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Research Article

Digital Electronics Workbench Software and Technical College Student's Learning Interest in Electronics Devices and Circuits in Bauchi State, Nigeria

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Abstract—The study investigates the digital electronics workbench software and technical colleges students` learning interest in electronics devices and circuits in Bauchi State, Nigeria. It entails for the study to achieved the aforementioned area as follows, two specific objectives were identified, so as two research questions were formed and two null hypotheses were examined to guide the study focus. Quantitative methodology and designs with pre-survey – post-survey method was used as the design of the study. The population of the study consist of 92 NTC II technical colleges students that were offering electronics devices and circuits. It further used a purposive sampling technique in selecting two colleges from the eight technical colleges selected. The method used for collection of data in the study signified electronics devices and circuits interest inventory (EDCII) which was validated by three specialists. It revealed that, the reliability coefficient of 0.81 was obtained using test retest method. The collected data for the research questions were analyzed using mean and standard deviation. However, the null hypotheses were tested using t-test at 0.05 level of significant. findings revealed that, students that were taught electronics devices and circuits using electronic workbench software in the urban have more interest than those in the rural areas, this shows that electronics workbench software can be utilized to compliment or directs the use of real practical facilities in constructing electronics circuits in Bauchi state technical colleges. The study recommended amongst others that; authorities should prioritize on providing materials that are required for practical for the teachers to comprehensively deliver what is expected of them in electronics circuit's construction to preclude the disinterest of leaving by the students and deliberately skipping segment of the curriculum. In furtherance of the recommendations, among others that, the ministry of education should not relent to fully introduce and implement the utilization of computer-aided instructions in Bauchi state technical colleges and beyond to stimulate quality teaching and learning of electronic circuit's construction.

Keywords— Learning Interest, Technical College, Digital Electronics Workbench Software, Devices and Circuits

1. Introduction

The significant of technological devices and their applications is widely acknowledged in the 21st century in both business and no-business sectors, particularly in education. The effective use of technology plays a crucial role in influencing students` learning interest. Information and communication technology (ICT) offer innovative tools that can enhance motivation and improve academic outcomes. According to [1], When educators shift from traditional to modern learning environments, they encourage active learning, promote higher-level thinking, enhance collaboration, and increase student engagement. In the context of today's services delivery, especially in technical colleges, the emphasis on the impact of technology cannot be overstated [2]. This is particularly true when considering the need for technological expertise and practices in managing practical work, scientific experiments, and other related studies, where physical engagement requires a strong understanding of technology [3]. Presently, there is growing focus on integrating technology into education, not only for administrative purposes but also as an instructional medium. Technological devices have transformed the education landscape, making teaching more dynamic, interactive, and accessible [4]. It takes various forms, including: Smartboards and Interactive Whiteboards, Tablets and Laptops, Virtual Classrooms and Online Platforms, Educational Apps and Software, Learning Management Systems (LMS), Projectors and Audio-Visual Devices, Gamification and Virtual Reality (VR), Mobile Phones, Flipped Classroom Technology, Artificial Intelligence (AI) and Machine Learning, 3D Printing, Wearable Technology, Cloud Computing [5]. The use of technological devices in teaching allows for a more flexible, engaging, and personalized learning experience. It helps address diverse learning needs, supports remote education, and enhances collaboration between students and teachers [6].

The integration of technology in teaching and learning spans all levels of education [7].

In Nigeria technical colleges play a crucial role in providing diverse forms of technical education, including radio/television and electronics work, refrigeration and air conditioning, electrical installation and maintenance work, carpentry and joinery, welding and fabrication work among others [8]. Technical education aims to impart workplace skills such as creativity, problem- solving, collaboration, and high-order thinking skills, alongside academic skills, to enhance students` flexibility and job mobility. The technical college program emphasizes a balance of 40% theory and 60% practical training [9].

Radio/Television and electronics work (RTVE) is one of the trades offered in technical colleges focusing on providing training and imparting necessary skills for producing craftsmen and women, technicians, and other skills personnel who are enterprising and self-reliant. RTVE comprise four modules namely: electronics devices and circuits, radio communication, satellite transmission and reception [10]. Given the widespread acceptance of technology in teaching and learning, its incorporation into Nigerian technical colleges is deemed essential. The use of technology involves both software and hardware application. Utilization of software applications like digital electronics workbench software (DEWBS) and others is crucial for enhancing students` learning outcomes in both theoretical and practical aspects [11].

Digital Electronic Workbench (DEWBS) is a circuit simulation software that was widely used for designing and testing electronic circuits without the need to physically build them. Its graphical interface allows users to create and simulate various types of analog and digital circuits. One of its main attractions is its ease of use, particularly for students and professionals looking to prototype designs [12]. Later versions of the software were branded under Multisim, which is part of the National Instruments product suite. Some key features of Electronic Workbench (and later, Multisim) include: Circuit Design and Simulation, Real-time Simulation, Support for Digital and Analog Circuits, Oscilloscopes, Multimeters, and Other Tools, Component Libraries [13]. Bear in mind that simulations conducted using DEWBS generate ideal outputs unaffected by factors like interference (referred to as noise in electronics) or disruptions commonly encountered in real-world electrical/electronic circuits. DEWBS enables the repetition of experiments without causing damage or wastage of components and circuits accessories. Not only does this approach save costs on purchasing electronics components and accessories but It also enables learners to perform experiments safely while maintaining their interest over time [14]. Interest refers to feeling of the sense organs or giving attention to some person, activity, situation or object [15]. Interest and motivation are closely connected because interest serves as a driving force or a factor that stimulates focused attention. It leads individuals to select specific objects or activities that are advantageous and enjoyable, ultimately resulting in satisfaction over time. Thus, encouragement, attention, and pleasure within an activity are interconnected with the factors that generate interest [16]. When the factors generating interest are lacking, it can diminish a person's level of interest.

Interest is a fixed inclination to concentrate on and remember certain activities [17]. When someone possesses interest in something, they exhibit a heightened sense of engagement by consistently paying attention and experiencing feelings of pleasure. The presence of pleasure leads to satisfaction. This inclination is evident when students consistently direct their attention toward a subject, enabling them to actively engage and learn. Interest is described as a motivating force that compels individuals to pursue activities of their choosing. When individuals perceive an activity as advantageous, it piques their interest, resulting in a sense of fulfilment [18]. However, if satisfaction decreases, interest also wanes. This illustrates that an individual's actions are influenced by their level of interest. Greater interest generates a stronger drive to undertake tasks, whereas diminished interest yields reduced motivation. Intense interest propels individuals to exert more effort in their pursuits. Similarly, in the context of learning, students who possess interest are motivated to enhance their learning outcomes. Interest is also linked to the inclination to engage with people, objects, activities, and experiences, all of which are stimulated by the activity itself, thereby influencing one's behavioural tendencies [19].

The rate of increase in unemployment in Nigeria, especially Bauchi State required educational institutions to employed students-centered instructional pedagogy in Teaching and learning for effective acquisition of practical skills in electronics devices and circuit [20]. Technical college graduates in Nigeria are anticipated to possess the necessary knowledge and skills for effective workplace performance [21]. This assertion includes Bauchi State. The curriculum mandates that the teaching and learning of trade courses, such as electronic devices and circuits in RTVE, should prioritize skill acquisition for students. This approach enables them to perform well in their practical examinations. In furtherance, students' performance in Electronics Device and Circuit is quite discouraging. This cannot be unconnected to the state of practical skill acquisition in the course of teaching and learning in the technical colleges. The above observation has been supported by other researchers like [1] who buttressed that inadequacy of facilities both qualitative and quantitative has put the learners and the teachers at a disadvantage.

Digital electronic workbench software has become widely accepted across much of the world, including in Nigerian tertiary institutions, but is still not well defined in Bauchi State technical colleges which may be because the Electronics Devices and Circuit teacher are not aware of it numerous advantages. Despite all the advantages of EWB software in enhancing students learning outcomes, it effects in improving Electronics Devices and Circuit students' performance at Bauchi State technical colleges is yet to be ascertain in the literature [16]. It is based on this background that The study investigates the digital electronics workbench software and

technical colleges students` learning interest in electronics devices and circuits in Bauchi State, building upon the context provided.

1.2 Purpose of the Study

The primary objective of this study is to assess the impact of digital electronics workbench software on the learning interest of technical college students in electronic devices and circuits in Bauchi State. Specifically, the study aims to:

1) Compare urban and rural Electronics Devices and Circuit student's interest toward digital electronics workbench software in technical colleges before the implementation.
2) Compare urban and rural Electronics Devices and Circuit student's interest toward digital electronics workbench software in technical colleges after the implementation.

1.3 Research Questions

This study aims to address the following research questions:

1) What is the difference between the urban and rural Electronics Devices and Circuit students' interest toward digital electronics workbench software in technical colleges before the implementation?
2) What is the difference between the urban and rural Electronics Devices and Circuit students' interest toward digital electronics workbench software in technical colleges after the implementation?

1.4 Research Hypotheses

In line with research questions, the following null hypotheses were postulated:

$H_{01:}$ There is no notable difference between urban and rural Electronics Devices and Circuit student's interest toward digital electronics workbench software in technical colleges before the implementation.

$H_{02:}$ There is no notable difference in the interest of urban and rural students studying electronics devices and circuits towards digital electronics workbench software in technical colleges after its implementation.

1.5 Significance of the Study

The study would be of immense importance to the following:

Students: The research will be applied in classrooms to help students excel in their studies, enhance their understanding of electronic circuits, and improve the practical use of electronics in the workplace, aligning with global standards.

Teachers: The study would also ease teaching, guide and facilitate the learning process.

Curriculum planners: Moreover, the study would also be important to curriculum planers by enabling them considering electronics workbench software in electronics devices and circuits when designing curriculum.

Government: This research will assist the government in evaluating the effectiveness of using electronics workbench software in teaching electronic devices and circuits. Successful outcomes from its use could guide the government's decision on whether to introduce and implement the software in technical colleges across Nigeria.

Future Researches: This research work would serve as a source of data for enhancing future related researches. It would also be useful for the researchers as a basis for further researches and also be used for reference purposes as well as in theory building and testing.

1.6 Scope of the Study

The study focused on the impact of digital electronics workbench software on the learning interest of technical college students in electronic devices and circuits in Bauchi State. The independent variable is the electronics workbench software, while the dependent variable is the students' learning interest in Electronics Devices and Circuits. The study's content was drawn from the National Board for Technical Education (NBTE) approved syllabus for Electronics Devices and Circuits for the National Technical Certificate two (NTC II) [2]. The content area covered in Electronics Devices and Circuits include the following sub-topics: Astable Multivibrator, Simple Transistor Amplifier and Power Supply. These contents served as basis for measuring academic performance in Electronics Devices and Circuit before (pre-test) and after (post-test) instruction in electronic workbench as the performance test.

2. Related Work

The study conducted by [22] examined the impact of a Computer Assisted Instructional (CAI) Package on senior secondary school students' achievement in Mathematics as part of post-COVID sustainable development in Nigeria. The primary objective was to assess the effects of the CAI package on students' Mathematics performance. The study was guided by two specific objectives, two research questions, and two null hypotheses. A quasi-experimental design was adopted, with the target population consisting of all senior secondary two students in public secondary schools in the Federal Capital Territory, Abuja. The findings showed that students taught Mathematics using the CAI package outperformed those taught using traditional methods. The study concluded by recommending that CAI should be used to enhance students' achievement in Mathematics, particularly in the post-COVID era, and advised against relying on conventional teaching methods.

[23] conducted a study on the effects of computer-mediated instruction (CMI) on the misconceptions and achievement of physics student-teachers in Federal Colleges of Education in the South-South Zone of Nigeria. For this research, three specific objectives were established, and for each objective, three corresponding research questions and three null hypotheses were formulated. An experimental design was employed, with a study population of 51 second-year physics combination student-teachers. The findings indicated that physics students possess several misconceptions regarding Mechanics and Properties of Matter II. Additionally, the results showed that CMI can enhance students' achievement in Mechanics and Properties of Matter II while also reducing their misconceptions. Based on these findings, it is recommended that physics lecturers effectively implement computer-mediated instruction to address students'

misconceptions and improve their academic performance in physics courses.

A study was conducted by [24] to explore the added value of integrating the Electronics Workbench (EWB) simulator into the teaching of electrical concepts to Moroccan high school students. The main objective of this research is to assess the impact of using the EWB simulator on students' learning in amplitude modulation and demodulation. Three specific objectives were established, along with three research questions and three null hypotheses. A mixed methods research design was employed, combining both qualitative and quantitative approaches. The study focused on a population of 50 Moroccan students in the second year of the scientific baccalaureate program in physical sciences at Abdellah Laroui High School in Fez. The findings revealed that students were highly motivated to use the simulator for learning electrical concepts, although it cannot replace hands-on laboratory experiments. Additionally, 72% of the interviewed students believed that the EWB simulator aids in understanding electrical concepts, while 98% considered it a complementary tool to actual experiments.

[25] conducted a study on the use of virtual laboratories, specifically the Electronic Workbench (EWB), as an alternative method for learning physics during the COVID-19 pandemic. The primary aim of the research was to examine the implementation of EWB-assisted virtual laboratories in physics experiments. The study included three specific objectives, three research questions, and two null hypotheses. A quasi-experimental design was utilized, focusing on a population of 820 Radio Television and Electronics Work students in the National Technical Certificate III (NTC III) program. The findings revealed a significant difference in the mean performance scores of students who were taught using multimedia instructional strategies compared to those taught with traditional lecture methods.

A study conducted by [26] focused on the design of work instruction (WI) for an electronic workbench-assisted electrical measuring device to enhance the internship experience of students in the Basic Electronics II course. The primary objective was to assess the impact of this design on improving students' internship skills in the course. The research was structured around three objectives, three research questions, and three null hypotheses. A quasi-experimental research design was utilized, and the study took place in Indonesia. The study's population consisted of all physics students from the Faculty of Teacher Training and Education at the University of Muhammadiyah Mataram. The findings indicated a significant positive effect of the WI electronic workbench-assisted electrical measuring device design on enhancing the internship experience for students in the Basic Electronics II course.

A study was conducted by [27] to examine the effect of computer-assisted instruction (CAI) on the academic performance of technical college students in Electrical Installation and Maintenance Work in Enugu State. The research aimed to investigate how CAI influences students' academic outcomes in this field. Three specific objectives were established, along with three corresponding research questions and three null hypotheses. A quasi-experimental design was used, featuring non-equivalent control and experimental groups. The study population consisted of 400 NTC II students (347 males and 53 females) from twenty-one technical colleges in Enugu State. The findings indicated that CAI had a significant positive impact on students' academic performance. The study recommended that CAI be officially implemented in technical colleges, secondary schools, and vocational institutions for teaching Electrical Installation and Maintenance Work to enhance students' academic performance.

A study was conducted by [28] on the effect of computer-aided instruction on students' interest in selected topics within the electronic libraries course at federal tertiary institutions in Anambra State, Nigeria. The research was guided by two specific objectives, two research questions, and three null hypotheses. A quasi-experimental design was used, featuring a pre-test post-test control group with intact, non-equivalent groups, consisting of 30 students in the experimental group and 30 in the control group. The study population included all third-year Library and Information Science students in the federal tertiary institutions in Anambra State enrolled in the electronic libraries course. The findings showed that the computer-aided instruction method significantly increased students' interest in electronic libraries compared to the modified lecture method. It was recommended that lecturers adopt computer-aided instruction for teaching electronic libraries in tertiary institutions to boost students' interest in the subject.

A study was conducted [29] on the impact of AutoCAD Application Instruction (AAI) on students' academic performance and motivation in Building/Engineering Drawing in technical colleges in Adamawa State, Nigeria. The objective was to assess how the use of AAI influences both academic outcomes and students' motivation in the subject. The study was guided by two specific objectives, two research questions, and two null hypotheses, using a quasi-experimental design. The population included 96 National Technical Certificate (NTC) 2 students. The findings revealed that teaching and learning Building/Engineering Drawing with AAI significantly increased students' motivation and academic performance. It was recommended that technical colleges incorporate AutoCAD Application Instruction into the teaching of Building/Engineering Drawing.

A study was conducted by [30] on the effect of multimedia instructional strategy on the academic performance of students in Radio and Television Electronic Work in technical colleges in Kano State. The research was guided by four specific objectives, four research questions, and one null hypothesis. A quasi-experimental design was employed, and the study took place in Kano State, Nigeria. The population consisted of all NTC III students (both male and female) enrolled in the Radio and Television Electronic Work Trade in two technical colleges in the state, with a total of 40 students included in the study. The entire population was

purposely used as the sample. The findings revealed that multimedia instruction was more effective than conventional teaching methods. Based on these results, the researcher recommended that educational stakeholders provide multimedia instructional tools and promote their use in technical colleges in Kano State.

A study was also conducted by [31] on the effects of computer-assisted instruction (CAI) on students' academic achievement in physics at the secondary school level. The primary aim was to assess the impact of CAI on the academic performance of secondary school students in physics. The study was guided by three specific objectives, along with three corresponding research questions and three null hypotheses. An experimental research design was adopted, with the population consisting of all secondary school students in public schools in Karak District. A sample of 46 Grade 9 students was randomly selected from Government Boys High School Khurram Karak. The findings indicated that CAI had a significant positive effect on students' academic achievement and retention in physics. Based on these results, it was recommended that science teachers use CAI to enhance and improve students' academic performance in physics at the secondary level.

3. Experimental Method/Procedure/ Design

Research Design

This study employed a quantitative methodology with a pre-survey and post-survey design for the experimental group, without the inclusion of a control group. This design was chosen because randomly sampling subjects and assigning them to groups would have disrupted the academic schedule and timetable of the technical colleges involved in the research [32].

Population of the Study

[33] defines population as the totality or set of all elements, objects, events or members that are of interest for a particular study that pass a specified set of one or more common characteristics or objects or events that are of interest for a particular study. Population also is a group of individual who are of the same characteristics [32]. A target population (or the sampling frame) in the other hand is a group of individuals (or a group of organizations) with some common defining characteristic that the researcher can identify and study. The population for this study comprised all NTC II students of Electronic Devices and Circuit in the two technical colleges in Bauchi State and the Electronic Devices and Circuit have been accredited by NBTE. The totals of 92 students were used for the study. NTC II students were choosing because significant portion of the Electronic Devices and Circuit curriculum were taught to the students.

Table 1: Population of the Study

S/N	Name of Schools	No. of Students
1	Government Technical College, Gumau	43
2	Government Day Technical College, Bauchi	49
	TOTAL	**92**

Source: Field Survey (2024)

Instrument for Data Collection

The instrument used for collection of data in this study was Electronics Devices and Circuits Interest Inventory (EDCII) that was adapted from [18].

The Electronics Devices and Circuits Interest Inventory (EDCII) was a thirty (30) items interest measure designed to elicit students' likes and dislikes that could arouse their curiosity and desire to learn as the teacher teaches. Yahya et al., (2023), interest and enthusiasm to learn often correlate positively with performance. Interest to learn enhances other cognitive processes, such as attention which also leads to students' performance; and students' high scores. In all these were evidence of teaches' effectiveness and superiority.

Basically, the EDCII was students' self-report inventory or questionnaire. The items were worded in accordance with [18], (a) "in such a way that students cannot easily guess the purposes of the questions", (b) "To determine if the students were answering the questions or merely checking responses at random, the same question was asked in two different ways". The EII was made up of 30 items using a summated five-point Likert scale as follows:

Strongly Disagree (SD)	-	1
Disagree (D)	-	2
Undecided (U)	-	3
Agree (A)	-	4
Strongly Agree (SA)	-	5

A. Method of Data Analysis

The research questions for the study were analyzed using Mean and Standard Deviation. This was because Mean and Standard Deviation has more reliability than other measures of central tendency [35]. Moreover, the Null hypotheses H_{01}-H_{02} formulated for the study were tested at 0.05 level of significant using independent sample t-test. The data collected was analyzed using Statistical Package for Social Science (SPSS) computer analysis software package.

4. Results and Discussion

The result and discussion of findings were presented below:

Results

The results were presented below:

II. RESEARCH QUESTION ONE

What is the difference between the urban and rural Electronics Devices and Circuit students' interest toward digital electronics workbench software in technical colleges before the implementation?

The result presented in the Table 2 shows the pre-survey mean interest score of urban and rural technical colleges, that is the urban technical college had a pre-survey mean interest score of 62.57, standard deviation of 17.97 and the standard error of 2.56. The rural technical college with the pre-survey mean interest score of 60.09, Standard deviation of 18.14 and Standard error of 2.76 with mean difference of 2.48. This shows that student's interest toward digital electronic workbench software in electronics devices and circuits in both technical colleges is almost the same before the implementation. Therefore, insignificant differences exist between the technical colleges before the implementation.

Table 2: Summary of students' mean interest scores of pre-survey of urban and rural technical colleges

School Name	N	Mean (X)	Std. Dev.	Mean Difference
GDTCB (Urban)	49	62.57	17.97	14.56
GTCG (Rural)	43	60.09	18.14	

Source: Field work, 2024

Research questions two

What is the difference between the urban and rural Electronics Devices and Circuit students' interest toward digital electronics workbench software in technical colleges after the implementation?

The data collected in respect of this research question and the summary is presented in the table 3. The result presented in table 3 indicated the mean learning interest of 83.28, standard deviation of 32.87 and the standard error of 5.20 for the urban technical college while, rural technical college with 72.90 mean learning interest, 36.40 standard deviation, standard error of 5.01 and mean difference of 10.38. This shows the mean interest of students in electronics devices and circuits in urban technical college are higher than that of the rural technical colleges after the implementation. That is to say the difference is significant.

Table 3: Summary of students' mean interest scores of post-survey of Urban and Rural technical colleges

School Name	N	Mean (X)	Std. Dev.	Mean Difference
GDTCB (Urban)	49	83.28	32.87	10.38
GTCG (Rural)	43	72.90	36.40	

Testing Null Hypotheses

Two null hypotheses were tested to meet the study's objectives. The pre-survey and post-survey scores from the Electronics Devices and Circuit Interest Inventory (EDCII) were statistically analyzed at a 0.05 significance level, and the results were interpreted. A paired sample t-test was used to analyze the research data for both null hypotheses. If the p-value exceeded the 0.05 significance level, the null hypotheses were accepted, indicating no significant difference between the variables. Conversely, if the p-value was less than 0.05, the null hypothesis was rejected, signifying significant differences between the variables.

Null Hypothesis One

$H_{01:}$ There is no notablet difference between the urban and rural Electronics Devices and Circuit student's interest toward digital electronics workbench software in technical colleges before the implementation.

Table 4: The data shows the results of a paired samples t-test comparing pre-survey scores for the outcome variable. The urban school's mean pre-survey score was 62.57 with a standard deviation of 17.97, while the rural school's mean score was 60.09 with a standard deviation of 18.14. The t-value at the 0.05 significance level was 0.677, and the p-value was 0.062. Since the p-value of 0.062 is higher than the 0.05 significance level, the null hypothesis is accepted.

The independent sample t-test results show an insignificant difference between the pre-survey scores for the outcome variable. The effect size was minimal, suggesting the difference between the means was of little significance.

Table 4: Test of differences between Urban and Rural Students pre-survey means scores.

Name of Sch.	N	X	SD	DF	t-cal	P-val	Remark
GDTCB (Urban)	49	62.57	17.97	90	0.677	0.062	Accepted
GTCG (Rural)l	43	60.09	18.14				

Source: Field work, 2024

A. Null Hypothesis Two

$H_{02:}$ There is no notable difference in the interest of urban and rural students studying electronics devices and circuits towards digital electronics workbench software in technical colleges after its implementation.

Table 5: The results of the paired t-test compared the post-survey mean scores between urban and rural schools. The urban school had a mean score of 83.28 with a standard deviation of 32.87, while the rural school's mean score was 72.90 with a standard deviation of 36.40. The t-value at a 0.05 significance level was -2.777, with a p-value of 0.007. Since the p-value of 0.007 is less than the 0.05 significance level, the null hypothesis is rejected, indicating that the mean difference is significant.

The independent sample t-test results showed a significant difference in learning interest between urban and rural schools. The effect size was large, suggesting the difference between the means was practically significant. The findings demonstrate that urban school students have a higher interest in using digital electronics workbench software compared to their rural counterparts in the learning process.

Table 5: Test of difference between Urban and Rural Students Post-Survey means scores.

Name of Sch.	N	X	SD	DF	t- cal	p-val	Remark
GDTCB (Urban)	49	83.28	32.87	90	-2.777	0.007	Rejected
GTCG (Rural)	43	72.90	36.40				

Source: Field work, 2024

Discussion of Findings

The research findings were discussed by analyzing the results of the research questions, tested hypotheses, and null hypotheses, all of which were tested at the 0.05 significance level. Each was explained in turn.

For the first research question, the pre-survey mean scores of the urban technical college were 62.57, slightly higher than the rural technical college's score of 60.09. However, the difference was insignificant, suggesting that both colleges had almost the same level of interest in digital electronics workbench software before the intervention. Additionally, the null hypothesis, which stated "there is no significant difference between urban and rural Electronics Devices and Circuit students' interest in digital electronics workbench software in technical colleges before implementation," was

supported by a t-value of 0.677 and a p-value of 0.062, which is greater than 0.05. This confirmed the lack of significant difference between the two colleges, leading to the acceptance of the null hypothesis. The findings align with [33], who noted that the pre-existing knowledge of experimental and control groups should be similar in experimental research.

Furthermore, a study by [36] on the design of work instruction (WI) electronic workbench-assisted electrical measuring devices for improving students' internship concepts in the Basic Electronics II course found that while electronics workbench software slightly enhanced students' critical thinking and understanding of the internship concept, the impact was not significant. The authors concluded that more precise tools are needed to assess students' understanding of the psychomotor aspects of electrical concepts.

In the second research question, the post-survey learning interest scores of urban and rural technical colleges were found to be 83.28 and 72.90, with standard deviations of 32.87 and 36.40, respectively. This indicates a clear difference in learning interest between the two groups. Additionally, the second null hypothesis was tested using a paired sample t-test, which revealed a t-value of -2.777 and a p-value of 0.007, which is less than 0.05. This result indicates a significant difference in the learning interest of students from urban and rural technical colleges, confirming that their learning interest was distinct from one another after the intervention.

5. Conclusion and Future Scope

The study titled "Digital Electronics Workbench Software and Technical College Students' Learning Interest in Electronics Devices and Circuits in Bauchi State, Nigeria" aimed to examine how digital electronics workbench software affects the interest of technical college students in electronics devices and circuits in Bauchi State technical colleges. The study had two specific objectives, from which two research questions and two null hypotheses were derived and tested using a t-test at a 0.05 significance level. The research employed a quantitative methodology with a pre-survey and post-survey design for an experimental group without a control group. The study's population consisted of 92 NTC II students from two technical colleges in Bauchi State that offer Electronics Devices and Circuits courses. Intact classes from both colleges were used, with a total of 92 students serving as the sample. The experiment took place during the second term of the 2023/2024 academic session.

The data collection instrument used was the Electronics Devices and Circuits Interest Inventory (EDCII), adapted from a previous study [22] and validated by three experts—two from the Department of Vocational and Technology Education and one from the Department of Educational Foundations in the field of measurement and evaluation. The test items were administered before and after the treatment over a four-week data collection period. Both pre-survey and post-survey data were recorded and statistically analyzed. The first null hypothesis was accepted, while the second was rejected, as determined by an independent sample t-test.

The reliability coefficient of the test instrument was found to be 0.81, which is high and positive, using the split-half technique. As recommended by "Ref. [42]", any value between 0.5 and 0.9 is acceptable. The researchers and trained research assistants conducted the data collection, and the results were analyzed using mean and standard deviation to answer the research questions, with the t-test used to test the null hypotheses. The general findings indicated that the pre-survey results of the two groups suggested equivalent initial interest levels before the intervention. The findings also revealed that students taught Electronics Devices and Circuits using the electronic workbench software in urban areas demonstrated greater interest compared to those in rural areas.

Based on the research findings, the following recommendations were made:
i) Teachers should ensure that students with lower performance in electronics devices and circuits are given opportunities to use electronics workbench software to enhance their learning skills.
ii) Technical college authorities should encourage teachers of electronics devices and circuits to incorporate electronics workbench software in their practical lessons.
iii) The traditional demonstration method for teaching electronics devices and circuits practical should be avoided, as it has not effectively prepared technical college students to succeed in external exams in Bauchi State.

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