



Effects of Kolb's Experiential and Gardner's Multiple Intelligence Learning Models on Students' Achievement in Basic Electricity in Technical Colleges

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ABSTRACT

The study investigated the effects of Kolb's Experiential and Gardner's multiple intelligence learning models on students' achievement in Basic Electricity in Technical Colleges in Gombe state. Four research questions and four null hypotheses guided the study. The hypotheses were tested at a 0.05 level of significance. A quasi-experimental design was adopted for the study. The study sample consisted of 118 NTC2 students, who were 95 males and 23 females. A purposive sampling technique was used to select two schools from the Gombe and Yamaltu Deba Educational zones. Two intact classes tagged Kolb's and Gardner were used. The instruments used for data collection were 50 objective questions and a psychomotor test question developed by the researcher which was administered as a pre-test, and post-test to the two groups. The Pearson correlation coefficient formula was used to establish the reliability of the instrument which yielded a 0.81 correlation coefficient. The research questions were answered using mean scores whereas the hypotheses were tested using ANCOVA. The mean scores and ANCOVA results were calculated using SPSS version 23. The result showed that students taught with Gardner significantly impacted the academic performance of the students. The result for education implies that Gardner's multiple intelligence learning model is an effective mode of teaching capable of improving students' performance in Basic Electricity. Given the findings, it was recommended among others that the Gardner multiple intelligence learning model should be adopted in technical colleges, secondary schools and vocational schools for instruction in Basic Electricity to improve the academic performance of the students.

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INTRODUCTION

Technical education is the education meant for skill development and preparation of an Individual for paid or self-employment. It is an aspect of Technical and Vocational Education (TVET) whose purpose is to prepare a person(s) for employment in any occupation or groups of occupation (Uwaifor, 2019). According to International Labour Organization (ILO, 2015), all

Technical and Vocational training programmes are aimed towards acquisition of relevant knowledge, practical skills and attitudes for employment in a particular trade or occupational area.

Basic Electricity is one of the fundamental subjects offered in technical colleges with Electrical installation and maintenance work, Radio, Television (RTV) and electronic work

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(Amadike, 2015). This is because the National Business and Technical Education Board (NABTEB) syllabus outlined Basic Electricity as one among the trade-related subjects offered at the Technical College level (NABTEB, 2011). It is designed to teach and impart knowledge and understanding of electrical and electronic principles, maintenance and repair of domestic and industrial equipment and safe working procedures to students. Knowledge and understanding of the basic concepts and principles of Basic Electricity in this context connotes; ability to use tools and equipment in the maintenance and repair of electrical/electronic devices; understanding of the principle of operation and the application of simple electrical/electronic devices; understanding of safe working procedures and safety precautions in domestic and industrial installations.

The main teaching/learning methods employed by teachers in training Basic Electricity craftsmen in Technical Colleges are conventional teaching methods eg lecture/demonstration methods. Ukoha and Eneogwe (2016) maintained that lecture and demonstration methods are teaching methods based on the traditional viewpoint that the teacher is an ocean of knowledge. Thus, it is his responsibility to disseminate knowledge to passive listeners or learners. In other words, lecture and demonstration teaching methods are executed by the activities of the teacher while the learners only observe and listen. Furthermore, it is observed that most of the Basic Electricity graduates from Technical Colleges often find it difficult to apply their knowledge and skills to rectify Basic Electrical problems under varying technology situations in the industry.

Kolb's experiential learning model, according to Morrison (2019), maintains that learning is cyclical, involving four principal stages: Concrete Experience (CE), Reflective Observation (RO), Abstract Conceptualization (AC), and Active experimentation (AE). The Concrete Experience (CE) and Abstract Conceptualization (AC) explain how individuals perceive knowledge while Active Experimentation (AE) and Reflective Observation (RO) explain how

individuals process knowledge. Kolb postulated four types of learning styles: diverging, assimilating, converging and accommodating.

Explaining the four stages (modes) of learning and their characteristics, Kolb and Kolb (2015) stated that Concrete Experience (feeling) occurs when the learner is actively experiencing an activity (e.g. science lab, field class). This mode is a characteristic of learners who desire plenty of opportunities for direct human interpersonal interactions. These individuals also prefer to feel and experience rather than think. Reflective Observation (watching) occurs when the learner is consciously reflecting on that experience. This mode focuses on the ability to understand the meaning of ideas. Individuals who exhibit this mode value objective judgment. They prefer abstract understanding over practical applications, and they prefer to reflect and observe rather than act on a situation. Abstract Conceptualization (thinking) happens when the learner is being presented with or trying to conceptualize a theory or model of what is to be observed. Individuals oriented toward abstract conceptualization typically attend to tasks that involve logical investigation of ideas and concepts. People in this mode also value rigorous idea analysis. Active experimentation (doing) happens when the learner is trying to plan how to test a model, or theory or plan for a forthcoming experience. Individuals in this learning mode prefer to be involved in peer interactions that allow them to play an integral role in the decisions made in these interactions. This mode emphasizes practical applications or solutions rather than reflective understanding of a problem. People who use this mode focus on doing rather than observing.

Experiential learning model, therefore, requires activities to be organized in accordance with the steps of learning such as concrete experience, reflective observation, abstract conceptualization and active experience. Experiential learning emphasizes doing the task in order to learn it, which is a very context-based approach to the learning experience (Hansman, 2011). This learning model is today acknowledged by academics, teachers, managers and trainers

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as truly fundamental concepts towards understanding and explaining human learning behaviour, and towards helping others to learn (Zagorac, Ivanis, Nuhbegovic, & Steiner, 2018). According to Greenway (2004), experiential learning model finds its application in a wide range of disciplines, especially in education and computer science to improve students' learning abilities. Kolb's experiential learning model, just like Gardner's multiple intelligence model, aimed at improving learning.

Gardner's multiple intelligence learning models presupposes that all humans possess a number of distinct intelligences which manifest in different ways to learn and demonstrate understanding (Christison, & Kennedy, 2019). Gardner recognized eight intelligence patterns, which according to him, described different ways individuals' natural talents are manifested and how they learn best. The eight multiple intelligence patterns are: Verbal-linguistic intelligence (word smart), logical - Mathematical intelligence (number and reasoning smart), visual-spatial intelligence (picture smart), musical intelligence (music smart), bodily- kinesthetic intelligence (body smart), interpersonal intelligence (people smart), intrapersonal intelligence (self-smart) and naturalistic intelligence (nature smart).

Gardner described the eight intelligence patterns as follows: Verbal linguistic Intelligence is the ability to think in words and to use spoken and written words or languages to express ideas, and appreciate meaning and accomplish other goals. Logical-mathematical Intelligence is the ability to think conceptually and abstractly, and also involves the capacity to use numbers to calculate, quantify, and analyze problems logically as well as use inductive and deductive reasoning. Visual-Spatial Intelligence is the capacity to think in images and pictures, to visualize accurately and abstractly. Musical Intelligence is the ability to produce and appreciate rhythm, pitch and timbre. Bodily-Kinesthetic Intelligence is the ability to control one's body movements and to handle objects skillfully as well as to solve problems or fashion out products. Interpersonal Intelligence is the ability to work and interact with others and understand their moods, feelings and

temperaments. Intrapersonal Intelligence refers to the ability to understand oneself, recognize one's feelings, strengths and weaknesses and to use the information to plan and direct one's life. Naturalist Intelligence is the ability to recognize and categorize plants, animals and other objects in nature.

Achievement connotes final accomplishment of something noteworthy after some effort. However, achievement in this study relates to accomplishment of learning by a student in either cognitive or psychomotor domains of learning. The word, cognitive relates to knowledge and the development of mental and intellectual abilities. It involves thinking, reasoning and remembering. Cognitive achievement by a student therefore, connotes performance in a school subject as symbolized by a score or mark in an achievement test. Psychomotor involves manipulative or practical skills. Psychomotor achievement, according to McGraw (2013), is the degree of skill demonstrated by an operator in the completion of a task. Therefore, psychomotor achievement in this study refers to achievement attained by a student in psychomotor tasks in a school subject as represented by a score or marks obtained in a performance test. Okoro (2016) explained that performance test involves the use of tools and equipment in a direct assessment of the number of practical skills possessed by the student. Student's cognitive and psychomotor achievement is influenced by several factors among which are the instructional method and the learner's ability (Atherton, 2013).

Purpose of the Study

The purpose of this study is to determine the effects of Kolb's experiential learning model and Gardner's multiple intelligence learning model on students' achievement in Basic Electricity in Technical Colleges. Specifically, the study is designed to determine the effect of:

1. Kolb's experiential learning model (KELM) and Gardner's multiple intelligence learning model (GMIM) on students' cognitive achievement in Basic Electricity.

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2. Gender on students' cognitive achievement in Basic Electricity when taught using KELM and GMIM
3. KELM and GMIM on students' psychomotor achievement in Basic Electricity.
4. Gender on students' psychomotor achievement in Basic Electricity when taught using KELM and GMIM

4. There is no significant difference between the effect of gender on Basic Electricity psychomotor achievement of students when taught using KELM and GMIM.

Research Questions

The following research questions were posed to guide the study:

1. What is the effect of Kolb's experiential learning model (KELM) and Gardner's multiple intelligence learning model (GMIM) on students' cognitive achievement in Basic Electricity?
2. What is the effect of gender on cognitive achievement of Students when taught Basic Electricity using KELM and GMIM?
3. What is the effect of KELM and GMIM on students' psychomotor achievement in Basic Electricity?
4. What is the effect of gender on students' psychomotor achievement in Basic Electricity when taught using KELM and GMIM?

Hypotheses

The following null hypotheses were tested at .05 level of significance:

1. There is no significant difference between the effect of Kolb's experiential learning model (KELM) and Gardner's multiple intelligence learning model (GMIM) on students' cognitive achievement in Basic Electricity.
2. There is no significant difference between the effect of gender on Basic Electricity cognitive achievement of students when taught using KELM and GMIM.
3. There is no significant difference between the effect of KELM and GMIM on students' psychomotor achievement in Basic Electricity.

METHODOLOGY

A quasi-experimental design was adopted in this study. Specifically, the pretest, posttest, non-equivalent comparison group designs were adopted for the study. According to Gall, Gall and Borg (2017) quasi-experimental design can be used when it is not possible for the researcher to randomly sample the subjects and assign them to treatment groups without disrupting the academic programme of the schools involved in the study. Therefore, this design was considered suitable to conduct this study because intact classes (non-randomized groups) were assigned to the two different groups in order to determine the comparative effect of Kolb's experiential learning model and Gardner's multiple intelligence learning model on students' cognitive and psychomotor achievement in Basic Electricity.

The pre-test was first conducted before the commencement of the treatment. The pre-test exercise provided baseline data that was used to compare students in both groups. The quasi-experimental process was conducted following the guide as symbolized below:

It is symbolically represented thus:

Group A: O1 X1 O2,

Group B: O1 X2 O2

Where;

O1 represent pre-tests

O2 represent post-tests

X1 -Kolb's experiential learning model treatment

X2 -Gardner's multiple intelligence learning model treatment

--- --- indicates that both treatment groups were non-randomized



RESULTS

Research Question 1: What is the effect of Kolb's experiential learning model (KELM) and Gardner's multiple intelligence learning model (GMIM) on students' cognitive achievement in Basic Electricity?

The mean of pre-test scores and post-test scores of the two groups are presented in table 1

Table 1: Mean and Standard Deviation of Pretest and Posttest Scores of Kolb's Experiential Learning Model Group and Gardner's Multiple Intelligence Learning Model Group in the Cognitive Achievement Test

Group	N	Pretest scores		Posttest scores		Mean Gain
		\bar{X}	SD	\bar{X}	SD	\bar{X}
KELM	58	22.16	6.54	47.63	10.11	25.47
GMIM	60	25.08	6.17	59.67	9.11	34.59

The data presented in Table 1 shows that Kolb's experiential learning model group had a Mean score of 22.16 and Standard Deviation of 6.54 in the pre-test and a Mean score of 47.63 and Standard Deviation of 10.11 in the post-test making a pre-test, post-test Mean gain of 25.47. Gardner's multiple intelligence learning model group had a Mean score of 25.08 and Standard Deviation of 6.17 in the pre-test and a post-test Mean of 59.67 and Standard Deviation of 9.11, with a pre-test, post-test Mean gain of 34.59. With these results, both Gardner's multiple intelligence learning models and Kolb's experiential learning model are effective in improving students' cognitive achievement in Basic Electricity, but the

effect of Gardner's multiple intelligence learning model in improving students' cognitive achievement in Basic Electricity is higher than the effect of Kolb's experiential learning model.

Research Question 2: What is the effect of gender on cognitive achievement test of students when taught Basic Electricity using KELM and GMIM?

The mean of pre-test scores and post-test scores of male and female students of the two groups are presented in table 2.

Table 2: Mean and Standard Deviation of Pretest and Posttest Gender (male and female) Cognitive Achievement Scores of Students Taught Using Kolb's Experiential Learning Model (KELM) and Gardner's Multiple Intelligence Learning Model (GMIM)

Group	Gender	N	Pretest scores		Posttest scores		Mean Gain
			\bar{X}	SD	\bar{X}	SD	\bar{X}
KELM	M	42	21.67	5.91	47.25	10.02	25.58
	F	16	22.35	6.85	45.00	10.23	22.65
GMIM	M	43	26.40	6.72	53.30	8.08	26.90
	F	17	24.59	6.01	49.96	9.00	25.37

Table 2 shows that male students taught Basic Electricity with Kolb's experiential learning model had a Mean score of 21.67 and Standard Deviation of 5.91 in the pre- test and a Mean score of 47.25 and Standard Deviation of 10.02 in the post-test making a pre-test, post-test mean gain for the male students of 25.58. Female students

taught Basic Electricity with Kolb's experiential learning model had a mean score of 22.35 and Standard Deviation of 6.85 in the pre-test and a post-test Mean of 45.00 and standard deviation of 10.23, with a pre-test, post-test mean gain of 22.65. Also, male students taught with Gardner's multiple intelligence learning model had a mean

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score of 26.40 and Standard Deviation of 6.72 in the pre-test and a Mean score of 53.30 and Standard Deviation of 8.08 in the post-test making a pre-test, post-test Mean gain for the male students 26.90. At the same time, female students taught Basic Electricity with Gardner's multiple intelligences learning model had a mean score of 24.59 and Standard Deviation of 6.01 in the pre-test and a Mean score of 49.96 and Standard Deviation of 9.00 in the post-test making a pre-test, post-test Mean gain for the female students 25.37. With these results male students taught Basic Electricity with Kolb's experiential learning model and Gardner's multiple intelligence learning model had higher posttest mean scores than

female students in the cognitive achievement test. Therefore, there is an effect attributed to gender on students' cognitive achievement in Basic Electricity.

Research Question 3: What is the effect of Kolb's experiential learning model (KELM) and Gardner's multiple intelligence learning model (GMIM) on students' psychomotor achievement in Basic Electricity?

The mean of pre-test scores and post-test scores of the two groups are presented in Table 3.

Table 3: Mean and Standard Deviation of Pretest and Posttest Scores of Kolb's Experiential Learning Model, Gardner's Multiple Intelligences Learning Model Groups in the Psychomotor Achievement Test

Group	N	Pretest score		Posttest score		Mean Gain
		\bar{X}	SD	\bar{X}	SD	\bar{X}
KELM	58	23.12	5.25	51.51	23.03	28.39
GMIM	60	24.92	6.26	57.05	17.84	32.13

Table 3 shows that Kolb's experiential learning model group had a Mean score of 23.12 and Standard Deviation of 5.25 in the pre-test and a Mean score of 51.51 and Standard Deviation of 23.03 in the post-test making a pre-test, post-test Mean gain of 28.39. Gardner's multiple intelligence learning model group had a Mean score 24.92 and Standard Deviation of 6.26 in the pre-test and a post-test Mean of 57.05 and Standard Deviation of 17.84, with a pre-test, post-test Mean gain of 32.13. With these results, both Kolb's experiential learning model and Gardner's multiple intelligence learning model are effective in improving students' psychomotor achievement in Basic Electricity but the effect of Gardner's

multiple intelligence learning model in improving students' psychomotor achievement in Basic Electricity is higher than the effect of Kolb's experiential learning model.

Research Question 4: What is the effect of gender on student's psychomotor achievement in Basic Electricity when taught using Kolb's experiential learning model (KELM) and Gardner's multiple intelligences learning model (GMIM)?

The mean of pre-test scores and post-test scores of male and female students of the two groups are presented in table 4.

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Table 4: Mean and Standard Deviation of Pretest and Posttest Gender (male and female) Psychomotor Achievement Scores of students taught using Kolb’s Experiential Learning Model (KELM) and Gardner’s Multiple Intelligences Learning Model (GMIM)

Group	Gender	N	Pretest score		Posttest score		Mean Gain
			\bar{X}	SD	\bar{X}	SD	\bar{X}
KELM	M	42	24.52	5.13	53.58	23.82	29.06
	F	16	20.08	5.65	32.75	21.61	12.6
GMIM	M	43	26.33	6.27	58.83	14.59	32.50
	F	17	19.50	6.29	32.70	25.48	13.20

The data in table 4 shows that male students taught Basic Electricity with Kolb’s experiential learning model had a Mean score of 24.52 and Standard Deviation of 5.13 in the pre-test and a Mean score of 53.58 and Standard Deviation of 23.82 in the post-test making a pre-test, post-test mean gain in the male students of 29.06. Female students taught Basic Electricity with Kolb’s experiential learning model had a mean score of 20.08 and Standard Deviation of 5.65 in the pre-test and a post-test Mean of 32.75 and standard deviation of 21.61, with a pre-test, post-test mean gain of 12.67. Also, male students taught with Gardner’s multiple intelligence learning model had a Mean score of 26.33 and Standard Deviation of 6.27 in the pre-test and a Mean score of 58.83 and Standard Deviation of 14.59 in the post-test making a pre-test, post-test Mean gain in the male students of 32.50.

At the same time, female students taught Basic Electricity with Gardner’s multiple intelligence learning model had a mean score of 19.50 and Standard Deviation of 6.29 in the pre-test and a Mean score of 32.70 and Standard Deviation of 25.48 in the post-test making a pre-test, post-test Mean gain in the female students of

13.20. With these results male students taught Basic Electricity with Kolb’s experiential learning model and Gardner’s multiple intelligence learning model had higher posttest mean scores than female students in the psychomotor achievement test. Therefore, there is an effect attributed to gender on students’ psychomotor achievement in Basic Electricity.

Test of Hypotheses
Hypotheses 1 and 2

1. There is no significant difference between the effect of Kolb’s experiential learning model (KELM) and Gardner’s multiple intelligences learning model (GMIM) on student’s cognitive achievement in Basic Electricity
2. There is no significant difference between the effects of gender on Basic Electricity cognitive achievement of students when taught using KELM and GMIM.

Summary of Analysis of Covariance (ANCOVA) test for hypotheses 1 & 2 are presented in the table below.

Table 5: Summary of Analysis of Covariance (ANCOVA) for Test of Significance of Effect of Treatments (KELM and GMIM), their Gender and Interaction Effect with Respect to their Mean Scores on Basic Electricity Cognitive Achievement Test

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Covariate	357.717 ^a	5	71.543	1.734	.133
Intercept	289850.574	1	289850.574	3.886E3	.000
Method	45116.214	2	22558.107	302.425	.000
Gender	51.460	1	51.460	.308	.310
Method*Gender	425.872	2	212.936	.045	.062
Error	8354.161	112	74.591		

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Total	415636.000	118
Corrected Total	60004.780	117

***Significant at sig of F < .05**

The data presented in the Table above shows F-calculated values for three effects: treatment, gender and interaction effect of treatments and gender on students' cognitive achievement in Basic Electricity. The F-calculated value for treatment is 302.425 with a significance of F at .000. Since the F-calculated value is higher than the significant F value, the null-hypothesis of no significant mean difference between the effect of Kolb's experiential learning model and Gardner's multiple intelligence learning model on students' cognitive achievement in Basic Electricity is, therefore, rejected at .05 level of significance. The result implies that the mean difference between the effects of Gardner's multiple intelligence learning model and Kolb's experiential learning model was significant.

The F-calculated value for gender as shown in Table 7 is .308 with a significance of F at .310. Since the F-calculated value is less than the significant F value the null hypothesis of no significant mean difference between the effect of gender (male and female) on students' cognitive achievement in Basic Electricity is accepted at .05 level of significance. This means that there was no significant mean difference between the effects of

gender on students' cognitive achievement in Basic Electricity. The interaction of treatments and gender has F-calculated value of .045 with significance of F at .062. Since F-calculated is less than the significant F value, the null hypothesis of no significant interaction effect of treatments on gender is accepted. This means that there was no significant interaction effect of treatments given to students taught with Kolb's experiential learning model and Gardner's multiple intelligence learning model and their gender with respect to their mean scores on Basic Electricity cognitive achievement test.

Hypotheses 3 and 4

1. There is no significant difference between the effect of KELM and GMIM on students' psychomotor achievement in Basic Electricity.
2. There is no significant difference between the effects of gender on Basic Electricity psychomotor achievement of students when taught using KELM and GMIM.

Summary of Analysis of Covariance (ANCOVA) test for hypotheses 3 & 4 are presented in the table below.

Table 6: Summary of Analysis of Covariance (ANCOVA) for Test of Significance of Effect of Treatments (KELM, GMIM), their Gender and Interaction Effect with Respect to their Mean Scores on Basic Electricity Psychomotor Achievement Test

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Covariate	401.082 ^a	5	80.216	1.895	.101
Intercept	243694.797	1	243694.797	763.390	.000
Method	24204.582	2	12102.291	13.911	19.001
Gender	292.357	1	292.357	.041	.196
Method*Gender	1.468	2	.734	.002	.398
Error	35753.440	112	319.227		
Total	384944.000	118			
Corrected Total	65872.000	117			

***Significant at sig of F < .05**

Table 8 shows F-calculated values for effect of treatment (KELM and GMIM), gender and

interaction of treatment and gender on students' psychomotor achievement in Basic Electricity. The

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F-calculated value for treatment is 13.911 with a significance of F at 19.001. Since the F-calculated value is less than the significant F value, the null-hypothesis of no significant difference between the effect of treatments (Kolb's experiential learning model and Gardner's multiple intelligence learning model) on students' psychomotor achievement in Basic Electricity is, therefore, accepted at .05 level of significance. This means that there is no significant difference between the effect of Kolb's experiential learning model and Gardner's multiple intelligence learning model on students' psychomotor achievement in Basic Electricity.

The F-calculated value for gender is .041 with a significance of F at .196. Since the F-calculated value is higher than the Significant F-value, the null hypothesis is, therefore, rejected at .05 level of significance. This result means that there is significant effect of gender in favour of males on students' psychomotor achievement in Basic Electricity. The interaction effect of treatment and gender has F-calculated value of .002 with significance of F of .998. Since the F-value is higher than the F-calculated value, the null hypothesis of no significant interaction effect of treatments given to students taught with Kolb's experiential learning model and Gardner's multiple intelligence learning model and their gender with respect to their mean scores on Basic Electricity psychomotor achievement test is accepted at .05 level of significance. This, therefore, means that there is no significant interaction effect of treatments given to students taught with Kolb's experiential learning model and Gardner's multiple intelligences learning model and their gender with respect to their mean scores in Basic Electricity psychomotor achievement test.

DISCUSSION OF FINDINGS

The purpose of this study was to determine the comparative effect of Kolb's experiential learning model and Gardner's multiple intelligence learning model on student's cognitive and psychomotor achievement as well as their effect on gender in Basic Electricity. The findings that have emerged from the study are hereby discussed. The data presented in Table 1

provided answer to research question one. It was revealed that Kolb's experiential learning model and Gardner's multiple intelligence learning model are effective in improving students' cognitive achievement in Basic Electricity, but the effect of Gardner's multiple intelligence learning model in improving students' cognitive achievement in Basic Electricity is higher than Kolb's experiential learning model. Analysis of covariance was used to test the first hypothesis (Table 5) at the calculated F-value (302.425), Significance of F (.000) and confidence level of .05. The result shows that the difference between the effect of Gardner's multiple intelligence learning model and Kolb's experiential learning model in Basic Electricity cognitive achievement was statistically significant. This means that Gardner's multiple intelligence learning model is more effective than Kolb's experiential learning model in improving students' cognitive achievement in Basic Electricity.

The above findings are consistent with the findings of Campbell and Campbell (2019), Geimer, Getz, Pochet and Pullam (2015), Udoudo, (2017) and Koksai (2014) who, in their separate studies in other subjects found that the multiple intelligence-based instructions had significant effect upon the students' cognitive achievement than other instructional formats. The findings of this study also support some literature evidence such as Calson (2019) who stated that when learners are exposed to new ideas that are presented through different intelligences, they will have a better chance to learn, remember the information and apply their learning experiences to other situations which can lead to higher achievement. Therefore, the result of this study with regard to students' cognitive achievement is attributed to the treatment given to students in Gardner's multiple intelligence learning model group.

The findings could be explained by the fact that teacher's adoption of various instructional techniques (such as active learning, collaborative learning, and self-assessment) in the multiple intelligence classroom appealed to the students' different intelligences and engaged the students in the learning process which increased their

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motivation to learn and strengthened their memory. The results could as well be explained thus: giving students opportunity to participate actively in the class through free interaction with the teacher and their peers and allowing them to learn in groups and assess their performance themselves engaged the students in the learning process; and consequently, improved their verbal-linguistic, logical-mathematical, interpersonal and intrapersonal intelligences. This, in turn, improved their learning and thinking abilities which led to deeper understanding of difficult technology concepts and principles associated with Basic Electricity. It implies that students in Gardner's multiple intelligence learning model group remembered and applied more of their learning in Basic Electricity than the other group of students that were taught through Kolb's experiential learning model.

The data presented in Table 2 provided answer to research question two. Findings revealed that gender has influence on students' cognitive achievement in Basic Electricity in favour of male students. However, analysis of covariance was used to test the second hypothesis (Table 5), at the calculated F-value of (.308), Significance of F (.310) and confidence level of .05. The result revealed that the null hypothesis of no significant effect of gender on students' cognitive achievement in Basic Electricity was accepted since the F-calculated value is less than the significant F-value. This means that the difference between the mean scores of male and female students in Basic Electricity cognitive achievement test was not significant. The result of this study on gender achievement in Basic Electricity, which revealed that there is no significant difference between the mean scores of male and female students in Basic Electricity cognitive achievement test, is at variance with the findings of Igboko (2017), and Owoso (2014) who reported a significant difference in the cognitive achievement test mean scores of male and female students taught by the constructivist method in favour of male students. Also, the finding of this study in respect of male and female students' achievement in Basic Electricity does not support the writings of Okeke, (2015) who concluded that girls and

women perform far below the level of boys and men in science and technology and the allied fields.

Research has shown that, on general measures of intelligence, the sexes perform about equally the same. Also, Weiman (2014) emphasized that there are more similarities than differences between the cognitive abilities of males and females. Similarly, Jovanovic (2017) maintained that there are no genetically based differences between male and female students in their ability to learn. Therefore, it is unlikely that gender differences in academic achievement is explained by biological differences, if biology were the reason, girls would not have improved significantly in certain subjects (such as mathematics and science) where boys used to outperform girls traditionally, in the past two decades (Gallagher, 2015). However, findings of the present study with regards to gender achievement in Basic Electricity confirm the findings of Ogwo (2016), Umunadi (2019), and Oviawe (2020) who, in their separate studies in other vocational subjects, found out that male and female students have no significant difference in cognitive achievement.

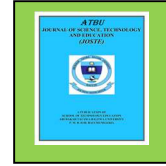
The results of the present study, which have revealed that male and female students have no significant difference in cognitive achievement in Basic Electricity, also tend to support some literature evidence questioning the validity of gender differences in cognitive achievement since this depends, among other things, on students' interest, mental and intellectual ability and not gender. One factor which is said to always give the male students advantage over their female counterparts in their achievement in technical/vocational education subjects is the male physical superiority, since these subjects require more muscle power. However, the Basic Electricity cognitive achievements test in this study only task students' cognitive abilities with little or no physical activity. Therefore, there is no obvious reason for gender to account for differences in Basic Electricity cognitive achievement since both male and female subjects of this study think and show no physical or psychological differences in their cognitive abilities

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in Basic Electricity. More evidence is still required for any conclusion on gender differences in Basic Electricity achievement; otherwise any observed difference may be attributed to chance.

In addition, Analysis of covariance was used to test the third hypothesis (Table 7), at the calculated F-value (.045), significance of F (.062) and confidence interval of 0.05 there was no significant interaction effect of treatments given to students taught with Kolb's experiential learning model and Gardner's multiple intelligence learning model and their gender with respect to their mean scores on Basic Electricity cognitive achievement test. The result therefore, implies that the null hypothesis was accepted since the F-calculated value is less than the significant F-value. This result implies that the effectiveness of Kolb's experiential learning model and Gardner's multiple intelligence learning model on students' achievement in Basic Electricity does not depend on the level of gender. In other words, none of the teaching methods discriminated between the sexes. The result, therefore, means that students' gender (male or female) will not be a barrier to the learning of Basic Electricity subject in technical colleges. Hence, Basic Electricity teachers are encouraged to accept the fact that gender issue (male or female) should not be seen as adversely influencing academic learning in Basic Electricity classroom.

The data presented in Table 3 provided answer to research question three. It was revealed that Kolb's experiential learning model and Gardner's multiple intelligence learning model are effective in improving students' psychomotor achievement in Basic Electricity, but the effect of Gardner's multiple intelligence learning model in improving students' psychomotor achievement in Basic Electricity is higher than Kolb's experiential learning model. The result indicates that Gardner's multiple intelligence learning model is more effective in improving students' psychomotor achievement in Basic Electricity. However, analysis of covariance was used to test the fourth hypothesis (Table 6) at the calculated F- value (37.911), significance of F (.000) and confidence level of .05. It was revealed that the mean difference between the effect of Kolb's experiential

learning model and Gardner's multiple intelligence learning model on students' psychomotor achievement in Basic Electricity was not statistically significant. Hence, the null hypothesis of no significant mean difference was accepted. The result means that there was no significant mean difference between the effect of Kolb's experiential learning model and Gardner's multiple intelligence learning model on students' psychomotor achievement in Basic Electricity.

The result of this study regarding students' psychomotor achievement could be explained by the fact that teachers' adoption of authentic instructional technique in Gardner's multiple intelligence learning model group, where visual aids (e.g. Basic Electricity wiring circuits/diagrams) were not only used to address students' visual-spatial intelligence but also used in tracing and diagnoses of electrical components/faults, engaged the students in higher order thinking tasks such as analysis, synthesis and evaluation. This improved the students' problem-solving abilities in Basic Electricity. Patton (2017) noted that authentic instruction fosters higher order thinking skills in students. He explained that higher order thinking requires students to manipulate ideas in ways that transform their meaning and applications. The manipulation of information and ideas allows students to discover solution to problems (Newman & Wehlage, 2018). It implies that students in this group could have traced and rectified Basic Electrical problems more effectively. In addition, practical activities in Gardner's multiple intelligence learning model group, aimed at addressing and developing students' bodily-kinesthetic intelligence, consequently, improved students' technological understanding by applying theoretical principles to real life situations. This, therefore, also enhanced their manipulative skills and mastery of problem-solving strategies which led to their considerable psychomotor achievement.

Students in Kolb's experiential learning model group could have benefited so much by going through the experiential learning cycle. Experiential learning emphasizes doing the task in order to learn it, which is a very context-based

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approach to the learning experience (Hansman 2017). The experiential learning cycle, particularly active experimental stage, afforded the students in this group opportunity to experiment their ideas in solving some Basic Electricity problems with the use of tools and materials of the trade. The concrete experience stage gave the students more opportunities to gain experience by carrying out problem solving tasks in the tracing and rectification of Basic Electrical problems. Sprau & Keig (2021) stated that the experiential learning cycle, if followed sequentially, can guide students to acquire higher-order thinking skills to deal with subsequent learning experiences. Therefore, the results of the present study which shows that both Gardner's multiple intelligence learning model and Kolb's experiential learning model are effective in facilitating students' psychomotor achievement in Basic Electricity is attributed to the fact that students in both Gardner and Kolb's learning models developed strong higher order thinking skills and problem-solving strategies which assisted them to effectively solve Basic Electrical problems.

The data presented in Table 4 provided answer to research question four. Findings revealed that gender has effect on students' psychomotor achievement in Basic Electricity in favour of male students. Analysis of covariance was used to test the fifth hypothesis (Table 8) at the calculated F-value (.041), Significance of F (.196) and confidence level of .05. The result revealed that the null hypothesis was rejected. This means that the difference between the mean scores of male and female subjects of this study in Basic Electricity psychomotor achievement test was statistically significant.

The finding that there is significant difference between the mean scores of male and female students' psychomotor achievement in Basic Electricity in favour of male students confirms the findings of Owoso (2014) who found out a significant difference in motor vehicle mechanics psychomotor achievement test mean scores in favour of male subjects and Ayang, Edu and Idaka (2017) who found male students to portray higher psychomotor abilities in Basic Electricity than their female counterparts. Ayang,

Edu & Idaka attributed their findings to the fact that male students possessed superior positive self-concept and attitude than their female counterparts towards technical subjects than any other factor. Fowler (2015) maintains that gender differences in psychomotor tasks exist and that most women hold a feeling of physical incapacity when it comes to psychomotor tasks. However, Rateliff, (2016) explained that gross motor skills develop faster in men than in women, which give men an advantage in physical skills. Rateliff noted that boys, even at infancy, prefer activity and move earlier than girls and that boys' preference for movement may explain why males prefer to learn kinesthetically and with hands-on activities while girls prefer visual and auditory instruction. Males tend to perform faster than females in response time tasks that require more physical effort (Roalf, Lowery & Turetsky, 2016).

The result of this study with regard to gender on students' psychomotor achievement also tends to support the report of Spierer, Petersen, Duffy, Corcoran & Rawls-Martin (2017) that boys tend to have more muscle fiber, which allows them to perform physical actions more quickly than girls. Therefore, male students' higher achievement over their female counterpart in Basic Electricity psychomotor achievement in this study could be attributed to the fact that males possess greater confidence in psychomotor abilities which gave them advantage over female students in Basic Electricity psychomotor achievement test.

In addition, Analysis of covariance was used to test the sixth hypotheses (Table 6) at the calculated F-value (.002), significance of F (.398) and confidence interval of .05. The result indicated that the null hypothesis of no significant interaction effect of treatments given to students taught with Kolb's experiential learning model and Gardner's multiple intelligence learning model and their gender with respect to their mean scores in Basic Electricity psychomotor achievement test was accepted at the confidence interval of .05. This means that there was no significant interaction effect of treatments given to students taught with Kolb's experiential learning model and Gardner's multiple intelligence learning model and

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their gender with respect to their mean scores on Basic Electricity psychomotor achievement test. This result implies that the effectiveness of Kolb's experiential learning model and Gardner's multiple intelligence learning model on students' psychomotor achievement in Basic Electricity does not depend on the level of gender.

SUMMARY OF THE FINDINGS

Based on the data collected and analyzed in this study the following are the findings of the study:

1. Gardner's multiple intelligences learning model is more effective than Kolb's experiential learning model in enhancing students' achievement in Basic Electricity. The effect was found to be significant.
2. Gardner's multiple intelligences learning model is more effective than Kolb's experiential learning model in improving students' psychomotor achievement in Basic Electricity. The effect was found to be significant.
3. Gardner's multiple intelligences learning model is more effective than Kolb's experiential learning model in stimulating students' interest in Basic Electricity. The effect was found to be non-significant.
4. It was found out that there was an effect of Gender on students' cognitive achievement in Basic Electricity favouring male students. But the effect was not found to be significant.
5. The study revealed that there was an effect of Gender on students' psychomotor achievement in Basic Electricity favouring male students. The effect was found to be significant.

CONCLUSION

Based on the results of this study, which shows that Gardner's multiple intelligence learning model is more effective in improving students' achievement in Basic Electricity than Kolb's experiential learning model, there was an effect attributable to gender on students' achievement in Basic Electricity. Also, the study found out no significant interaction effect of treatments given to students taught using Kolb's experiential learning

model and Gardner's multiple intelligence learning model and gender on achievement of Technical College students in Basic Electricity. This means that the effectiveness of Gardner's multiple intelligence learning model on students' achievement in Basic Electricity does not depend on the levels of gender. Hence, irrespective of nature of gender, learners will record improved performance in achievement in Basic Electricity when Gardner's multiple intelligence learning model is employed to teach Basic Electricity in Technical Colleges. These results, therefore, show that Gardner's multiple intelligence learning model is a viable teaching method for teaching/learning Basic Electricity in Technical Colleges.

Instruction based on Gardner's learning model is a contemporary teaching approach which maximizes students' learning potentials by minimizing the problems caused by the students' individual differences and creating a learning environment appropriate for each student's intelligences. The learning model will give teachers the opportunity to engage the students in the learning process, which will increase their self-esteem and enthusiasm and their willingness to take ownership and responsibility for their learning. Thus, if Gardner's multiple intelligence learning model is adopted to teach Basic Electricity in Technical Colleges, the Basic Electricity craftsmen will, undoubtedly, be equipped with knowledge and skills that will help them easily adapt and apply their skills in Basic Electricity as well as perform and cope more effectively with complexities in the vast changing Technological world of work.

RECOMMENDATIONS

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

1. Workshops, seminars and conferences should be organized by State Science and Technical Schools Board to enlighten and train Basic Electricity teachers on the application of Gardner's multiple intelligence learning model for improving students' achievement in studying Basic Electricity.

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- National Board for Technical Education (NBTE) should consider the review of curriculum for Basic Electricity with a view to incorporating activities that reflect students' multiple intelligences to enable students learn more effectively.
- Basic Electricity teachers in technical colleges should adopt Gardner's multiple intelligence learning model in their classroom teaching. This will help the teachers equip Basic Electricity craftsmen with the knowledge and skills needed to easily cope and perform more effectively in the world of work.
- State Science and Technical Schools Board should equip workshops in technical colleges with relevant modern equipment, tools and machines. This will help improve students acquisition and mastery of psychomotor skills..

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