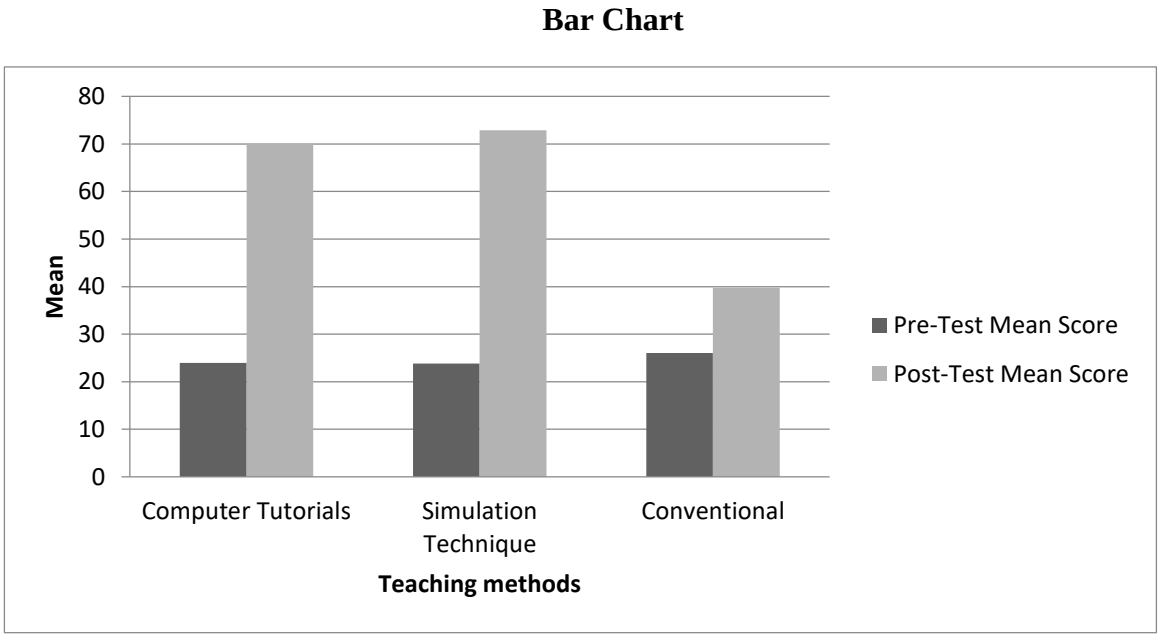

Figure i: Bar chart on the performance of students before and after treatments in electrical installations

Testing of Hypotheses

Hypothesis 1: There is no significant difference in the performance mean scores of students exposed to computer tutorials, simulation techniques, and conventional methods before treatment in electrical installation

Table 2: Difference in academic performance of students in experimental and control groups before treatment in electrical installation

	1.976	2	.988	0.078	0.925
	987.605	78	12.662		
	989.580	**80**			

P > 0.05

The result presented in table 2 showed that F-cal value of 0.078 was not significant because the P-value (0.925) > 0.05 at 0.05 level of significance. Hence, the null hypothesis was not rejected.

This implied that there was no significant difference in the performance mean scores of students exposed to computer tutorials, simulation techniques, and conventional methods before treatment in electrical installation. The implication of these findings is that the students in the experimental and control groups were homogeneous at the commencement of the study.

Hypothesis 2: There is no significant difference in the performance mean scores of students exposed to computer tutorials, simulation techniques, and conventional methods after treatment in electrical installation.

Table 3: Difference in academic performance of students in experimental and control groups after treatment in electrical installation

	14435.664	2	7217.832	84.968*	0.000
	6625.892	78	84.947		
	21061.556	80			

*P < 0.05

The result presented in table 3 showed that F-cal value of 84.968 was significant at P-value (0.000) < 0.05 at 0.05 level of significance. Hence, the null hypothesis was therefore rejected. This implied that there was significant difference in the performance mean scores of students exposed to computer tutorials, simulation techniques, and conventional methods after treatment in electrical installation. In order to determine the source of the significant differences observed, Post – Hoc analysis with mean difference was carried out in Table 4.

Table 4: Scheffe Post – Hoc Multiple Range test of the students' performance in experimental and control groups after treatment in electrical installation

Groups		**N**	**Mean**	**A**	**B**	**C**
				69.89	72.88	39.74
Computer Tutorials	**(A)**	37	69.89			
Simulation Technique	**(B)**	25	72.88			
Conventional	**(C)**	19	39.74	*	*	

* P < 0.05

In Table 4, significant difference was found between students' performance in electrical installation exposed to computer tutorials (69.89) and conventional method (39.74) in favour of students exposed to computer tutorials. Also, there was significant difference between students' performance in electrical installation exposed to simulation technique (72.88) and conventional method (39.74) in favour of students exposed to simulation techniques. However, there was no significant difference between students' performance in electrical installation exposed to computer tutorials (69.89) and simulation technique (72.88). It can be deduced from the findings that students exposed to simulation technique performed best in electrical installation.

Hypothesis 3: There is no significant difference in the performance mean scores of students exposed to computer tutorials, simulation techniques, and conventional methods before and after treatment in electrical installation.

Table 5: Analysis of Covariance for difference in the pre-test and post-test mean scores of students in electrical installation in the groups

Source	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	14481.252[a]	3	4827.084	56.485	<.001
Intercept	5298.689	1	5298.689	62.003	<.001
Pre-Test	45.588	1	45.588	.533	.467
Groups	14355.780	2	7177.890	83.993	<.001
Error	6580.304	77	85.458		
Total	350155.000	81			
Corrected Total	21061.556	80			

a. R Squared = .688 (Adjusted R Squared = .675)

The result presented in table 5 showed that there was a significant difference in the pre-test and post-test mean scores of students in the experimental and control groups as F_{cal} = 83.993, P= 0.000<0.05 at 0.05 level of significance. Hence, the null hypothesis was therefore rejected. By implication, there was significant difference in the pre-test and post-test mean scores of students in the experimental and control groups. This implied that there was significant difference in the performance mean scores of students exposed to computer tutorials, simulation techniques, and

conventional methods before and after treatment in electrical installation. In order to find out the more probable effective strategy, Multiple Classification Analysis (MCA) was carried out. The result is shown in Table 6.

Table 6: Multiple Classification Analysis (MCA) of students' performance in electrical installation by treatment.

Grand Mean = 63.74

Variable + Category	**N**	**Unadjusted Dev'n**	**Eta^2**	**Adjusted for Independe + Covariate**	**Beta**
Computer Tutorial	37	6.15		6.07	
Simulation Technique	25	9.14	0.83	9.06	0.71
Conventional	19	-24.00		-24.31	
Multiple R					0.829
Multiple R^2					0.688

The result in table 6 showed the Multiple Classification Analysis (MCA) of students' performance in electrical installation by treatments. It revealed that, with a grand mean of 63.74, students exposed to simulation technique had the highest adjusted mean score of 72.88(63.74+9.14), followed by the students exposed to computer tutorial with adjusted mean score of 69.89(63.74+6.15), and conventional method with adjusted mean score of 39.74(63.74+ (-24.00)). This means that students exposed to simulation technique performed better than students exposed to computer tutorial and conventional method. The treatment explained about 83% (Eta^2 = 0.83) of the observed variance in students' performance in electrical installation. The treatment strategies accounted for 68.8% (R^2 = 0.688) contribution to academic performance of the students in electrical installation.

DISCUSSION

The study's results indicated no significant change in the mean performance scores of students subjected to computer tutorials, simulation techniques, and traditional methods prior to treatment in electrical installation. The data suggest that the students in both the experimental and control groups were homogenous at the study's outset. The knowledge baseline for the three

groups participating in the research is equivalent. Thus, any substantial change seen thereafter would be attributed not to chance, but to the particular therapy administered.

The research demonstrated a substantial difference in the mean performance scores of students subjected to computer tutorials, simulation techniques, and traditional methods after therapy in electrical installation. Students subjected to simulation techniques excelled at electrical installation. Numerous studies have proven the beneficial effect of computer tutorials on student performance in several courses. Nkweke (2012) demonstrated that interactive multimedia training, a kind of simulation, improved students' academic performance and interest in Biology. Alake and Olojo (2020) also showed substantial improvements in student performance when instructed using a computer simulation tool.

Yusuf and Afolabi (2010) discovered that students subjected to Computer-Assisted Instruction (CAI) in Biology outperformed their peers instructed using conventional lecture techniques. Suleman et al. (2017) similarly showed that CAI significantly enhanced students' academic performance in Physics and their inclination to pursue further studies in the discipline. The advantages of simulation techniques and computer tutorials persist even when a student transitions to a classroom where the instructor does not use these methods. Umar and Bala (2019) found no significant difference between the two approaches, indicating that CAI may not consistently surpass conventional methods in technical disciplines. This contrasts with the present study's result that simulation approaches yielded superior performance, underscoring the potential limits of CAI in practical, skill-based disciplines.

The results indicated a substantial difference in the mean performance scores of students subjected to computer tutorials, simulation techniques, and traditional methods before and after the intervention in electrical installation. This indicates that pupils subjected to the simulation methodology outperformed those engaged with computer tutorials and the traditional way.Simulation approaches are highly acknowledged for their efficacy in improving students' academic performance. Supporting this conclusion, research by Gambari (2010), Nkweke et al. (2012), and Alake and Olojo (2020) has shown a substantial favourable effect of simulation approaches on students' academic performance. Nevertheless, the research suggests that computer tutorials may substantially improve students' academic performance, as shown by Yusuf and Afolabi (2010), Suleman et al. (2017), and Agwagab et al. (2019). The discrepancy between the findings and certain literature, including Umar and Bala (2019), which reported no significant difference between Computer-Assisted Instruction (CAI) and demonstration methods, indicates that the efficacy of instructional methods may fluctuate based on the subject matter, instructional context, and quality of implementation.

Gambari (2010) demonstrated that simulation approaches substantially enhance academic achievement. Alake and Olojo (2020) identified the impact of a computer simulation program on students' academic performance. Mwale and Bahati (2021) demonstrated that pupils

instructed using Solve Elec exhibited much superior performance compared to those educated by conventional chalk-and-talk techniques. This validates the efficacy of simulation approaches in enhancing students' performance in technical disciplines.

CONCLUSION

Based on the findings of this study, it could be concluded that, the three groups (computer tutorials, simulation technique, and conventional method) were homogeneous at the commencement of the experiment. The use of computer tutorials, and simulation technique enhanced better performance of students in electrical installation than the conventional method with simulation technique being the most effective strategy. Computer tutorials and simulation technique are not gender biased and there was no interaction effects of treatments and gender on students' performance in electrical installation.

Recommendations

Based on the findings of this study, the following recommendations were made.

1. The use of computer tutorials and simulation technique should be encouraged in electrical installation class in technical colleges so as to enhance better academic performance of students in electrical installation.

2. Electrical installation teachers should be given adequate orientation through workshops and seminars to update their knowledge in the use of computer tutorials and simulation technique in teaching.

3. Due to the processes involved in computer tutorials and simulation technique, teachers should manage the time allocated well in order to accommodate the use of the strategies in teaching electrical installation.

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