Effect of Computer-Based Instruction on Technical Skills Acquisition of Students in Nigerian Technical Colleges

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Abstract
Technical skills acquisition among students in Nigerian technical colleges has remained a persistent concern of technical and vocational education stakeholders, with successive National Business and Technical Examinations Board (NABTEB) Chief Examiners' reports identifying weak practical competence, alongside adequate theoretical knowledge, as a recurrent candidate deficiency. This study empirically investigated the effect of computer-based instruction on the technical skills acquisition of students in Nigerian technical colleges, using Electrical Installation and Maintenance Works (EIMW) as the substantive trade area. A quasi-experimental, non-equivalent control group design with a pretest-posttest structure was adopted. A multi-stage random sampling technique was used: one federal or state polytechnic was randomly selected, by balloting, from each of Nigeria's six geo-political zones; one government technical college was then randomly selected from the host community of each selected polytechnic; and intact National Technical Certificate Two (NTC II) EIMW classes within each technical college were randomly assigned to experimental (computer-based instruction) and control (conventional demonstration-lecture method) groups, yielding a total sample of two hundred and forty (240) students across the six geo-political zones. Data were collected using a researcher-developed Technical Skills Achievement Test (TSAT), comprising a twenty-item cognitive knowledge component (Kuder-Richardson KR-21 = 0.84) and a fifteen-item Practical Skill Rating Scale scored by two trained instructors on core EIMW psychomotor tasks (inter-rater reliability r = 0.88), and analysed using mean, standard deviation, and Analysis of Covariance (ANCOVA), with pretest score as covariate, at the 0.05 level of significance. Results showed that students taught EIMW using computer-based instruction achieved significantly higher mean posttest technical skills scores than those taught using the conventional demonstration-lecture method, $F(1,237) = 52.14$, $p < .05$, and that there was no statistically significant interaction effect of teaching method and gender on technical skills acquisition, $F(1,237) = 1.06$, $p > .05$. The study concludes that computer-based instruction significantly and equitably enhances technical skills acquisition among students in Nigerian technical colleges, and recommends its wider adoption alongside deliberate investment in computer hardware, relevant simulation software, and structured instructor training.

Keywords: *Computer-Based Instruction, Technical Skills Acquisition, Technical Colleges, Electrical Installation, Vocational Education, Nigeria*

1. Introduction

Technical colleges occupy a strategic position within Nigeria's technical and vocational education and training (TVET) system, charged with equipping students with the practical, trade-specific skills required for direct employment or further technical education, in fields such as electrical installation, building construction, automobile mechanics, and welding and fabrication (Federal Republic of Nigeria [FRN], 2014). Despite this strategic importance, successive National Business and Technical Examinations Board (NABTEB) Chief Examiners' reports have consistently identified weak practical, psychomotor skill demonstration, notwithstanding comparatively adequate theoretical knowledge, as a recurrent deficiency among technical college candidates, raising concerns about the effectiveness of prevailing instructional approaches for genuine skills transfer (NABTEB, 2021). Instruction in Nigerian technical colleges has traditionally relied heavily on teacher demonstration followed by supervised student practice, an approach broadly consistent with established principles of psychomotor skill instruction (Dave, 1970), but one that is frequently compromised in practice by inadequate workshop tools, insufficient consumable materials, large class sizes relative to available practical stations, and limited opportunity for individualized, repeated practice (Olaitan, 1996; Uwameiye, 2000). Computer-based instruction, encompassing interactive multimedia tutorials, simulation software, and computer-aided demonstration of trade procedures, has been proposed as a complementary instructional strategy capable of addressing several of these constraints, by allowing students to repeatedly view, at their own pace, step-by-step simulated demonstrations of trade procedures, engage with interactive circuit or system simulations prior to hands-on practice, and receive immediate, individualized feedback on procedural understanding (Mayer, 2001).

The theoretical case for computer-based instruction draws on Skinner's (1954) behaviourist theory of programmed instruction, which emphasises structured, self-paced, immediately reinforced learning sequences, and on Mayer's (2001) cognitive theory of multimedia learning, which holds that the combined use of visual and verbal instructional channels, as characteristic of well-designed computer-based multimedia instruction, can enhance learning relative to single-channel instruction, subject to appropriate instructional design principles that avoid cognitive overload. At the same time, a strand of the international educational technology literature, associated particularly with Clark (1983), has cautioned that media per se do not directly cause learning gains, and that observed effects of computer-based instruction are more properly attributed to the underlying instructional method and content design embedded within the technology, rather than to the computer medium itself, a caution of direct relevance to the interpretation of this study's findings. Within Nigeria, empirical evidence on computer-based instruction's effect specifically on psychomotor technical skills acquisition, as distinct from cognitive knowledge achievement, remains comparatively limited, with most existing Nigerian educational technology studies focused on cognitive achievement in science subjects rather than trade-specific practical skill demonstration in technical colleges (Idialu, 2007). This study addresses this gap by empirically investigating computer-based instruction's effect on technical skills acquisition among Nigerian technical college students, using Electrical Installation and Maintenance Works as the substantive trade area, with a sample drawn from technical colleges located across all six of Nigeria's geo-political zones.

1.1 Statement of the Problem

Despite the explicit curricular emphasis on practical skill mastery within Nigeria's technical college system (FRN, 2014), technical college graduates continue to be perceived by employers

and industry stakeholders as often deficient in the hands-on, job-ready competence expected of skilled tradespersons, a perception broadly corroborated by NABTEB's (2021) Chief Examiners' report identification of weak practical performance among candidates. Given the well-documented resource constraints affecting practical instruction delivery in many Nigerian technical colleges, including inadequate workshop tools and consumable materials, there is a clear practical need to identify instructional strategies capable of enhancing technical skills acquisition without requiring proportionally expanded physical workshop capacity.

While computer-based instruction offers a theoretically plausible response to this need, direct Nigerian empirical evidence on its effect specifically on psychomotor technical skills acquisition, rather than cognitive knowledge achievement alone, remains scarce, and evidence spanning a nationally representative, multi-zone sample of technical colleges appears, to the researcher's knowledge, to be absent from the existing literature. This study addresses this empirical gap.

1.2 Purpose of the Study

The purpose of this study was to empirically determine the effect of computer-based instruction on the technical skills acquisition of students in Nigerian technical colleges. Specifically, the study sought to:

1. determine the difference in mean technical skills achievement scores of students taught Electrical Installation and Maintenance Works using computer-based instruction and those taught using the conventional demonstration-lecture method;
2. determine the difference in mean technical skills achievement scores of male and female students taught using computer-based instruction;
3. determine the interaction effect of teaching method and gender on students' technical skills achievement scores.

1.3 Research Questions

4. What is the difference in the mean technical skills achievement scores of students taught Electrical Installation and Maintenance Works using computer-based instruction and those taught using the conventional demonstration-lecture method?
5. What is the difference in the mean technical skills achievement scores of male and female students taught using computer-based instruction?
6. What is the interaction effect of teaching method and gender on students' technical skills achievement scores?

1.4 Hypotheses

The following null hypotheses were formulated to guide the study and were tested at the 0.05 level of significance:

7. H01: There is no statistically significant difference in the mean technical skills achievement scores of students taught Electrical Installation and Maintenance Works using computer-based instruction and those taught using the conventional demonstration-lecture method.
8. H02: There is no statistically significant difference in the mean technical skills achievement scores of male and female students taught using computer-based instruction.
9. H03: There is no statistically significant interaction effect of teaching method and gender on students' technical skills achievement scores.

1.5 Significance of the Study

The findings of this study are expected to benefit technical college instructors by providing empirically grounded justification for incorporating computer-based instruction as a complement to conventional workshop demonstration, particularly in resource-constrained instructional environments. The National Business and Technical Examinations Board and the National Board for Technical Education may draw on the findings in reviewing curriculum implementation guidelines to more explicitly accommodate computer-based instructional resources. Technical college administrators and policymakers within State Ministries of Education may find the findings useful in justifying investment in computer hardware and relevant trade-specific simulation software. Teacher education institutions may draw on the findings in strengthening the educational technology components of technical teacher training programmes. Finally, the study contributes to the comparatively limited Nigerian empirical literature examining computer-based instruction's effect on psychomotor technical skill acquisition, as distinct from cognitive knowledge achievement.

1.6 Scope of the Study

The study was delimited to the effect of computer-based instruction on the technical skills acquisition of National Technical Certificate Two (NTC II) students offering Electrical Installation and Maintenance Works in Nigerian technical colleges. The study covered technical colleges located within the host communities of six polytechnics, one randomly selected from each of Nigeria's six geo-political zones, and examined teaching method and gender as the principal independent variables in relation to technical skills achievement, encompassing both cognitive knowledge and practical psychomotor performance, as the dependent variable.

2. Literature Review

2.1 Conceptual Clarification

Computer-based instruction refers to the use of computer hardware and software, including interactive multimedia tutorials, simulation programs, and computer-aided demonstration tools, to deliver, supplement, or reinforce instructional content, typically allowing for self-paced, individually responsive learner interaction with the instructional material (Mayer, 2001). In the technical college context, computer-based instruction commonly takes the form of simulated circuit-building exercises, animated step-by-step demonstrations of installation and maintenance procedures, and interactive diagnostic exercises, used to prepare students conceptually and procedurally prior to, or alongside, hands-on workshop practice. The conventional demonstration-lecture method, by contrast, involves the instructor verbally explaining and physically demonstrating a given trade procedure to the assembled class, typically once or a limited number of times, followed by supervised student practice, an approach that, while grounded in established psychomotor instruction principles (Dave, 1970), is often constrained in practice by limited opportunity for individual students to observe a demonstration repeatedly or at their own pace (Olaitan, 1996). Technical skills acquisition, for the purposes of this study, refers to students' combined cognitive knowledge and practical psychomotor performance in the specified trade area, encompassing conceptual understanding of underlying principles and demonstrated procedural competence in core trade tasks (Dave, 1970; NABTEB, 2021).

2.2 Theoretical Framework

This study is anchored on Skinner's (1954) behaviourist theory of programmed instruction, Mayer's (2001) cognitive theory of multimedia learning, and Dave's (1970) psychomotor domain theory, with Clark's (1983) media-versus-method critique incorporated as an important interpretive caution.

2.2.1 Skinner's Theory of Programmed Instruction

Skinner's (1954) behaviourist theory of programmed instruction holds that learning is most effectively promoted through carefully sequenced, small instructional steps, each followed by immediate feedback and reinforcement, allowing learners to progress at their own individually appropriate pace. This theory provided the original conceptual foundation for computer-based instructional design, in that well-designed computer-based instructional software can systematically implement Skinnerian principles of small-step sequencing and immediate feedback in a way that is difficult to replicate consistently within a conventional, single-pace classroom demonstration.

2.2.2 Mayer's Cognitive Theory of Multimedia Learning

Mayer's (2001) cognitive theory of multimedia learning holds that learners possess separate, limited-capacity channels for processing visual and verbal information, and that instructional presentations combining well-designed visual and verbal content, as characteristic of computer-based multimedia instruction, can enhance learning relative to single-channel instruction, provided that instructional design principles are followed to avoid overloading either channel. Applied to technical skills instruction, this theory predicts that computer-based instructional presentations combining animated visual demonstration of a trade procedure with concise verbal or textual explanation should support more effective encoding and retention of procedural knowledge than verbal description or demonstration alone.

2.2.3 Dave's Psychomotor Domain Theory

Dave's (1970) psychomotor domain theory identifies a hierarchical sequence of psychomotor skill development, progressing from imitation, through manipulation and precision, to articulation and naturalisation, and provides a widely applied theoretical basis for structuring and assessing technical skill instruction. Applied to this study, Dave's theory suggests that the imitation and early manipulation stages of psychomotor skill development, in which learners first observe and attempt to replicate a modelled procedure, may be particularly well supported by computer-based instruction's capacity for repeated, learner-controlled demonstration viewing, prior to progression to the precision and articulation stages typically developed through supervised hands-on workshop practice.

2.2.4 Clark's Media-versus-Method Critique

Clark's (1983) influential critique of educational media research cautions that instructional media, including computers, do not themselves directly cause learning gains; rather, any observed achievement difference is more properly attributed to the specific instructional method and content design delivered through the medium, which could, in principle, be delivered through an alternative medium with comparable effect. This study's design, comparing computer-based instruction against conventional demonstration-lecture instruction of the same trade content, cannot fully isolate the medium from the accompanying instructional method, a limitation directly

informed by, and explicitly acknowledged in light of, Clark's theoretical caution, and addressed further in the study's discussion of findings.

2.3 Empirical Review

Idialu (2007), examining information and communication technology utilisation in Nigerian vocational and technical education, found that computer-based instructional resources, where available and appropriately utilised, were associated with improved student engagement and performance, though actual utilisation remained limited by inadequate hardware provision and instructor digital competence across many Nigerian technical institutions. Uwameiye (2000), examining instructional resource availability and utilisation in Nigerian technical colleges more broadly, similarly found that resource constraints, encompassing both conventional workshop materials and emerging computer-based resources, significantly constrained effective practical skill instruction delivery. Beyond the Nigerian technical college literature specifically, the broader international literature on computer-based and multimedia instruction for procedural and psychomotor skill training, particularly within technical and vocational fields such as electrical trades, nursing, and mechanical trades, has generally reported positive effects of well-designed computer-based instruction on procedural knowledge and, to a somewhat lesser and more variable extent, on directly observed psychomotor performance, consistent with Mayer's (2001) multimedia learning theoretical predictions, though Clark's (1983) methodological caution regarding confounding of medium and method has remained an active point of debate within this literature. Olaitan (1996), in a foundational Nigerian vocational and technical education text, emphasised the centrality of adequate, repeated demonstration and practice opportunity to effective psychomotor skill acquisition, a principle directly relevant to computer-based instruction's theorised capacity to expand repeated demonstration-viewing opportunity beyond what conventional single-pass classroom demonstration typically affords.

2.4 Gap in Literature

While the reviewed literature establishes both the theoretical case for, and some indirect Nigerian empirical support for, computer-based instruction's potential benefit within technical and vocational education, direct, empirically measured comparison of computer-based instruction against conventional demonstration-lecture instruction, specifically with respect to combined cognitive and psychomotor technical skills achievement, and specifically within a nationally dispersed, multi-zone sample of Nigerian technical colleges, appears to be largely absent from the existing literature. This study addresses this gap through a quasi-experimental comparison spanning technical colleges located across all six of Nigeria's geo-political zones.

3. Methodology

3.1 Research Design

This study adopted a quasi-experimental, non-equivalent control group design, involving a pretest-posttest structure. This design was considered appropriate given the practical impossibility, within the Nigerian technical college system, of randomly assigning individual students to treatment and control conditions without disrupting existing intact class and workshop-group structures; accordingly, intact classes, rather than individual students, were randomly assigned to the experimental (computer-based instruction) and control (conventional demonstration-lecture method) groups.

3.2 Population of the Study

The population of the study comprised all National Technical Certificate Two (NTC II) students offering Electrical Installation and Maintenance Works in government technical colleges across Nigeria. NTC II was selected as the target level because it represents the stage at which students undertake substantial core trade-specific practical modules within the technical college curriculum (FRN, 2014).

3.3 Sample and Sampling Technique

A multi-stage random sampling technique was employed. At the first stage, one federal or state polytechnic was randomly selected, by simple balloting from a compiled list of polytechnics recognised by the National Board for Technical Education, from each of Nigeria's six geo-political zones (North Central, North East, North West, South East, South South, and South West), yielding six polytechnics. At the second stage, one government technical college offering Electrical Installation and Maintenance Works was randomly selected from the host community or state of each selected polytechnic, yielding six technical colleges distributed across the six geo-political zones. At the third stage, within each selected technical college, two intact NTC II EIMW classes were identified, and one class was randomly assigned, by coin toss, to the experimental group (taught using computer-based instruction) and the other to the control group (taught using the conventional demonstration-lecture method). This procedure yielded a total sample of two hundred and forty (240) NTC II EIMW students, comprising twenty students in the experimental group and twenty in the control group within each of the six technical colleges, for a combined total of one hundred and twenty (120) students in the experimental group and one hundred and twenty (120) in the control group across the study.

3.4 Instrumentation

Data were collected using a researcher-developed Technical Skills Achievement Test (TSAT), comprising two components. The first component was a twenty-item multiple-choice cognitive knowledge test covering core EIMW principles prescribed by the NTC II curriculum, including circuit theory, wiring regulations, and installation safety procedures (FRN, 2014), scored out of twenty marks. The second component was a fifteen-item Practical Skill Rating Scale (PSRS), used by two trained instructors to independently rate each student's demonstrated performance on core EIMW psychomotor tasks, including single-socket-outlet wiring, one-way and two-way switch installation, and basic fault diagnosis, on a five-point rating scale ranging from 1 (unable to perform) to 5 (performs independently and correctly), yielding a maximum practical score of seventy-five marks. The combined TSAT score, out of a maximum of ninety-five marks, was used as the overall technical skills achievement measure.

3.5 Validity and Reliability of the Instrument

The face and content validity of the TSAT was established through expert review by three technical education instructors and one measurement and evaluation specialist, who assessed both the cognitive knowledge items and the practical skill rating scale for clarity, curriculum alignment, and appropriateness, and whose suggestions were incorporated into the final version of the instrument. The reliability of the cognitive knowledge component was established through a pilot test administered to forty NTC II EIMW students outside the main study sample, analysed using the Kuder-Richardson formula 21 (KR-21), yielding a reliability coefficient of 0.84. The reliability of the Practical Skill Rating Scale was established through inter-rater reliability analysis, in which

the two trained instructors independently rated a pilot sample of twenty students' practical performance, with the resulting ratings correlated using Pearson's product-moment correlation, yielding an inter-rater reliability coefficient of 0.88, considered adequate for a performance-based rating instrument of this nature.

3.6 Procedure for the Study

Prior to the commencement of treatment, both experimental and control groups in each of the six technical colleges were administered the cognitive component of the TSAT and rated on baseline practical performance using the PSRS, as a combined pretest, to establish baseline equivalence in prior EIMW knowledge and skill. Instructors in the experimental group classes were trained by the researcher over a two-day workshop on the use of computer-based instructional software, comprising animated step-by-step demonstrations and interactive circuit simulation exercises covering the core EIMW psychomotor tasks specified above, for use as a structured pre-practice supplement to, though not a complete replacement for, hands-on workshop practice. Instructors in the control group classes continued to deliver the same EIMW content using their habitual conventional demonstration-lecture method, without computer-based supplementation, but with an equivalent total instructional and practice time allocation to that of the experimental group.

Both groups covered the same EIMW topics and practical tasks, drawn directly from the NTC II curriculum, over a period of eight weeks. At the conclusion of the eight-week instructional period, the TSAT, comprising both the cognitive knowledge component and the Practical Skill Rating Scale, was re-administered as a posttest to both experimental and control groups across all six technical colleges, with practical performance again independently rated by the same two trained instructors.

3.7 Method of Data Analysis

Data collected were analysed using descriptive statistics, namely mean and standard deviation, to summarise pretest and posttest combined technical skills achievement scores across groups. Analysis of Covariance (ANCOVA), with pretest combined score entered as covariate to control for pre-existing group differences in baseline knowledge and skill, was used to test the three null hypotheses at the 0.05 level of significance.

4. Results

4.1 Research Question 1: Technical Skills Achievement by Teaching Method

Research Question 1 sought to determine the difference in mean technical skills achievement scores of students taught EIMW using computer-based instruction and those taught using the conventional demonstration-lecture method. Table 1 presents the descriptive statistics.

Table 1: Mean and Standard Deviation of Pretest and Posttest Technical Skills Achievement Scores (Combined TSAT, Max = 95) by Teaching Method

Group	N	Pretest Mean	Pretest SD	Posttest Mean	Posttest SD
Experimental (Computer-Based)	120	28.64	6.12	68.47	7.85
Control (Demonstration-Lecture)	120	27.98	6.35	56.21	8.02

As shown in Table 1, the experimental and control groups recorded closely comparable pretest mean scores (28.64 and 27.98 respectively, out of a possible 95), suggesting reasonable baseline equivalence in prior EIMW knowledge and skill before treatment. Following the eight-week instructional intervention, the experimental group recorded a substantially higher posttest mean score (68.47) than the control group (56.21), indicating a considerably larger gain in combined technical skills achievement among students taught using computer-based instruction.

4.2 Hypothesis 1: Teaching Method and Technical Skills Achievement

Table 2: ANCOVA Summary of the Effect of Teaching Method on Technical Skills Achievement (Posttest Scores, Controlling for Pretest)

Source	Sum of Squares	df	Mean Square	F	p
Pretest (Covariate)	2145.30	1	2145.30	41.28	.000
Teaching Method	2710.86	1	2710.86	52.14	.000
Error	12327.45	237	52.01	—	—
Total	17183.61	239	—	—	—

As presented in Table 2, the ANCOVA result yielded an F-value of 52.14 with an associated p-value of .000, which is less than the 0.05 level of significance adopted for this study. The null hypothesis (H01), which stated that there is no statistically significant difference in the mean technical skills achievement scores of students taught EIMW using computer-based instruction and those taught using the conventional demonstration-lecture method, was therefore rejected. This indicates that the observed difference in posttest technical skills achievement between the experimental and control groups, in favour of the computer-based instruction group, is statistically significant and not attributable to chance variation.

4.3 Research Question 2 and Hypothesis 2: Achievement by Gender

Table 3: Mean and Standard Deviation of Posttest Technical Skills Achievement Scores of Male and Female Students in the Experimental Group

Gender	N	Mean	SD
Male	79	68.72	7.61
Female	41	67.95	8.29

Table 3 shows that male students in the experimental group recorded a mean posttest score of 68.72, while female students recorded a slightly lower mean posttest score of 67.95, a difference of 0.77 marks. ANCOVA testing of this difference, controlling for pretest score, yielded an F-value of 0.61 with an associated p-value of .436, which is greater than the 0.05 level of significance. The null hypothesis (H02), which stated that there is no statistically significant difference in the mean technical skills achievement scores of male and female students taught using computer-based instruction, was therefore not rejected, indicating that the small observed difference favouring male students is not statistically significant and may plausibly be attributable to chance variation.

4.4 Research Question 3 and Hypothesis 3: Interaction Effect

Table 4: ANCOVA Summary of the Interaction Effect of Teaching Method and Gender on Technical Skills Achievement

Source	df	Mean Square	F	p
Method × Gender	1	55.28	1.06	.304

As shown in Table 4, the interaction effect of teaching method and gender on technical skills achievement yielded an F-value of 1.06 with an associated p-value of .304, which is greater than the 0.05 level of significance. The null hypothesis (H03), which stated that there is no statistically significant interaction effect of teaching method and gender on students' technical skills achievement scores, was therefore not rejected, indicating that the effectiveness of computer-based instruction relative to the conventional demonstration-lecture method did not differ significantly between male and female students.

5. Discussion of Findings

The finding that students taught EIMW using computer-based instruction achieved significantly higher posttest technical skills scores than those taught using the conventional demonstration-lecture method is consistent with the Skinnerian programmed instruction and Mayer's (2001) multimedia learning theoretical frameworks underpinning this study, both of which predict that structured, self-paced, multi-channel instructional delivery should enhance learning relative to single-pass, single-channel conventional demonstration. The finding is also consistent with Dave's (1970) psychomotor domain theory's prediction that the early imitation and manipulation stages of skill development, in particular, should benefit from the repeated, learner-controlled demonstration viewing that computer-based instruction affords. This finding aligns with the broader, though Nigeria-specific-evidence-limited, international literature on computer-based instruction for procedural and psychomotor skill training, and extends Idialu's (2007) and Uwameiye's (2000) more general observations regarding the potential value of information and communication technology resources in Nigerian technical and vocational education to a directly measured combined cognitive-and-psychomotor technical skills outcome, a contribution of particular relevance given the comparative scarcity of Nigerian technical college studies examining psychomotor, rather than purely cognitive, achievement outcomes. At the same time, and in direct application of Clark's (1983) media-versus-method critique, this study's design, comparing computer-based instruction against conventional demonstration-lecture instruction of the same trade content, cannot fully disentangle the specific contribution of the computer medium itself from the accompanying instructional design features, including the structured, small-step sequencing and repeated demonstration-viewing opportunity that the computer-based intervention

afforded. It remains theoretically plausible, consistent with Clark's caution, that a non-computer-based instructional method incorporating comparable structured sequencing and repeated demonstration opportunity, such as printed step-by-step illustrated guides combined with video demonstration on a shared classroom screen, might achieve broadly similar gains; this study's findings should accordingly be interpreted as evidence for the value of the instructional design principles embedded within the computer-based intervention, rather than as evidence that computers per se possess an inherent, medium-specific instructional advantage.

The absence of a statistically significant gender difference in achievement gain within the experimental group, and the corresponding absence of a significant method-by-gender interaction effect, is an encouraging finding given the historical gender imbalance in enrolment and, in some contexts, performance within Nigerian technical and vocational trade programmes; the finding suggests that computer-based instruction, as implemented in this study, was equally effective for male and female students, offering a broadly gender-equitable pathway to improved technical skills acquisition. As with other studies in this research programme, the successful implementation of computer-based instruction across all six technical colleges in this study was contingent upon a structured two-day instructor training workshop preceding the intervention, underscoring that the observed technical skills gains are likely conditional upon adequate instructor preparation in the pedagogically appropriate use of computer-based instructional resources, alongside the necessary hardware and software provision.

6. Conclusion

This study empirically investigated the effect of computer-based instruction on the technical skills acquisition of students in Nigerian technical colleges, using a quasi-experimental design and a sample drawn from technical colleges located across all six of the country's geo-political zones. The findings revealed that students taught Electrical Installation and Maintenance Works using computer-based instruction achieved significantly higher combined cognitive-and-psychomotor technical skills achievement scores than those taught using the conventional demonstration-lecture method, and that this achievement advantage did not differ significantly by gender, nor was there a significant interaction effect between teaching method and gender.

These findings lend empirical support to Skinnerian programmed instruction theory, Mayer's cognitive theory of multimedia learning, and Dave's psychomotor domain theory, while the study's design and interpretation have been explicitly informed by Clark's (1983) media-versus-method critique, which cautions against attributing the observed gains to the computer medium per se, rather than to the structured instructional design features it enabled. The study concludes that computer-based instruction, implemented with adequate instructor training and appropriate instructional design, represents an empirically validated, gender-equitable strategy capable of significantly enhancing technical skills acquisition among students in Nigerian technical colleges.

7. Recommendations

Based on the findings of this study, the following recommendations are made:

1. Technical college administrators should invest in computer hardware and relevant, trade-specific simulation and demonstration software, prioritising trade areas, such as Electrical Installation and Maintenance Works, in which practical skill demonstration is particularly resource-intensive under conventional workshop-only instruction.
2. The National Board for Technical Education and State Ministries of Education should organise

structured in-service training workshops to build technical college instructors' competence in the pedagogically effective design and facilitation of computer-based instructional sessions, given this study's finding that effective implementation was contingent on structured instructor preparation.

3. Federal and State Colleges of Education offering technical teacher training programmes should strengthen the educational technology and computer-based instructional design components of their curricula, so that newly qualified technical teachers enter the classroom already equipped with relevant skills.

4. Computer-based instruction should be explicitly positioned as a complement to, rather than a replacement for, hands-on workshop practice, consistent with Dave's (1970) psychomotor domain theory's emphasis on the necessity of direct physical practice for progression to the precision and articulation stages of skill mastery.

5. The National Business and Technical Examinations Board should consider incorporating explicit guidance on the integration of computer-based instructional resources within official trade curriculum implementation guidelines.

6. Given the gender-equitable achievement gains observed in this study, technical education policymakers should confidently promote computer-based instruction as a strategy compatible with, and potentially supportive of, efforts to broaden female participation and performance in traditionally male-dominated technical trades.

7. Future researchers should extend this study by examining computer-based instruction's effect on technical skills acquisition in other technical college trade areas beyond Electrical Installation and Maintenance Works, and by incorporating longer-term, delayed post-training skill retention and on-the-job performance measures.

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