Effects of Scaffolding and Collaborative Instructional Methods on Science Technical College Students' Performance in Basic Electronic in Gombe State Nigeria

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Abstract
The study was guided by three objectives, three research questions and three null hypotheses. Plackett - Burman factorial design a sub design was used Quasi - experimental pretest, posttest design was adopted in the study. The population of the study consists of 80 students of National Technical Certificate (NTC) II of the only three Government Science Technical Colleges that have Electronic trade department in Gombe State that offered Basic Electronic. The instruments that was used for data collection was Basic Electronic performance test (BEPT) and Basic Electronic Rating Scale (BERS). The instrument was validated by experts and pilot tested, and the result of the pilot study was analyze using spearman's 'rho' correlation coefficient. Before the treatment students was subjected to pretest and after two weeks, they were subjected to treatment. The marks obtained was analyzed using statistical package of social science (SPSS) version 23 to compute mean, standard deviation, mean difference and mean range to answer the research question. In the test of the null hypotheses, analysis of variance (ANOVA) was employed to test null hypotheses, all the hypotheses were tested at 0.05 level of significance.

Keywords: Scaffolding, Collaborative instructional methods, *Students*' performance, Basic electronic

1. Introduction

Nigeria as a nation has seen the increasing importance of global technology developments. In recent times most of the policies are tilted towards technology as the main driver of economics development (Okonji, 2019) [28]. In recognition of technology as the touch stone of development, Nigeria in its National School Curriculum included the teaching of technology as a field of specialization at secondary education level. Subjects under this field includes: Basic Electronics Technical Drawing, Building Construction, Woodwork, Home Management, Food and Nutrition, and Clothing and Textile West African Examination Council (WAEC, 2022) [30].

The objective of studying electronics in secondary schools in Nigeria as contained in WAEC Syllabus include among others; to equip candidates with broad understanding of the technology of manufacturing, maintenance and repairing of domestic and industrial equipment. It is also intended to offer learners sufficient knowledge and skills to form valuable foundation for electronics - related vocation or pursue further educational qualifications (WAEC, 2022) [30]. Technology is achieved through a combination of knowledge, method, tools and skills. Thus, electronics as a technology subject is activity or practical - oriented and the appropriate method of teaching it resources base. This suggests that the mastery of electronics skills cannot be fully achieved without the effective use of constructivist - based instructional approaches.

Basic Electronic is one of the vocational courses offered at the upper level of Nigerian Secondary School System. It is a branch of science and technology which deals with the study of the flow and control of electrons in electrical circuit and their behavior and effects in vacuums, gases and semi - conductors. The curriculum has Four (4) objectives for its products National Education and Research Development Council (NERDC, 2021) [25]. For this objective to be realized, teachers who are the implementers of this curriculum, apart from being versed in the subject matter, the selection of an appropriate Instructional Methodology and its effective use greatly determine their level of success which itself is measured by their students' achievement (Ofojebe, 2020) [27].

Conventional method has been identified as tools that facilitate covering a large content area at a time and very suitable for large class but the method was criticize for being teacher-centred, failure to recognize the uniqueness of the learners and does not facilitate the development of reasoning skills and processes in the students, Hussaini, Ina mullah and Naseerud Din (2018) [8]. Criticized the conventional method which is predominantly used in colleges for not yielding desired learning objectives, and Sultana and Zaki reported that conventional metod used in colleges have failed to ensure the quality instructions learners need. The need to improve the general academic performance of students prompted scholars to investigate the instructional methods that would be more effective. There are number of literature that shows effectiveness of scaffolding and collaborative instructional methods such as (Lai - Chong & Ka - Ming) (Seize), (Mark & Dabbagh), (Jackson) and (Cholevinski).

In recent time, there have been reports that the academic achievement of students has been below expectation. According to Ogundola, Aboidum & Jonathan (2020) [19], this failure to meet expected standard is attributable to the continuous use of unsuitable instructional methodologies (mostly traditional instructional approach) by teachers in teaching their students. Worry on the skills level of both male and female graduates of Science Technical College students for self-sufficiency and national progress has been revealed in the literature. For instance, Amoer (2016) [4] stated that the low value of technical college alumnae has been a main concern by most employers of labour in Nigeria. This may not be unrelated to the use of conventional instructional methods by most of the teachers. Tumba and Chinda observed that Electronic students of Science Technical Colleges find it hard to understand the principles and practices of Electronic which leads to poor performance of the students in their practical examinations. Their findings revealed that the use of conventional method of teaching was among the main factors affecting the performance of students.

Consequent upon teachers of courses like Basic Electronic are therefore faced with the challenges of presenting relevant classroom activities that can facilitate conceptual change, allows understanding and recognize individual differences amongst students. The instructional technique having these qualities is constructivist based instructional approach.

According to Reise (2014) [21] Scaffolding is the process by which a teacher, an instructor or a more knowledgeable peer assists a learner, altering the learning task so that the learner can solve problems or accomplish tasks that would ordinarily be impossible for him and to learn from the experience. While McNamora and Brown, defined Collaborative learning as a successful teaching strategy in which small team, each with students of different levels of ability use a variety of learning activities to improve their understanding of a subject. If the potentials of Scaffolding and collaborative learning are fully utilized, the academic achievement of student of a subject like Basic Electronic could improve significantly.

Gender refers to state of being male or female. For a long time, gender was listed by researchers as one of the factors that influenced the academic achievement of the child (Abubakar & Oguegou) and Gupta *et al*. (2022) [7] there has been a lot of debate on whether gender really affects academics' achievement, some researchers believed that males often outperform their females' counterparts in most subject's areas. While some conclude the other way round Malik *et al*. (2019) [14] and Jabor *et al*. (2021) [9] the aim of using Scaffolding and Collaborative Instructional Methods in teaching Basic Electronic is to encourage both male and female students due to the failure in National Business and Technical examination Board (NABTEB). NABTEB Chief Examiners' report (2019-2022) indicated that, performance of male and female students in practical courses of Electronic trade seemed to be low. In 2019, out of the 23% of the female that sat for the practical, only 5% passed and out of the 77% of the male that sat for the practical, only 28% passed; In 2020, out of the 16% of the female that sat for the practical, only 2% passed and out of the 84% of the male that sat for the practical, only 31% passed; In 2021, out of the 15% of the female that sat for the practical, only 4% passed and out of the 85% of the male that sat for the practical, only 35% passed; In 2022, out of the 18% of the female that sat for the practical, only 7% passed and out of the 82% of the male that sat for the practical, only 25% passed; This showed that there is a need to investigate empirically whether Scaffolding and Collaborative Instructional Methods will help in balancing the gender differences in performance in Basic Electronic Trade.

Statement of the Problem

Concern on the skills level of both male and female graduates of Science and Technical College students for self-reliance and national development has been lamented (NECO 2022). Amoer (2016) [4] stated that the low quality of technical college graduates has been a major concern by most employers of labour in Nigeria. This may not be unconnected to the use of conventional instructional methods by most of the teachers. Tumba and Chinda (2021) [24] observed that Electronic students of Science and technical colleges find it difficult to understand the principles and practices of Electronic which leads to poor performance of the students in their practical examinations. Their findings revealed that the use of conventional method of teaching was among the major factors affecting the performance of students.

Over the years, researches reveal that the use of student-centered approach such as Scaffolding and Collaborative Instructional Methods have been found to be effective in fields related to electrical engineering. Among the recent ones include Poorahmadi (2019) [20] and Safadi and Rababah (2022) [22], their studies revealed that Scaffolding Instructional Method improved students' performance in learning Basic Electronic courses similarly, Law (2020) [13] and Jalilifar (2020) [10] revealed that Collaborative Instructional Method also improved performance of students in Basic Electronic.

Despite all these advantages of Scaffolding and Collaborative Instructional Methods, the researcher observed that there is a limited literature on the application of the two methods in Nigerian context, particularly on students' performance and gender in Science and Technical Colleges. In view of the above, the researcher proposes to fill in the existing gap to determine the Effects of Scaffolding and Collaborative Instructional Methods in Government Science Technical College Students' Performance in Basic Electronic in Gombe State.

Purpose of the Study

The main purpose of this study is to determine the Effects of Scaffolding and Collaborative Instructional methods on Government Science Technical College Students'

Performance in Basic Electronic in Gombe State. Specifically, the study intends to:

1. Determine the difference among the pretest mean performance of Basic Electronic students in experimental and control groups in Government Science Technical Colleges in Gombe State.
2. Determine the difference among post-test mean performance of students taught Basic Electronic using conventional, scaffolding and collaborative instructional methods in Government Science Technical Colleges in Gombe State.
3. Determine the difference among post-test mean performance of female students taught Basic Electronic using conventional, scaffolding and collaborative instructional methods in Government Science Technical Colleges in Gombe State.

Research Questions

The study will be guided by the following Research Questions -

1. What is the difference among the pretest mean performance of Basic Electronic students in experimental and control groups in Government Science Technical Colleges in Gombe State?
2. What is the difference among post-test mean performance of students taught Basic Electronic using conventional, scaffolding and collaborative instructional methods in Government Science Technical Colleges in Gombe State?
3. What is the difference among post-test mean performance of female students taught Basic Electronic using conventional, scaffolding and collaborative instructional methods in Government Science Technical Colleges in Gombe State?

Hypotheses

The researcher tested the null hypotheses stated below at the level of significance 0.05:

$H0_1$: There is no significant difference among the pretest mean performance of Basic Electronic students in experimental and control groups in Government Science Technical Colleges in Gombe State.

$H0_2$: There is no significant difference among posttest mean performance of students taught Basic Electronic using conventional, scaffolding and collaborative instructional methods in Government Science Technical Colleges in Gombe State.

$H0_3$: There is no significant difference among post-test mean performance of female students taught Basic Electronic using conventional, scaffolding and collaborative instructional methods in Government Science Technical Colleges in Gombe State.

1.7. Scope of the Study

This study will be delimited to National Technical Certificate (NTC) II Electronic students of Government Science Technical Colleges (GSTCs) in Gombe State. These include; GSTC Gombe, GSTC Kumo and GCTC Barunde because they are the only three Technical Colleges that offer Electronics Works.

The study will cover the basic areas of Basic Electronic Devices which is coded CRT 12 (NBTE, 2016; UNESCO, 2021). With regard to this study, four topics will be selected. The choice of the topics was based on James (2019) who outlined some difficult and significant key topics in Basic Electronics at technical level. The topics are; application of the principles and features of common Electronic Devices, construction of power supply and its experiment on circuit rectification, connection of transistors and integrated circuits (I.Cs) on Vero-board and connection of Light Depending Resistor (LDR) for automatic control of circuit, construction of digital logic circuit such as AND, OR, NOT, NAND, NOR, XOR gates with their truth tables (NBTE, 2016 & UNESCO, 2021). Fortunately, all NABTEB practical examinations for electronic were mostly extracted within the above topics.

Methodology

The design of the study was factorial design which was developed by Plackett and Burman in 1946 while working in British Ministry of supply. Sambo (2008) stated that, for the experimental procedure of the factorial design, a researcher has the option to choose the type of arrangement of the test groups. That is why the researcher chose quasi-experimental research (pretest and posttest design) as a sub-design for the test procedures since the researcher will use the intact class Without randomization of the participants. This research design refers to studies in which experimental techniques are applied without random allocation of students into groups ((Nworgu, 2016). This is because the researcher will avoid disruption of the normal class set up organized by school authorities.

Table 1: Plackett-Burman Factorial Design for 12 Interactions with Two-level factor

Factors	G_1	G_2	G_3
General Performance	Y_{11}	Y_{12}	Y_{13}
	Y_{21}	Y_{22}	Y_{23}
Gender Performance	Y_{31}	Y_{32}	Y_{33}

***Source*:** Sambo (2008)

Table 2: The design is symbolically represented as follows

Experimental Group	Pre-test	Treatment	Post-test
G_1	Y_{11}	X_1	Y_{12}
G_2	Y_{21}	X_2	Y_{22}
G_3	Y_{31}		Y_{32}

***Source*:** Sambo (2008)

Where

G_1 stands for experimental group 1
G_2 stands for experimental group 2
G_3 stands for control group
Y_{11} stands for pre-test observation group 1
Y_{12} stands for post-test observation group 1
Y_{21} stands for pre-test observation group 2
Y_{22} stands for post-test observation group 2
Y_{31} stands for pre-test control group
Y_{32} stands for post-test control group
X_1 stands for treatment using scaffolding
X_2 stands for treatment using collaborative (Sambo 2008)

The study was carried out in Gombe State in the North Eastern Nigeria located at longitude $8^0.5^{-0}$ and $11^0.45$ E and latitude $9^0.30^0$ and $12^0.30^0$ N and share a boundaries with Yobe, Borno, Adamawa, Taraba and Bauchi State. Gombe State Ministry of Education Survey (GSMES, 2023). There are eight Science Technical Colleges in Gombe state namely; Government Science Technical College (GSTC) Gombe,

Government Science Technical College Barunde, Government Science Technical College Kumo, Government Science Technical College Amada, Government Science Technical College Deba, Government Science Technical College Kwami, Government Science Technical College Tula, Government Science Technical College Nyuwar (Balanga). The aforementioned Technical Colleges access students for enrollment from pre-vocational schools called Government Vocational Training Centers.

The population of the study consisted of 80 National Technical Certificate (NTC) II students of Basic Electronics in the only three Government Science Technical colleges in Gombe State that have Electronic Trade Department as shown on **Table 3.**

Table 3: Technical Certificate (NTC) II students of Basic Electronics

S/N	School	Male	Female	Total
1.	GSTC Gombe	16	6	22
2.	GSTC Kumo	23	7	30
3.	GSTC Barunde	20	8	28
Total		59	21	80

***Source*:** Ministry of Education (2023)

The sample is made up of (Male and Female) NTC II Basic Electronic students, the target population. This is because the numbers of schools that have electronic Trade department are only three and the number of students is few. Therefore, there was no sampling, the study was used all the students in an intact class for experimental group 1, 2 respectively and control group.

The instrument was used in collecting data for this study is Basics Electronic Performance Test (BEPT) which was constructed by the researcher. It will contained one performance test question titled: The Basic Electronic Rating Scale (BERS) with 25 - items instrument for assessing how students was conducted the practical (see APPENDIX C; for detail). Graphical rating - scale was used and tabular scale for evaluating formative and summative performance/practical test, it has series of cells for a rater or examiner to tick the appropriate quality or performance of practical work of a person to be rated (Enemali, 2020). It was used for the assessment of each step of a particular task, using: "Highly Skilled" (HS) which carries 4 marks, "Skilled"(s) which carries 3 marks, "Moderately Skilled" (MS) which carries 2 marks, "Limitedly Skilled" (LS) which carries 1mark and "Not Skilled" (NS) carries 0 mark. This gives a total of 100 marks for a student that scored 4 marks in all the 25 items in the Basic Electronic Rating Scale. The aforementioned rating scale was obtained from Basic Electronic Performance Test (BEPT) and Job-Specification table. Basic Electronic Performance Test (BEPT) contains 9 Essay practical questions on how students perform certain work practically in a sequential order; it has been adapted from NABTEB 2022 practical past question paper of Electronic-Trade Examination. While the Job-Specification table (JST) was an extension of BEPT which carries the steps of task being assessed. The instrument was also subjected to validity test by three experts in the subject area

The researcher was basically conducted a pilot study at Government Science Technical College Bauchi in Bauchi State in order to establish reliability of the instruments. The researcher was conducted two experiments at the above schools in order to obtain data for the pilot study. The pilot study was used to ascertain the internal consistency of BEPT. The internal consistency deals with the degree to which the items inside the instrument were constructed based on the research variables. The measurement of internal consistency was assessed by using Spearman's' Correlation Coefficient (rho).

The data was collected by the researcher with the help of research assistants who are the teachers of Electronic Trade from the three Government Science Technical Colleges. Data collected was used for analysis using Statistical Packages for Social Sciences (SPSS) version 23.0. The package was used to compute descriptive statistic including mean, standard deviation, mean difference and mean range to answer the research questions.

The Analysis of variance (ANOVA) was employed to test null hypotheses. The decision was in line with Adamu and Musa (2022) [2] who maintained that the use of ANOVA allows researcher to test whether a sample mean of a normal distributed interval variable is significantly differs from a hypothesized value. The researcher was also calculate the t-cal and compared with the t-crit at 0.05 levels of significance. The null hypothesis was accepted whenever the calculated t-value or p-value is greater than t critical or p critical. While null hypothesis was rejected whenever the calculated t-value or p-value is less than the t-critical or p-critical and therefore alternative hypothesis was accepted.

Results

Research Question One

What is the difference among pretest mean performance of Basic Electronic Students in experimental and control groups in Government Science Technical Colleges in Gombe State?

The pretest mean performance of the three groups of students used in the research work revealed the mean difference of less than one with mean range of 0.63. The result on Table 4 therefore shows that there was no much difference within the pretest mean performance of Basic Electronic Students in Government Science Technical Colleges in Gombe State.

Table 4: Difference among the pretest mean performance scores of Basic Electronic Students

(U) Methodology	Mean	(V) Methodology	Mean Diff.	Std Error	Remark	Range
Scaffolding	37.27	Collaborative	0.570	1.2391	TD	
		Conventional	0.630	1.3289	TD	
Collaborative	36.70	Scaffolding	−0.570	1.6780	TD	
		Conventional	0.060	1.3289	TD	
						0.63
Conventional	36.64	Scaffolding	−0.630	1.6780	TD	
		Collaborative	−0.060	1.2391	TD	

***Source*:** Field work (2024), **Key:-** (Mean Diff = U-V), Range = Highest Mean Diff.

Research Question Two

What is the difference among post-test mean performance of students taught basic Electronic using Scaffolding, Collaborative and conventional instructional methods in Government Science Technical Colleges in Gombe State?

The difference among the mean performance of students taught basic electronic using scaffolding, collaborative and conventional instructional methods is presented in Table 5. From the table 5, the mean scores of 51.14 (EG1), 58.80 (EG2) and 41.88 for the control group were obtained the result shows that there was difference among the post- test mean performance of the students in EG1, EG2 and the control group with the overall mean range of 16.92.

Table 5: Difference among the post- test mean performance scores of students in EG1, EG2 and those in control Group

(U) Methodology	Mean	(V) Methodology	Mean Diff.	Std. Error	Remark	Range
Scaffolding	51.14	Collaborative	− 7.66	2.0036	LD	
		Conventional	9.26	1.4366	LD	
Collaborative	58.80	Scaffolding	7.66	2.3454	LD	16.92
		Conventional	16.92	1.4366	VLD	
Conventional	41.88	Scaffolding	– 9.26	2.3454	LD	
		Collaborative	− 16.92	2.0036	VLD	

***Source*:** Field work (2024), **Key:-** (Mean Diff = U-V), Range = Highest Mean Diff.

Research Question three

What is the difference among posttest mean performance of female students taught Basic Electronic using Scaffolding, Collaborative and Conventional Instructional Methods in Government Science Technical Colleges in Gombe State?

Research Question Three

What is the difference among post-test mean performance of female students taught Basic Electronic using conventional, scaffolding and collaborative instructional methods in Government Science Technical Colleges in Gombe State?

The result of question three presented in Table 6; revealed the posttest mean performance of female students taught basic electronic using scaffolding, collaborative and conventional instructional methods of 48.83 (EG1), 63.29 (EG2) and 40.38 (C) respectively. The result shows that there was difference among the posttest mean performance of female students, this can be seen in the observed mean range of 22.91 (VLD).

Table 6: Difference among the posttest mean performance scores of female students EG1, EG2 and Control Group

Gender	(U) Methodology	Mean	(V) Methodology	Mean Diff.	Std. Error	Remark	Range
	Scaffolding	48.83	Collaborative	−14.48	8.2017	VLD	
			Conventional	8.45	5.1201	LD	
Female	Collaborative	63.29	Scaffolding	14.48	9.1961	VLD	22.91
			Conventional	22.91	5.1201	VLD	
	Conventional	40.38	Scaffolding	−8.45	8.2017	LD	
			Collaborative	−22.91	9.1961	VLD	

***Source*:** Field work (2024), **Key:-** (Mean Diff = U-V), Range = Highest Mean Diff.

Test of Hypothesis One

There is no significant difference among the pre- test mean performance of basic electronic students in experimental and control groups in Government Science Technical Colleges in Gombe State.

The analysis of variance used to test hypothesis one presented on Table 7 revealed the value of 5.80 and 1748.09 for squares of between groups and within groups with mean square of 2.90 and 22.70 respectively. The ratio of variance between group and within group was 0.1278 and the p-value obtained stood at 3.15. The result shows that no significant difference exist among the pre- test mean performance of the three groups of basic electronic students in Government Science Technical Colleges in Gombe State. The hypothesis was therefore accepted.

Table 7: Analysis of variance among the mean pre- test performance of basic electronic students of experimental and control groups

Source of Variance	SS	df	MS	F	P	Remark
Between Group	5.80	2	2.90			
Within Group	1748.09	77	22.70	0.1278	3.15	Accepted
Total	1753.89	79	22.13			

***Source*:** Field work (2024)

Test of Hypothesis Two

There is no significant among post- test mean performance of students taught basic electronic using scaffolding, collaborative and conventional instructional methods in Government Science Technical Colleges in Gombe State.

Analysis of variance used to determine hypothesis four in Table 8 revealed the squares value of 4161.67 and 2272.82 for between groups and within groups respectively, and sum of squares of 6434.49. The result shows mean square values of 2080.84 and 29.52 respectively for between groups and within groups. The f-value obtained was 70.49 and the p-value at confidence level of 0.05 was 3.15. The result shows that there is significant difference among the post-test mean performance of the three groups of students taught basic electronic. It can be seen that f-value is greater than p-value (70.49 > 3.15). Therefore the hypothesis is rejected. Details of the results are presented in Table 8.

Table 8: Analysis of variance among the mean performance of the three groups of students of Basic Electronic used for the study

Source of Variance	SS	df	MS	F	P	Remark
Between group	4161.67	2	2080.84			
Within group	2272.82	77	29.52	70.49	3.15	Rejected
Total	6434.49	79	81.45			

***Source*:** Field work (2024)

Test of Hypothesis three

There is no significant difference among mean performance of female students taught basic electronic using conventional, scaffolding and collaborative instructional methods in Government Science Technical Colleges in Gombe State.

Analysis of variance used to determine hypothesis nine in Table 9. Revealed the sum square value of 3273.14 the square value of 2059.01 and 1214.14 for between groups and within groups respectively. The result shows a mean square value of 163.66 for the sum square while 1029.51 and 67.45 for between groups and within groups respectively. F-value obtained was 15.26 and P-value at confidence level of 0.05 was 3.55. The result shows that F-value is greater than the P-value (15.26 > 3.55).

Therefore, the hypothesis is rejected. Details of the results are presented in Table 9.

Table 9: Analysis of variance among the mean performance of female students in three groups used for the study

Source of Variance	SS	df	MS	f	P	Remark
Between Groups	2059.01	2	1029.51			
Within Groups	1214.14	18	67.45	15.26	3.55	Rejected
Total	3273.4	20	163.66			

***Source*:** Field work (2024)

Discussion of the Findings

The result of the research question one which was affirmed by test of corresponding null hypothesis shows that there was no significant difference among the pre- test mean performance of students used in the research work. This signified that the students used for the study have the same background knowledge prior to the research work. The findings is in line with the findings of who conducted a research and reported that there was no difference in the mean performance of the subjects at the pre- test among the experimental and control groups. The subjects performed nearly the same before the treatment. This is also in line with the findings of who stated in his findings that, the performance of students in both experimental and control group was the same at the pre- test level. The findings is also in agreement with that of who conducted a study and reported that there was no mean difference in the performance of students in pre- test of both the experimental and control groups. Similarly, in the findings of Safali and Rababah stated that there was no significant difference in performance of students at the pre- test level.

The result of research question two and the test corresponding null hypothesis it was discovered that there was a significant difference among the mean performance of the three groups after treatment with the overall performance by the students taught using collaborative instructional method which is in line with the findings of where he attributed the difference on the team work and interactive nature of the methods. This findings was also supported by Wachyumi and Zhang, but the findings is contrary to the findings of Shaban who stated that those taught with scaffolding instructional method perform better because there was a differential effects on students of lower ability in collaborative method.

The result of research question three and test of corresponding hypothesis revealed that there was significant difference among mean performance of female students taught basic electronic using the three instructional methods. This difference was attributed to the different methods they were exposed to. The overall mean performance was recorded from those female taught using collaborative instructional methods. Finding is further confirmed by Undumfehe (2015) he revealed that students taught using collaborative instructional methods outperform those taught with scaffolding and conventional method.

Conclusion

The use of Scaffolding and Collaborative instructions as instructional methods of teaching practical course (Basic Electronic) were effective because Scaffolding and collaborative instructions produced a significant effect on students' performance The approaches keep the teacher off stage and actively involved learners in lessons. The study also showed a new method of teaching students for getting higher in practical courses of electronic engineering trade. Similarly it can also reduce the rate of failure in practical examinations.

Recommendation

The following recommendations were made based on the findings of the study:

1. The National Board for Technical and Business Education (NABTEB) should formulate policy guidelines by laying emphasis on the use of collaborative instructional methods in teaching practical to improve learner's abilities to construct simple electronic circuit.
2. Educational stake holders should encourage the use of learner-centred methods such as scaffolding and collaborative instructional methods in teaching practical.
3. The use of scaffolding instructional method should be employed to identify potential skills acquired by the learners which in turns encourage creativity.

Acknowledgements

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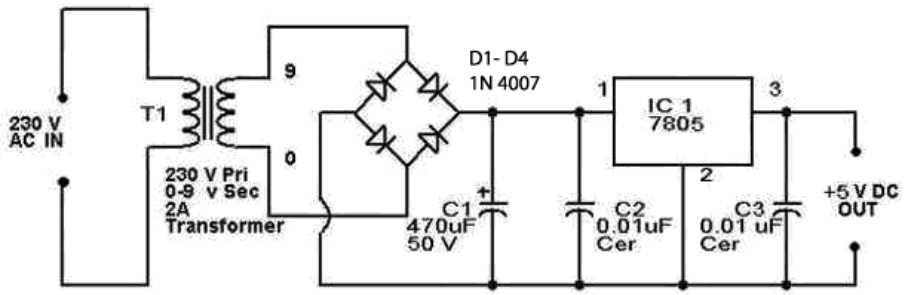
Appendix A

Basic Electronics Performance Test (Pre-Test)

Instruction: Scrap papers should not be use neither a full account of the method of carrying out experiment nor a detailed description of the apparatus is required. The theory of the experiment is not required.

Apparatus	Quantity
45cm solder less breadboard	1pc
500mA/9V transformer	1pc
1N400x Diode	5pc
5V (7805) regulator	1pc
1000µf/100V, 450µf/50V electrolytic capacitors and 0.5µf ceramic capacitor	4
22AWG Twined hook up wire	1pc

Circuit Diagram of Simple Power Supply Unit



1. Cut the connector off the code attached to the transformer, split the code strip about 3/4 wire from each lead, and twist the ends. And indicate the positive and negative.
2. Connect the positive lead of the transformer (+ 9v) to one of binding post (GND).
3. Connect the black binding post to the (GND) row of the bread board.
4. Place your regulator in the last three columns of the bread board nearest to the binding.
5. Connect the red binding post with the positive lead from the transformer to pin 1 of the regulator.
6. Connect pin 2 of the regulator to GND.
7. Connect pin 3 of the regulator to out rows of the bread board.
8. Connect the GND and v out rows of the breadboard together (not to each other though) connects each horizontal row to 'the -vertical at one side also connect each horizontal row together across its midpoint, the circuit is otherwise broken here.
9. Connect your capacitors across the power supply (DANGER) make sure you get the polarity right, the gold strip must go to GND and finally.
10. To verified that you have wired your power supply, ask the instructor to test the output voltage.

Appendix B

Job Specification Table (JST) Pre-Test for 2022 Electronic Work Nabteb Practical Examination On Construction Of Simple Power Supply Unit

Duties	Tasks: Manipulative (hands-on)	Tasks Steps and Marks
Construction of simple power supply unit using 500MA/9V to produce 5V.	1. Connecting the transformer	a. Placing all the electronic gad gage on the work bench. b. Cutting the conductor off the code attached to the transformer. c. Splitting the cut strip about ¼ of the wire from it lead. d. Twisting the ends and indicating the positive and negative terminal. e. Connecting the positive lead of transformer to one of the binding post GND.
	2. Connecting the rectifier circuit. 3. Connecting the filter circuit. 4. Connecting the regulator circuit. 5. Connecting the complete circuit. 6. Measuring the voltage output.	a. Connecting the 4 diode D1, D2, D3 and D4 to form a full wave rectifier. b. Connecting the full wave rectifier to the transformer output terminal at junction D1/D3 and D2/D4. c. Connecting the full wave rectifier to GND at junction D1/D2. d. Connecting the full wave rectifier to the positive terminal of the capacitor C1 (1000µf/100v. e. Mounting the capacitor C2 (450µf/50V) next to C1. f. Mounting the capacitor C3 (250µf/25V) next to C2. g. Connecting the output of the filter circuit to the regulator. h. Connecting the black binding post to GND row of the bread board. i. Placing the regulator in the last three columns of the bread board nearest to the binding post. j. Connecting the red binding post with the positive lead from the transformer to pin 1 of the regulators. k. Connecting pin 2 of the regulator to V out rows of the

		bread board. l. Connecting the GND and V out rows of the bread board together. m. Connecting each horizontal row to the vertical at the one side. n. Connecting each horizontal row together across it mid-point. o. Connecting the diode D5 across the regulator at pin 1 and pin 2 of the regulator.

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