



Effect of Guided Inquiry Teaching Method on Students Academic Performance in Electrical Installation and Maintenance Work in Technical Colleges in Gombe State

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ABSTRACT

This study investigated the effect of guided inquiry teaching method on students' academic performance in Electrical Installation and Maintenance Work in Technical Colleges in Gombe State. Two research questions and two null hypotheses guided the study. The hypotheses were tested at 0.05 level of significance. Quasi-experimental design was adopted for the study. The samples for the study were 118 NTC2 students made up of 95 males and 23 females. Purposive sampling technique was used to select two schools from Gombe and Yamaltu Deba Educational zones. The instruments used for data collection were 50 objective questions. Pearson correlation coefficient formula was used to establish the reliability of the instrument which yielded 0.81 correlation coefficient. The research questions were answered using mean scores whereas the hypotheses were tested using ANCOVA. The result showed that guided inquiry significantly impacted on the academic performance of the students. It also showed that the effect of guided inquiry on academic performance was not significant in relation to gender. In view of the findings, it was recommended among others that guided inquiry should be adopted in technical colleges, secondary schools and Vocational schools for instruction in EIMW to improve academic performance of the students.

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INTRODUCTION

Education is one of the tools that help a child to modify his behavior in order to become a better citizen and contribute positively to the society. With this as a priority, teachers are expected to devise ways of motivating their students to develop positive attitude towards technology and technology related disciplines, which fundamentally are offered in Technical colleges in Nigeria.

Technical College is a specialized institution of learning where trade, modular and science courses are offered. It is a post-basic school established by Federal and state governments to implement Technical Education programs at that level. Graduates of Technical colleges are expected to be employable or self-reliant due to the knowledge, skills and attitudes gained at that level.

Trade courses offered in Technical Colleges run for three years and lead to the award of National Technical Certificate in Woodwork Technology, Building Technology, Metalwork Technology,

Automobile Technology and Electrical Electronics Technology. These trade courses are departmentalized at Technical College level. For Electrical Electronics Department, the following trades/subjects are offered: Electrical Installation and Maintenance Work (EIMW), Appliances Repairs and Radio, Television and Electronics Work (NABTEB 2007).

Electrical installation is viewed as an assembly of associated electrical equipment and materials to fulfill a specific purpose that has a certain coordinated characteristics. (NABTEB 2007) In this context, electrical equipment refers to any item for such purpose as generation, conversion, transmission, distribution or utilization of electrical energy such as transformers, machines, measuring instruments, protective devices, appliances and apparatus. Electrical materials on the other hand are used here to include wiring materials and accessories such as wires, consumables, sockets and ceiling rose. On the other hand, maintenance simply



means the activities or actions performed to keep a system or network such as electricity equipment and materials functional and safe.

The complexity in the field of Electrical Electronics technology requires specialized and well trained teachers with very good teaching methods. With this when a student completes the required training in Electrical Installation and Maintenance Work (EIMW) course in Technical College, the student should be able to: carry out with expertise domestic and industrial installation work, detect and repair fault in domestic and industrial appliances, carry out the various tests on new and existing electrical installations, install and rewind electrical machines and other portable electrical devices and interpret electrical working drawings and manuals (NBTE, 2007). The degree to which the students perform these stated goals is referred to as the students' academic performance.

Performance connotes final accomplishment of something noteworthy, after some effort. However, performance in this study relates to accomplishment of learning by a student in both cognitive and psychomotor domain of learning. The word cognitive relates to knowledge and the development of mental and intellectual abilities, it involves thinking, reasoning and remembering (Alome & Bargu, 2016). Psychomotor involves manipulative or practical skills. Okoro (2012) explained that performance test involves the use of tools and equipment in a direct assessment of the amount of practical skills possessed by the student.

The academic performance of students of EIMW in Technical colleges in Gombe State is poor since graduates of the trade do not seem to have achieved the above stated goals and even the result in external examinations shows that their performance is poor, with less than 20% having credits and distinctions between 2014 and 2016. (Appendix A) With this poor performance in external examination which is meant to assess students' level of acquisition of skills, knowledge and attitude, one begins to imagine if this objective could really be achieved.

Students' poor academic performance in EIMW has been observed from literature to be caused by many factors such as teacher's insensitivity to the nature of EIMW when planning instructional objectives in the classroom (Aminu, 2011), inadequate infrastructural materials and poor or ineffective teaching methods (Yidi & Ya'u, 2013).

According to Ahmed and Tijjani (2011) teacher's predominant usage of conventional method of instruction (lecture and demonstration) in EIMW could be a contributory cause of failure in the subject. The resultant effect is poor academic performance among students in EIMW.

Teaching is the art of imparting knowledge, skill, attitudes, ideas, appreciation and change in behavior (Alome & Bargu, 2016). The teacher's job therefore is to impart desirable changes in behavior into the learners through the use of appropriate teaching methods namely: Lecture, Discussion, Inquiry/Discovery, Expository, Experimentation, Demonstration, Field-trip/Excursion, etc. Learning on the other hand is a process of gaining knowledge or acquiring skills or having understanding of a new concept and imbibing a better way of carrying out instructional tasks (Olabiya & Keshinro, 2013).

Damisa and Didam (2013) explained that lecture and demonstration methods are teaching methods based on the traditional view point that the teacher is an ocean of knowledge, thus, it is his responsibility to disseminate knowledge to passive listeners or learners. In other words, the teaching methods are executed by activities of the teacher while the learners only observe and listen. Hence, students are not always given enough opportunities to be fully involved in the learning process. Often, it results to learning difficulties, disinterest and inability to acquire knowledge and skills they can easily adapt, apply and transfer to new situations under varying technology development. Moreover, research findings over the years especially by Olawale and Augustus (2010) have been consistent on the weakness of traditional instructional approaches in teaching/learning of trades in Technical Colleges in the 21st century that warrants looking for alternative instructional methods such as inquiry teaching method. Though the traditional method of instruction (lecture and demonstration) have their merits, but it appears such advantages is not very adequate to ensure students improved performance in the trades offered in technical colleges for instance, lecture method of teaching requires less time for instructional delivery. It as well permits wide coverage of learning experiences, but exclude students' full participation in classroom setting, which could be a contributing factor to students poor performance in Technical college trade such as EIMW hence, the search for alternative instructional method becomes paramount.



Inquiry teaching method is a method of teaching where learners seek to discover and create answers to recognized problems through a procedure of making a diligent search, sometimes with minimum guidance from the teacher (Callaham, Clark & Kelloogh, in Suleiman, 2011). Inquiry teaching method is also a term used in teaching that refers to a way of questioning, seeking knowledge or information or finding out about phenomenon. It involves investigating data and arriving at conclusion (Sola & Ojo in Suleiman, 2011). Students learn both the concept, self-direction, responsibility and social communication in an inquiry situation. It also permits students to assimilate and accommodate information. Inquiry is a way people learn when they are left alone.

Cheval and Hart in Suleiman (2011) classify inquiry teaching method into three, namely: structured inquiry, guided inquiry and open inquiry. In structured inquiry, the teacher gives the student the problem to investigate during hands on activities as well as the procedure and materials, the students must determine the outcome. Examples of structured inquiry are laboratory activities with procedures, materials and questions specified. In guided inquiry the teacher gives the students the problem and material, the students will have to determine the process and outcome. Example: what are the working principles of a cell, while in open inquiry the students determine the problem, procedure and outcome. Example: students are taken out on a field trip to investigate a garden; working with a partner must identify research problems and conduct an investigation based on the problems. There is no one type of inquiry that is the best or the worst but any form of inquiry can be useful to students when taught appropriately well. In the process, the effect of guided inquiry teaching method on students' academic performance and interest in Electrical Installation and Maintenance Work (EIMW) will be investigated with attention paid also to influence of gender on their performance and interest.

Gender is characteristics of sex: boy/girl, male/female. It refers to the socially constructed roles, behaviors, activities, and attributes that a given society considers appropriate for men and women. Gender according to Myers (2012) refers to the characteristics, whether biological or social; influenced by which people define male and female. The term gender in this study simply refers to male and female. Available literatures sometimes are

conflicting, while some advocate male superiority, others take opposite view. For example, Umunadi (2009) in a study found that males performed better than their female counterparts in Radio, Television and Electronic Work while the study conducted by Oviawe (2010) revealed that gender had no significant effect on students' performance in Building Technology. Thus the form of male and female performance in EIMW will be critical to EIMW teachers particularly in classroom instruction. Also critical is gender if it manifests in their performance in the trade.

Poor performance of students in Electrical Installation and Maintenance Work (EIMW) subject in NABTEB, WAEC and NECO examinations has become worrisome to technical educators and other stake holders namely: parents/guardians, Government in education. An analysis of the results in some selected trades in NABTEB examination from the year 2006 to 2010 by Olatunde (2011), reveal poor performance of students in EIMW across Nigeria. A review of the number of schools in Gombe State that registered her students for EIMW in NABTEB examination and their corresponding performance from year 2014 to 2016 by Gombe State Science and Technical Schools Board also revealed that performance of students is unsatisfactory (see Appendix A).

There are also reported cases of Technical College graduates who could not recall and explain simple concepts in EIMW during job interview (Odu, 2010). The causes of poor academic performance in EIMW (Ukachukwu, 2011) are dependent on many factors such as: Lack of qualified teachers who are specialist in the area, inadequate supply of facilities and equipment, lack of instructional materials and wrong method of teaching. Among these factors, teacher's method of instruction has been seen to have direct impact on students' academic performance in EIMW, (Duruji, Azuh, Segun, Olanrewaju & Okeke, 2014; Ukachukwu, 2011).

EIMW has been taught using different methods like lecture and demonstration methods among others; which implies that this method of instruction had not elicited the desired outcome going by the student results in Appendix A page 68 depicting very poor performance in their external examination. The resultant effect is that most of the graduates of EIMW will not perform creditably well in their practical work of domestic and industrial power installation. It is possible that most buildings will be set ablaze and many electrical appliances



damaged due to poor practical work. The Nigerian workforce could also lack competent technicians/technologists for improved economy. The poor practical work of the technical graduates may also cause parents to withdraw their wards from entry into technical education at tertiary level of education. Opinions (Aminu & Tijjani, 2011) indicate that students-centered method such as guided inquiry method could improve students' academic performance better than teacher-centered method. Therefore, the study is designed to determine the effect of guided inquiry teaching method on academic performance and interest of students of EIMW in Technical colleges in Gombe State.

Purpose of the Study

The main purpose of this study is to determine the effect of guided inquiry teaching method on students' academic performance and interest in Electrical Installation and Maintenance Work (EIMW). Specifically, the study intends to find out if there is any:

1. Difference in the mean scores of the students taught EIMW with the conventional method and those taught using guided inquiry teaching method.
2. Difference in the mean scores of male and female students taught EIMW with the conventional method and those taught using guided inquiry teaching method.

Research Questions

The following research questions guided the study

1. What is the difference in the pre-test mean scores and post-test mean scores

Group	Pre-test	Experimental	Post- test	Interest Inventory
E	O1	X1	O2	O3
C	O2	X2	O2	O3

Where,

E = Experimental group

C = Control Group

O1 – Pre test

O2 – Post test

O3 – Interest Inventory

X1 – Experimental (Guided Inquiry Teaching Method)

X2 – Control (Lecture/Conventional Method)

Research Question 1: What is the difference in the pretest mean scores and posttest mean scores of the

of the experimental and control groups in EIMW?

2. What is the difference in the pre-test mean scores and the post-test mean scores of male and female students of the experimental and control groups in EIMW?

Hypotheses

The following null hypotheses were tested at 0.05 level of Significance.

1. There is no significant difference in the academic performance of students taught EIMW with guided inquiry and those taught using the conventional method with reference to their performance mean scores.
2. There is no significant difference in the academic performance of male students taught EIMW with guided inquiry and those taught using the Conventional method with reference to their performance mean scores.

METHODOLOGY

Quasi-experimental research design of pre-test, post-test non randomized control group was used for the study. Intact or pre-existing groups are used. The groups are not equivalent or equated. Intact classes were chosen to be used because there was no random assignment of the subjects to treatment condition. Nworgu (2015) in agreement to this said that in a situation where there is no randomization in the assignment of individual participants to treatment conditions; intact classes method is most suitable. The structure that was used for conducting the study is symbolically presented as follows;

experimental and control group in EIMW. Answer to this research question is presented in Table 1



Table 1: Pre-test and Post-test academic performance mean scores of students taught EIMW with guided inquiry

Group	N	Mean	SD	Mean gain	Remark
Pre-test conventional	58	12.98	1.67		
Post-test conventional	58	33.53	2.66	20.55	Positive effect
Pre-test guided inquiry	60	14.53	2.76		
Post-test guided-inquiry	60	40.53	2.68	26.00	Positive effect
Difference				5.45	

The data in Table 1 shows positive effect for both experimental and control group. However, the mean gain of 26.00 (40.53- 14.53) for the experimental group is higher than that of the control group which is 20.55 (33.53- 12.98). This implies that guided inquiry teaching method is more effective in enhancing students' academic performance in EIMW than lecture method of instruction with an aggregate mean gain of 5.45. The standard deviation scores

showed that the mean responses were closely related.

Research Question 2: What is the difference in the pretest mean scores and posttest mean scores of male and female students of the experimental and control groups in EIMW. The answer to this research question is presented in Table 2.

Table 2: Pre-test and Post-test academic performance mean scores of male and female students taught EIMW with guided inquiry method

Group	Pre-test			Post-test			Remark
	N	Mean	SD	Mean	SD	Mean gain	
Male	49	14.61	2.69	42.27	2.35	27.66	Positive effect
Female	11	14.18	3.17	40.14	3.44	25.96	Positive effect
Difference						1.70	

In Table 2, data revealed that guided inquiry had a positive effect on academic performance of students' in EIMW with respect to gender. However, the mean gain of 27.66 (42.27-14.61) for male students is higher than 25.96 (40.14-14.18) for their female counterparts. This shows that guided inquiry has more positive effect on academic performance of male than that of the female students.

Test of Hypotheses:

The null hypotheses that guided the study were tested at 0.05 levels of significance, the result are presented below:

Hypothesis 1: There is no significance difference in the academic performance of students taught EIMW with guided inquiry and those taught using the conventional method with reference to their performance mean scores.

The statistical test for hypotheses 1 is presented in Table 5.

Table 3: Analysis of Covariance (ANCOVA) for difference in the academic performance of students taught EIMW with guided inquiry and those taught using the conventional method with reference to their performance mean scores.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Squared	Eta
Corrected Model	1445.007 ^a	2	722.504	100.473	.000	.636	
Intercept	4369.875	1	4369.875	607.685	.000	.841	
Pretest	.397	1	.397	.055	.815	.000	
Treatment	1308.402	1	1308.402	181.949	.000	.613	
Error	826.968	115	7.191				
Total	164629.000	118					
Corrected Total	2271.975	117					

a. R Squared = .636 (Adjusted R Squared = .630)



The data presented in Table 3 shows that there is a statistical difference in the academic performance mean scores of students taught EIMW with guided inquiry and those taught using the conventional method with reference to their performance mean scores. This is because the p-value (0.000) is less than the alpha level of 0.05. Hence, the null hypothesis is rejected implying that there is a statistical difference in the academic

performance mean score of students taught EIMW using guided inquiry method and those taught using conventional method.

Hypothesis 2: There is no significant difference in the academic performance mean scores of male students taught EIMW with guided inquiry and those taught using the Conventional method.

Table 4: Analysis of Covariance (ANCOVA) on the academic performance of male students taught EIMW with guided inquiry and those taught using the Conventional method with reference to their performance mean scores

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1521.309 ^a	4	380.327	57.252	.000	.670
Intercept	4102.541	1	4102.541	617.568	.000	.845
Pretest	.085	1	.085	.013	.910	.000
Treatment	1179.924	1	1179.924	177.617	.000	.611
Gender	.064	1	.064	.010	.922	.000
Error	750.666	113	6.643			
Total	164629.000	118				
Corrected Total	2271.975	117				

a. R Squared = .670 (Adjusted R Squared = .658)

Data presented in Table 4 indicate that from the ANCOVA analysis provided, the calculated F-ratio is 0.010 at a p-value of 0.922. The p-value of 0.922 is greater than the alpha level of 0.05 ($F_{1,113} = 0.922$, $P \geq 0.05$). Based on this analysis, the null hypothesis is accepted, implying that there was no significant difference in the academic performance of male students taught EIMW with guided inquiry and those taught using the conventional method with reference to their performance mean scores.

SUMMARY OF FINDINGS

From the analysis of data presented, the following major findings were made:

1. The mean gain of students taught EIMW using guided inquiry differs from that of those taught using lecture method by 5.45 (26.00-20.55) in favour of the experimental group taught with guided inquiry.
2. The mean gain of male students taught EIMW using guided inquiry differs from that of the female students also taught using guided inquiry by 1.76 (27.66-25.96) in favour of the males.
3. There is a statistical difference in the academic performance of students taught EIMW with guided inquiry and those taught using the conventional method with reference to their performance mean scores. This is because the p-

value (0.000) is less than the alpha level of 0.05. Hence, the null hypothesis is rejected implying that there is a statistical difference in the academic performance mean score of students taught EIMW using guided inquiry method and those taught using conventional method.

4. The calculated F-ratio is 0.010 at a p-value of 0.922. The p-value of 0.922 is greater than the alpha level of 0.05 ($F_{1,113} = 0.922$, $P \geq 0.05$). Based on this analysis, the null hypothesis is accepted, implying that there was no significant difference in the academic performance of male students taught EIMW with guided inquiry and those taught using the conventional method with reference to their performance mean scores.

DISCUSSION OF RESULTS

The discussions of the results of the study are done in line with the purpose of the study under the following headings: To find out if there is any

1. Difference in the mean scores of the students taught EIMW with the conventional method and those taught using guided inquiry teaching method.
2. Difference in the mean scores of male and female students taught EIMW with the



conventional method and those taught using guided inquiry teaching method.

Difference in the mean scores of the students taught EIMW with the conventional method and those taught using guided inquiry teaching method.

One of the specific purposes of the study was to find the effect of guided inquiry on academic performance of students in EIMW. Table 1 and 5 revealed that the academic performance of students taught EIMW using guided inquiry differed significantly from that of the students taught same lesson using lecture method in favour of the experimental group. Specifically, the experimental group had a mean gain of 26.00 while the control group had 20.55 mean gains. This gave a difference of 5.45 in favour of the experimental group.

This finding is in agreement with Suleiman (2012) who found that students taught using guided inquiry perform better than those taught using conventional method. In the same vein, this finding is supported by the findings of Okafor and Ile (2014) in a study that compared the effect of guided discovery teaching method on achievement of Financial Accounting. Okafor and Ile found that students taught with guided discovery score higher than those taught with the conventional method. Also in agreement with this finding, Ogbuanya and Owodunmi (2015) found that the experimental group taught using guided inquiry differs significantly from the control group in academic performance in Electronic works trade in favour of the experimental group. The similarities between the findings of these studies and the current study reveal that the use of guided inquiry in teaching trade subjects/courses and some career areas can improve students' academic performance.

Difference in the mean scores of male and female students taught EIMW with the conventional method and those taught using guided inquiry teaching method.

The study also sought to find the effect of guided inquiry on academic performance of students with respect to gender. The result shown in Table 2 indicate that male students exposed to EIMW using guided inquiry had a mean gain of 27.66 in academic performance against their female counterparts with 25.96 mean gain. This accounted for the difference of 1.76 in the mean gain in favour of the male students. However, the result in Tables 6 and Table 7 revealed that this difference in the academic

performance of male and female students is not significant. Hence such difference in the academic performance with respect to gender is a chance occurrence. The findings of the related literatures reviewed support this findings of the study on effect of guided inquiry on academic performance of students in EIMW in relation to gender. For instance, Okafor and Ile (2014) found that gender has no significant influence on students' academic achievement in Financial Accounting. Similarly, Obidile (2016) revealed that there was no significant effect of gender on academic performance.

This entails that guided inquiry method of instruction evenly influenced both male and female students of EIMW and some other career areas. Therefore, guided inquiry method of instruction can be a powerful means of check against bias in the learning process as a result of gender especially in technology related areas.

CONCLUSIONS

A number of conclusions can be drawn: Guided inquiry is an effective method of instruction with the ability of improving students' academic performance and interest ability in EIMW. Also, the academic performance ability and interest in EIMW are not influenced by gender when guided inquiry teaching method is employed.

RECOMMENDATIONS

The following recommendations were proffered based on the findings of the study.

1. Technical college teachers should adopt the use of guided inquiry teaching method/instructional technique to the teaching of EIMW to improve academic performance and interest ability of students.
2. National Board for Technical Education (NBTE) should consider reviewing the curriculum for EIMW with a view to incorporating guided inquiry instructional technique into the teaching of EIMW.
3. Workshops, seminars and conferences should be organized by Ministries of Education and Administration of Technical colleges to enlighten technical teachers and improve their knowledge and skills on the use of guided inquiry for improving students' academic performance and interest.

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