



# **Gender Differences in the Achievement and Retention of Nigeria Students Exposed to Concept in Electronic Works Trade through Reflective Inquiry Instructional Technique**

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## **Authors' contributions**

*This work was carried out in collaboration between all authors. Author OAS designed the study, performed the statistical analysis, and wrote the first draft of the manuscript. Author OIP Peter managed the analyses of the study, managed the literature searches and wrote the protocol. All authors read and approved the final manuscript.*

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## **ABSTRACT**

This study was designed to determine the gender differences in the achievement and retention of Nigerian students exposed to concepts in electronic works trade through reflective inquiry. The pre-test, post-test, non-equivalent control group, quasi-experimental research design was adopted. The study was carried out in Lagos State. 43 students constituted the subjects in the experimental group and 62 students constituted the subjects in the control group for the study. Two research questions and two null hypotheses, tested at 0.05 level of significance guided the study. The instrument for data collection was Electronic Work Trade Achievement Test (EWTAT). The instrument was subjected to face validation by five experts in Vocational teacher education and Electronic technology. The EWTAT was tested in trial to determine its psychometric indices and reliability coefficients. The EWTAT reliability coefficient was 0.83 using Kuder-Richardson's estimate formula. Mean was used to answer the research questions; while ANCOVA was employed to test the hypotheses. This study revealed that the mean score of boys was higher than the mean score of girls taught Electronic works trade using reflective inquiry instructional

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technique, but the mean score of girls was higher than that of the boys in the test for retention of learning. Consequently, the researchers recommended that Technical College teachers should adopt the use of the reflective inquiry instructional technique to the teaching of Electronic works trade and Ministry of education and administrators of Technical Colleges should always organize seminars, conferences and workshops to sensitize technical teachers on the use of instructional technique.

*Keywords: Gender difference; achievement; retention; electronic works trade and reflective inquiry instructional technique.*

## **1. INTRODUCTION**

There has been an increasing concern over the years globally about the right of women. This has been attributed to the observations and beliefs of many scholars that the female gender is greatly marginalized in Africa, Nigeria not being an exception [1,2]. The term gender is socio-cultural and is built based on the biological expectations of the individual on the basis of being a male or female. Gender has sound psychological background and is used to refer to specific cultural patterns of behaviour that are attributed to human sexes. Gender, then, refers to a set of assumptions about the nature and character of biological differences between males and females, assumptions that manifest in a number of ideas and practices that have a determinant influence on identity, social opportunities and life experiences of human actors [3]. The assumptions tend to define the task and roles of a particular sex, thus enhancing role and behavioural identity for the individual. It could influence what a person is expected to do or not. It also influences the person's belief in respect of being a male or female.

In the educational system, gender is important as it tends to influence the pattern of school enrolment and academic performance of students. This is partly because gender roles affect familiarity with academic content, career aspirations, attitude toward subjects, teacher expectations and preferred approaches which also affect academic performance [4,5]. In most societies, gender role has relegated females to the sidelines, preventing them from participating in and benefiting from educational and development efforts.

In the recent times, the gender factor has assumed prominence in science vocational and technical education discourse. It has been documented that disparity exists between male and female students performance in these disciplines. In some cases boys had an edge over girls in academic achievement [6,7]. On the other hand, it was reported [8] that such a difference does not exist. However, it was observed [9] that in some countries in conformity with certain traditions, technical and vocational education is regarded predominantly for boys only and that attempts are being made to facilitate girls' attendance in technical and vocational institutions. This sex biased tradition of technical education still exists in Nigeria. Women have little or no access to some programmes. Many scholars have researched into gender differences in academic performance especially in sciences and mathematics. Many have found that the male students performed better than their female counterparts [10,11, 12,13,14,15,16]. But, a few scholars have also found no significant difference in academic performance in science and mathematics between male and female students [17,18,19].

The controversy as to which of the sexes would have better academic performance therefore, continues. The same can also be said with regards to Electronic work trade. It was

discovered (Owoso, J.O. University of Nigeria, Unpublished thesis) that there was significant difference between boys and girls in academic achievement in Automobile technology trades in technical colleges. It is better to look beyond gender characteristics into the interaction between individual learner's specific characteristics and particular features of instructional treatment in order to determine the reasons for academic performance? The trait-treatment interaction theory suggests that there is a connection between personality traits of the learner and variables of the instructional situation and that the effect of learning must be interpreted as the result of that interaction [20].

Since learners have individual differences with different features of the instructional situations which may appeal to them, it is therefore, assumed that they would find a common ground not only for learning but for retaining what is learnt through reflective inquiry (critical thinking and inquiry) instructional technique. Inquiry is a term used in science and other related fields to refer to a way of questioning, seeking knowledge or information or finding out about phenomena [21]. They also explained that it involves investigation, searching, and doing, formulating hypotheses, gathering and interpreting data and arriving at a conclusion. Critical thinking is a reflective thinking which involves mentally engaging in cognitive processes to understand conflicting factors [22,23,24]. This mental engagement results in a person actively constructing knowledge about a situation in order to develop strategies for proceeding within that situation. Students must reflect on their previous understanding of the issue and their newly acquired knowledge in order to respond to an issue. Thus reflection helps students to develop higher-order thinking skills and prompt them to relate new knowledge to their prior understanding, think in both abstract and concrete terms, apply specific to a given tasks and understand their own thinking and learning [25].

Reflective inquiry is therefore, a thinking process through which individual can examines their experiences to better understand the assumptions and implications of events and actions in their lives [26]. The process of reflective inquiry entails asking penetrating questions, challenging assumptions and carefully examining the implications of their actions and choices. This study was designed to determine if gender difference would occur when students are exposed to Electronic works trade through reflective inquiry instructional technique.

#### Research Questions

1. What is the influence of gender on students' mean achievement scores in Electronic works trade?
2. What are the mean scores of students taught Electronic works trade with Reflective Inquiry instructional technique and those taught using the conventional teaching methods in the test for retention of learning?

#### Hypotheses

- HO<sub>1</sub>: There is no significant difference between the mean achievement scores of boys and girls taught Electronic works trade with reflective inquiry instructional technique.
- HO<sub>2</sub>: There is no significant difference between the mean scores of boys and girls taught Electronic works trade with reflective inquiry instructional technique in the test for retention of learning.

## **2. METHODS**

### **2.1 Design of the Study**

The study adopted the quasi-experimental research design. The research makes use of pre-test, post-test non-equivalent control group design. The researcher randomly assigned intact classes to treatment and control group. This was necessary in order not to disrupt the normal classes of the students and the school time-table. The design of the study was in the following ways:

$E_G, O_1 \times O_1$

$C_G, O_1 - O_1$

Where  $E_G$  stands for experiment group

$C_G$  stands for control group

$O_1$  stands for pre-test/post-test observation

**X** stands for the treatments using Reflective Instructional Technique

- stand for the use of the Conventional method

The independent variables consisted of conventional method and reflective inquiry instructional technique, while the dependent variables were the posttest and the retention tests.

### **2.2 Participants**

The 105 participants of this study comprise year II students of Electronic works trade in all the technical colleges that offer Electronic Work Trade in Lagos state. The entire population was 105 made up of 76 boys and 29 girls.

### **2.3 Research Instrument**

The instrument for data collection for this study consists of Electronic works trade achievement test (EWTAT). The EWTAT which was used to test the achievement and retention of students in Electronic works trade was developed based on the test blue print table. The pretest and posttest items were developed based on CRT 12 (Electronic Devices and Circuits) module. It consists of 30 multiples choice items with five options. The construction of the test blue print was based on National Board for Technical Education (NBTE) Electronic works trade curriculum and course specifications 2008. The test items covered all the contents of the lesson plans developed to cover the major topics used for the study. The Reflective Inquiry lesson plan was used to teach the experimental group while the control group was taught with conventional lesson plans.

The instrument was validated in the following ways. The face and content validities were determined by experts in electronic works trade, test and measurement and language education. The pilot tryout of EWTAT was conducted in Federal Science and Technical College Ijebu-Mushin, Ogun State and the psychometric test analysis was carried out to determine the Difficulty and Discrimination Index of each item in the test. An item is good if it has Difficulty Index ranging from 20 to 80; Discrimination of 0.20 and above and its entire distractor index a negative decimal [27]. Therefore, a total of the 30 items of the EWTAT had good difficulty, discrimination and distractor indices.

The trial test for determining the coefficient of stability of the EWTAT was carried out using test re-test reliability technique using two weeks interval. The reliability coefficient of the instrument was found to be .83 using Kuder Richardson formula 20 (K – R 20), since the test items are of multiple choice types.

## **2.4 Experimental Procedure**

One week intensive training programme was organized for the teachers that were involved in the study. The training exercise was based on the purpose of the study, the topic to be taught, the use of the lesson plans, the use of instrument and general conduct of the study. The conduct of the study took place during the normal school lesson periods. On the first day, before the lesson commenced, EWTEAT was administered as pre-test to both the experimental and control groups after which proper teaching commenced by using the prepared lesson plans. The experimental group was taught with reflective inquiry lesson plans while the control group was taught with the conventional lesson plans. Each lesson lasted for 90 minutes and the treatment lasted for 10 weeks. At the end of the treatment, a posttest was administered on both groups with the EWTEAT; the scores obtained from both groups were compared to determine if there is any significant difference in the performance of the two groups. The data collected was used for further analysis; therefore they were collected and kept under the custody of the researcher.

## **2.5 Reflective Inquiry and Classroom Teacher**

Inquiry and critical thinking have been universally accepted as being the ideals and central aim of education [28]. It refers to the activity engaged in to overcome a situation of doubt to generate knowledge with provisional and tenuous results posited in the light of new experience and insight. For reflective inquiry to have some practical value in a school environment with its multidisciplinary nature and developmental levels, reflective inquiry should be viewed as an overreaching concept and **method** (Institutional learning plan, 2003, University of Calgary). In reflective inquiry classroom, teacher has the following roles to play: a. guides **learner and assist students** to discover **meaning to a given** task which **encourage** them to become self-regulatory, self-mediating and self-aware, b. models learners' thoughts, commitments, beliefs and **attitudes** by helping students to reflect on the consequences of specific actions and thoughts in the learning process, c. guides the students and motivate the learners to put challenge into learning and transfer their current learning to **a new situation**, d. guides **the students to** form relationship between concepts, ideas, processes and principles of operation of devices, functions of the devices, e. guides the students to build on the existing concepts, principles and principles of operation of appliances and system, f. **guide the learners to reach their goals** by facilitating **learners ability** to build on existing concepts, knowledge, principles and internalize new information to become independent students, develop a deeper understanding of fundamental ideas and problem solvers, g. guide the students to structure information into organizational patterns and provide a framework for what to be learned. h. guides the students to question **prompt tacit assumptions** by asking penetrating, prompt and leading questions that will help the students to uncover meaning, and lead them to the solution of some specific tasks, i. guides and provides classroom environment that will enable students to learn and work in groups to discuss, think, proffer solution to problems and accomplish specific tasks, j. encourages bright students or **more experienced** and skillful students, to guide, coach and teach the dull or less skillful students to accomplish specific tasks, and k. takes on the role of a coach

or guardian and engages learners in active dialogue to encourage critical thinking, debate and reflection on specific tasks.

## 2.6 Data Analysis

Data collected were analyzed using the appropriate descriptive and inferential statistics of the statistical Package for the Social Sciences (SPSS) Programme. In testing for the possible post-experimental difference in achievement and retention between males and females, the Analysis of Covariance (ANCOVA) was used and the hypotheses were tested at 0.05 level of significance.

## 3. RESULTS AND DISCUSSION

### 3.1 Research Question 1

What is the effect of gender on academic achievement of students studying Electronic works trade?

The data presented in Table 1 show that male students taught Electronic works trade with reflective inquiry technique had a mean score of 4.37 in the pretest and a mean score of 25.03 in the posttest making a pretest, posttest mean gain in the male students taught with reflective inquiry techniques to be 20.66. Meanwhile, female students taught Electronic works trade with reflective inquiry technique had a mean score of 4.54 in the pretest and a posttest mean of 24.45 with a pretest, posttest mean gain of 19.91. Also, male students taught with conventional method had a mean score of 4.25 in the pretest and a mean score of 19.22 in the posttest making a pretest, posttest mean gain in the male students taught with conventional method 14.97. Meanwhile, female students taught Electronic works trade with conventional method had a mean score of 4.33 in the pretest and a posttest mean of 17.61 with a pretest, posttest mean gain of 13.28. With these results male students taught Electronic works trade had higher mean scores than female students in the Achievement Test. Thus, there is an effect attributable to gender on the achievement of students taught Electronic works trade.

**Table 1. Mean of Pretest and Posttest of Male and Female Students Taught Electronic works trade in the Achievement Test**

Gender	Reflective Inquiry Techniques				Conventional Method			
	n	Pretest	Posttest	Mean Gain $\bar{X}$	N	Pretest	Posttest	Mean Gain $\bar{X}$
Male	32	4.37	25.03	20.66	44	4.25	19.22	14.97
Female	11	4.54	24.45	19.91	18	4.33	17.61	13.28

### 3.2 Research Question 2

What are the mean scores of boys and girls taught Electronic works trade with Reflective Inquiry instructional Technique in the test for retention of learning?

The data presented in Table 2 shows that boys had a mean score of 35.67 in the post-test and a mean score of 34.33 in the test for retention. The girls also had a mean score of 35.48 in post- test and a mean score of 34.98 in the test for retention. The result indicates that the girls performed better than male students in the test for retention of learning.

**Table 2. Mean of Boys and Girls Taught Electronic works trade with the Reflective Inquiry Instructional technique in Achievement Post-Test and Test for Retention of Learning**

Group	N	Post-test	Test for Retention
		$\bar{X}$	$\bar{X}$
Male	76	35.67	34.33
Female	29	35.48	34.98

**Hypotheses**

- HO<sub>1</sub>: There is no significant difference between the effect of gender (male and female) on students achievement in Electronic works trade.
- HO<sub>2</sub>: There is no significant difference between the mean scores of boys and girls taught Electronic works trade with reflective inquiry instructional technique in the test for retention of learning.

The data presented in Table 3 shows F-calculated values for mean scores of experimental and control groups in the achievement test, gender and interaction effect of treatments and gender on students' achievement in Electronic works trade. The F-calculated value for Group is 151.225 with a significance of P at .000 which is less than .05. The null-hypothesis was therefore, rejected at .05 level of significance. With this result, there is a significant difference between the mean achievement scores of students taught Electronic works trade with reflective inquiry instructional techniques and those taught with conventional method. The F-calculated value for gender is 4.835 with a significance of P at .030 which is less than .05. This means that there was significant difference between the effects of Gender on students' achievement in Electronic works trade. Therefore, the null hypothesis of no significant difference between the effect of gender (male and female) on students' achievement in Electronic works trade is rejected at .05 level of significance. The interaction of treatments and gender has F-calculated value of 1.004 with significance of P of .319. Since .319 is higher than .05, the null hypothesis for interaction effect of treatment and gender is accepted. Hence, there is no significant interaction effect of treatments given to students and their gender with respect to their mean scores on the Electronic works trade Achievement Test.

- HO<sub>2</sub>: There is no significant difference between the mean scores of boys and girls taught Electronic works trade with reflective inquiry instructional technique in the test for retention of learning.

**Table 3. Summary of Analysis of Covariance (ANCOVA) for Test of Significance between the Mean Scores of Experimental and Control groups in the Achievement Test, Effects of Gender and Interaction Effect of Treatments given to Students and their gender with respect to their mean scores on the Electronic works trade Achievement Test**

Source	Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	992.311 <sup>a</sup>	4	248.078	47.871	.000
Intercept	1706.006	1	1706.006	329.203	.000
Pretest	3.478	1	3.478	.671	.415
Group	783.680	1	783.680	151.225*	.000
Gender	25.059	1	25.059	4.835*	.030
Group * Gender	5.202	1	5.202	1.004	.319
Error	518.223	100	5.182		
Total	48999.000	105			
Corrected Total	1510.533	104			

*\*Significant at sig of P < .05*

Table 4 shows that the F-value for group is 6619.048 with significant of P at .000, which is less than .05. The null-hypothesis was therefore, rejected at .05 level of significance. With this result, there was significant difference between the mean scores of students taught Electronic works trade with reflective inquiry instructional technique and those taught using conventional teaching method in test for retention

**Table 4. Summary of Analysis of Covariance (ANCOVA) Test of Significance between the Mean Scores of Experimental and Control groups in the Retention Test**

Source of Variation	Sum of Squares	DF	Mean Square	F	Sig of P
Covariates	23.924	1	23.924	2.777	.097
Pre-test	23.924	1	23.924	2.777	.097
Main Effects	57028.997	1	57028.997	6619.048	.000
Group	57028.997	1	57028.997	6619.048	.000*
Explained	57031.555	2	28515.669	3309.660	.000
Residual	2903.555	337	8.616		
TOTAL	59934.894	339	176.799		

*\*Significant at sig of P < .05*

The findings of this study have revealed that male students had a higher mean score in the Electronic works trade achievement test than that of female students. At the same time, analysis of covariance was employed to test the second hypothesis, Table 3, at the calculated F- value (4.835), significance of P (.030) and confidence level of .05, there was a significant difference between the main effects of gender (male and female) on students' achievement in Electronic works trade which confirmed that the difference between the achievement of male and female students in Electronic works trade was statistically significant favouring boys. The obvious implication of this finding is that there was an effect attributable to gender on achievement of students in Electronic works trade. This finding is similar to findings of several other studies that were conducted on gender effects on



achievement of male and female students in mathematics, sciences and technology fields. For instance, one of the important discoveries emerging from studies involving the effect of inquiry based instructional approach on academic achievement was the revelation of gender differences favouring boys. This also affirms that disparity exists between male and female students' performance in mathematics, sciences and technology fields [10,11], and in some cases boys had an edge over girls in academic achievement [5]. Generally, boys were consistently found to perform better than girls on vocational and technical achievement tests, suggesting that boys generally possess greater vocational and technical skills than girls. Male advantages in vocational and technical skills have been established in studies conducted by scholars [Owoso, J. O. University of Nigeria, Unpublished thesis, 29], where the trends of gender differences were found to be stable and consistent. Thus, in studies where differences in achievement were evident males typically had stronger vocational and technical skills than girls. The identified gender effect on achievement in Electronic works trade was responsible for the significant gender effect found in students' achievement in Electronic works trade. Thus, the superiority of male students in vocational skills acquisition was responsible for their improved achievement in Electronic works trade.

These findings revealed that students taught with reflective inquiry instructional technique had a higher mean score than those taught with the conventional teaching method in the test for retention of learning. The analysis of covariance of the retention test presented in Table 4 confirmed that the difference in the mean score of the students taught with the reflective instructional technique and those taught with conventional teaching method is significant. This showed that the reflective inquiry instructional technique has positive effect on the students' retention of learning in Electronic works trade. This affirms that active learning approach facilitates active knowledge construction, develops higher order thinking skills, improves memory and enhances transfer of learning to other situations [30,31]. Another author [32] was of the opinion that by teaching students to think, they will gradually begin to realize that conscious reflection secretes understanding. This finding is in support of many authors' views [Owoso, J. O. University of Nigeria, Unpublished thesis, 33,34], that retention of learning is not affected by gender but by the degree of original learning, time at which retention is measured and the individual's working memory capacity among other factors. Thus since boys and girls were taught with the same method, they acquired the same degree of original learning hence, their retention of learning was not significantly different.

#### **4. CONCLUSION**

The study revealed that there was significant difference in the achievement and retention of boys and girls in Electronic works trade when taught using reflective inquiry instructional technique. The difference in achievement was in favour of boys while the difference in retention was in favour of girls. Also, students retained their learning for a longer time when they were allowed to think on possible solutions to a problem while engaging in practical activities with real objects, tools and machines collaboratively.

#### **5. RECOMMENDATIONS**

Based on the findings the following recommendations are made:

\*Technical College teachers should adopt the use of the reflective inquiry instructional technique to the teaching of Electronic works trade.

\*Ministry of education and administrators of Technical Colleges should always organize seminar, conferences and workshops to sensitize technical teachers on the use of reflective inquiry instructional technique.

## **COMPETING INTERESTS**

Authors have declared that no competing interests exist.

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