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# Relative Effectiveness of Constructivism and Meta-Learning Teaching Methods on Male and Female Students' Academic Achievement and Retention in Basic Electricity in Technical Colleges

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**Abstract**
The study was conducted to determine the relative effectiveness of constructivism and meta-learning teaching methods on male and female students' academic achievement and retention in basic electricity. Technical Colleges in Anambra state was used for the study. Four research questions guided the study and four null hypotheses were tested at 0.05 level of significance. A quasi-experimental research design of non-equivalent group was adopted. The population of the study was 560 national technical college (NTC) year II students from 12 technical colleges in the area. Purposive sampling technique was used to select 108 students (79 males and 29 females) from four technical colleges in Anambra State. The instrument for data collection was Basic Electricity Achievement Test (BEAT). BEAT was developed by the researchers and validated by three experts in the Faculty of education, Nnamdi Azikiwe University, Awka. Kuder Richardson 20 formula was used to determine the reliability of the instrument which yielded reliability co-efficient of 0.87. Data collected for the study were analysed using mean for research questions and ANCOVA for null hypotheses at 0.05 level of significance. The result of the study revealed that constructivism teaching method was better for improving male and female technical college students' achievement in basic electricity while meta-learning teaching method was better for improving male and female technical college students' retention ability in basic electricity. And there was no significant difference in the male and female technical college students' academic achievement and retention when taught basic electricity using constructivism and meta-learning teaching methods. Based on the findings, it was recommended among others that basic electricity students should be given equal opportunity, encouragement and motivation during classroom instructions irrespective of gender. Also teachers of basic electricity should adopt the teaching method that incorporates constructivism and meta-learning teaching method in the teaching and learning of basic electricity in order to enhance knowledge mastery and retention among students since both teaching methods were effective in improving academic achievement and retention of male and female students in basic electricity.
**Keywords**: Gender. Constructivism, Meta-learning, Academic achievement, Retention, Basic Electricity, Technical colleges
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## 1.Introduction

Gender differentiations that exist in technical subjects which lead to variation in academic achievement in male and female students have been examined for sometime resulting in a substantial body of literature. The importance of examining academic achievement in relation to gender is based primarily on the socio-cultural differences between girls and boys. Some vocation and profession have been regarded as men's (engineering, agriculture, crafts etc) while others as women's (catering, nursing, typing etc.). It has also been the general belief in most part of the country that male students tends to perform better compared to female students in technologically-based subjects.

Basic Electricity is one of the engineering trades offered in technical colleges which is designed to provide the trainees with basic knowledge and practical skills in electrical electronics technology. Being the only module that cuts across the entire engineering and related technical subjects, it ought to be taught well to ensure that students acquire the necessary knowledge and skills for employment after graduation irrespective of gender.

Gender according to Singh (2010) refers to a socio-cultural construct that connotes the differentiated roles and responsibilities of men and women in a particular society. This implies that gender determine the role which one plays in relation to general political, cultural, social and economic system of the society. Gender is different from sex because sex describes the biologically determined physical distinctions between male and female which is universal (Irukwe in Ugbaja and Uzoka 2011). Okoye in Nnamani and Oyibe (2016) argue that because of various biological differences in human make-up such as those between male and female, people assume that

 

one sex may have a learning edge over the other. Intrinsically, there is practically no significant difference in the intelligence between male and female that can be traceable to gender differences. The authors further stated that, the fact that men are regarded as the dominant and superior sex does not mean they are artistically better than women. Gender differences in intellectual abilities can be as a result of gender role stereotyping. Therefore, gender differences in academic achievement cannot be assumed to be due to inherent biological differences due to gender even if they exist. In a study conducted by Abbas and Habu (2014) on effects of gender-related differences in academic achievement and retention of senior secondary school students taught geometry using problem-based approach, the findings revealed that gender has no significant effect on students' academic achievement and retention. Also, the findings of the study conducted by Eze, Ezenwafor and Obidile (2016) and Yusuf, Gambari and Olumorin (2012) showed that there is no significant difference in the academic achievement and retention of male and female students taught using problem-based teaching method and computer-supported cooperative learning strategy, respectively. In contrast, study conducted by Eze, Ezenwafor and Molokwu (2015), Ezeudu (2014), Owodunni and Ogundola (2013), Oludipe and Oludipe (2010), reported that gender has a significant effect on students academic achievement and retention.

Academic achievement refers to the successful result of interaction between a teacher and a student (Igbo and Ihejieme 2014). It is designed to measure an individual level of skill accomplishment or knowledge in a specific area. Academic achievement is appropriate in determining the efficacy of instruction and also useful in testing the retention of information and skill.

Retention, according to Hymen (2003) is the ability of someone to remember what was taught after a period of time. For the purposes of this study, retention is defined as the ability to keep the knowledge of basic electricity learnt and to be able to recall it when required. Retention helps in knowledge development and knowledge development can be guaranteed when students are actively involved in teaching and learning process. Kirschner, Sweller and Clark (2016) confirmed the statement when they said that students learn and retain more when they can develop their knowledge and meaning from their own experience. Retention in basic electricity is not acquired by mere memorization rather through students participation rooted in appropriate teaching methods. Shrun and Glinson in Eze and Okoye (2016) stated that the use of appropriate teaching method could avail students the opportunity to learn from what they know and as well grasp practical skills. Instructions in technical colleges are skill- oriented and for the instruction to be effective students' active participation must be considered. It is therefore necessary to provide students with opportunities that will promote their creative thinking and knowledge synthesis in order to develop and use higher order cognitive skills to solve real world problems by adopting the learner-centered approach to instruction such as constructivism teaching method, meta-learning teaching method, among others.

Constructivism teaching method is a learner centered approach to instruction based on constructivism learning theory that says that all learning is constructed from a base of prior knowledge. According to Cey in Akamobi (2019) constructivism teaching method is a teaching with an approach that seek opportunities for students to analyse, investigate, collaborate, share, build and generate ideas based on what they already know rather than facts, skills and processes they can parrot.

Meta-learning teaching method on the other hand is a learner-centered approach to instruction that trains the learners' consciousness on the use of meta-cognitive processes for learning (Ogwo and Oranu 2006). In a meta-learning classroom, basic electricity students can plan, execute, monitor and evaluate the learning activities. These two teaching methods emphasize active learning, providing the teacher with the instructional tools to cope with the diversities of abilities and learning preferences amongst students in the classroom. Studies carried out by Janta as cited by Fui (2011) showed that students process information more effectively when they are actively involved in the teaching and learning process. Research findings of Eze and okoye (2016) and Uwalaka and Oforma (2015) on effects of constructivism teaching method on students academic achievement and retention revealed that there is improvement in academic achievement and retention of students in constructivism group than their counterparts in conventional lecture group. In the same vein, study carried out by Eze, Ezenwafor and Molokwu (2015) on the effects of meta-learning teaching method on academic achievement of building trade students revealed that there is significant difference in the academic achievement of students taught building trade using meta-learning teaching method.

If research studies conducted on the effects of constructivism and meta-learning teaching methods on students academic achievement and retention in some subjects revealed that these two teaching methods could improve students' academic achievement and retention, it is therefore necessary to ascertain the relative effectiveness of constructivism and meta-learning teaching methods on male and female students academic achievement and retention in basic electricity in Technical Colleges

### 1.1. Statement of the Problem

Controversial reports on the effects of teaching methods on students' academic achievement and retention across gender in some science and technical subjects have been examined and had revealed that gender differences in

 

academic achievement and retention could not be as a result of inherent biological differences in gender but as a result of gender role stereotyping. However, at the moment, no study was found in the area of basic Electricity in technical colleges specifically using constructivism and meta-learning teaching methods. It is not known if these teaching methods will influence male and female students' academic achievement and retention in basic electricity differently. It therefore becomes necessary to examine the relative effectiveness of constructivism and meta-learning teaching methods on male and female students' academic achievement and retention in basic electricity in technical colleges.

### 1.2. Research Questions

1. What is the effectiveness of constructivism teaching method on academic achievement mean scores of male and female technical college students in basic electricity?
2. What is the effectiveness of meta-learning teaching method on academic achievement mean scores of male and female technical college students in basic electricity?
3. What is the effectiveness of constructivism teaching method on retention mean scores of male and female technical college students in basic electricity?
4. What is the effectiveness of meta-learning teaching method on retention mean scores of male and female technical college students in basic electricity?

### 1.3.Null Hypotheses

1. There is no significant difference between the academic achievement mean scores of male and female technical college students taught basic electricity using constructivism teaching method.
2. Significant difference does not exist between the academic achievement mean scores of male and female technical college students taught basic electricity using meta-learning teaching method.
3. There is no significant difference between the retention mean scores of male and female technical college students taught basic electricity using constructivism teaching method.
4. Significant difference does not exist between the retention mean scores of male and female technical college students taught basic electricity using meta-learning teaching method.

## 2. Method

Quasi-experimental design was adopted for the study. Specifically, the pre-test, post-test non equivalent treatment group design was adopted for the study. This design was adopted because it was not possible for the researchers to randomly sample the subject and assign them to groups without disrupting the academic programme and the time table of the technical colleges involved in the study. The study was carried out in Anambra State of the South-Eastern geopolitical zone of Nigeria. The population of the study comprised the entire 560 National Technical Certificate (NTC), year II basic electricity students in all the 12 technical colleges in Anambra State in the 2018/2019 academic year. A purposive sampling technique was used to select four schools from the 12 technical colleges in the state. A total number of 108 students (79 males and 29 females) were selected for the study. The sample was grouped into four intact classes. Two intact classes were randomly assigned experimental group 1 while the remaining two intact classes were also randomly assigned experimental group 2. The experimental group one has 44 males and 13 females while the experimental group two has 35 males and 16 females. The instrument for data collection was Basic Electricity Achievement Test (BEAT) for measuring achievement and retention of Technical College Students in Basic Electricity. The instrument consists of 40 multiple - choice questions based on the NABTEB curriculum contents for Basic Electricity for National Technical Certificates for NTC level. BEAT was designed to cover the following contents- resistors, capacitors and inductors which were taught during the study. The instrument (BEAT) was validated by three experts, two from Department of Technology and Vocational Education and one from Measurement and Evaluation Unit of the Department of Educational Foundations, all in Faculty of Education, Nnamdi Azikiwe University, Awka. The reliability of the instrument was determined by administering the instrument to a trial group of intact class of 30 NTC II Basic electricity students of government Technical College Ofagbe, Delta State. Reliability co-efficient of the score was established using Kuder-Richardson 20 formula which yielded 0.87.

Permission was obtained from the Head of Department of electricity and the principals in the four technical colleges to allow the study to be carried out in their schools. The basic electricity teachers were trained on how to conduct the experimental treatment and were given prepared lesson plans. Pre-test was administered to the two experimental groups after which the teaching commenced using the prepared lesson plans. Each lesson lasted for 40 minutes and the treatment lasted for 4 weeks. At the end of the treatment, a post-test was administered on both groups using the BEAT and after two weeks interval, delay post-test was administered to both groups to ascertain their retention level. Data collected for the study were analyzed using mean scores and standard deviation to answer research questions and the null hypotheses were tested at 0.05 level of significance using Analysis of Covariance (ANCOVA).

 

**3.Results**

**Research Question 1:** What is the effectiveness of constructivism teaching method on academic achievement mean scores of male and female technical college students in Basic Electricity.

**Table 1: Mean and standard deviation of male and female students' academic achievement mean score in Basic Electricity for constructivism group.**

| Group | N | Pre-test | | Post-test | | Mean gain/loss |
|---|---|---|---|---|---|---|
| | | $\bar{x}$ | $SD_1$ | $\bar{x}$ | $SD_2$ | $\bar{x}$ |
| Male | 44 | 24.32 | 6.14 | 78.25 | 6.25 | 53.93 |
| Female | 13 | 22.92 | 5.56 | 75.23 | 6.76 | 52.31 |

Note: N=Number of students, $SD_2$=Standard deviation for post test, $SD_3$= standard deviation for delay post-test, $\bar{x}$=mean.

Result of Table 1 reveals that male in constructivism group had a pre-test and post-test achievements mean scores of 24.32 and 78.25 with a standard deviation of 6.14 and 6.25 respectively. The mean gain is 53.93. The female had a pre-test and post-test achievement mean score of 22.92 and 75.23 with a standard deviation of 5.56 and 6.76 respectively. The mean gain of female is 52.31. This shows that both males and females in constructivism group had mean gain with males having a higher mean gain. The slight difference in mean score seems to show that males in constructivism teaching groups were more favoured than their female counterparts.

**Research Question 2:** What is the effectiveness of meta-learning method on academic achievement mean scores of male and female technical college students in Basic Electricity.

**Table 2. Mean and standard deviation of male and female students' academic achievement mean score in Basic Electricity for meta-learning group.**

| Group | N | Pre-test | | Post-test | | Mean gain/loss |
|---|---|---|---|---|---|---|
| | | $\bar{x}$ | $SD_1$ | $\bar{x}$ | $SD_2$ | $\bar{x}$ |
| Male | 35 | 32.46 | 7.80 | 75.54 | 8.40 | 43.08 |
| Female | 16 | 31.81 | 8.18 | 75.31 | 9.46 | 43.50 |

Data presented in Table 2 show that males in meta-learning group had a pre-test achievement mean score of 32.46 with a standard deviation of 7.80 and a post-test achievement mean score of 75.54 with a standard deviation of 8.40. The mean gain is 43.08. The females had a pre-test achievement mean score of 31.81 with standard deviation of 8.18 and a post-test achievement mean score of 75.31 with a standard deviation of 9.46. The mean gain is 43.50. This shows that both males and females in meta-learning group had mean gain with the female having higher mean gain. The slight difference in the mean gain score seems to indicate that females in meta-learning teaching group have performed better than their male counterparts.

**Research Question 3:** What is the effectiveness of constructivism teaching method on retention mean scores of male and female technical college students in Basic Electricity.

**Table 3. Mean and standard deviation of male and female students' retention mean scores in basic electricity for constructivism group.**

| Group | N | Post-test | | Delay Post-test | | Mean gain/loss |
|---|---|---|---|---|---|---|
| | | $\bar{x}$ | $SD_2$ | $\bar{x}$ | $SD_3$ | $\bar{x}$ |
| Male | 44 | 78.25 | 6.25 | 77.41 | 5.73 | -0.84 |
| Female | 13 | 75.23 | 6.76 | 75.38 | 4.68 | 0.15 |

Table 3 shows that males in constructivism group had a post-test retention mean score of 78.25 with a standard deviation of 6.25 and delayed post test retention mean score of 77.41 with a standard deviation of 5.73.The mean loss is -0.84. The females had a post-test retention mean score of 75.23 with a standard deviation of 6.76 and a delayed post test of 75.38 with a standard deviation of 4.68. The mean gain is 0.15. This shows that males in constructivism group had retention loss while their female counterparts had knowledge retention.

**Research Question 4**: What is the effectiveness of meta-learning teaching method on retention mean scores of male and female technical college students in Basic Electricity.

**Table 4. Mean and standard deviation of male and female students' retention mean scores in basic electricity for meta-learning group.**

| Group | N | Post-test | | Delay Post-test | | Mean gain/loss |
|---|---|---|---|---|---|---|
| | | $\bar{x}$ | $SD_2$ | $\bar{x}$ | $SD_3$ | $\bar{x}$ |
| Male | 35 | 75.54 | 8.40 | 75.06 | 9.23 | -0.48 |
| Female | 16 | 75.31 | 9.46 | 74.81 | 8.98 | -0.50 |

Data presented in Table 4 show that males in meta-learning group had a post-test retention mean score of

 

75.54 with a standard deviation of 8.40 and a delay post-test retention mean score of 75.06 with a standard deviation of 9.23. The mean loss is -0.48. The females had a post-test retention mean score of 75.31 with a standard deviation of 9.46 and a delay post-test retention score of 74.81 with a standard deviation of 8.98. The mean gain is -0.50. This shows that both male and female students in meta-learning group had retention loss.

**Null Hypothesis 1:** There is no significant difference between the academic Achievement mean scores of male and female Technical College Students taught Basic Electricity using Constructivism Teaching Method.

To test this hypothesis, the academic achievement mean scores of male and female students taught Basic Electricity using constructivism teaching method were analyzed using ANCOVA and the result of the analysis is summarized in Table 5

**Table 5. ANCOVA summary of gender on students' academic achievement mean scores in Basic Electricity using constructivism teaching method.**

| Source | Sum of squares | Df | Mean of squares | F-cal | Sig. | Remark |
|---|---|---|---|---|---|---|
| Gender | 43.008 | 1 | 43.008 | 1.755 | .191 | Accepted |
| Error | 1323.488 | 54 | 24.509 | | | |
| Total | 345221.00 | 57 | | | | |

Table 5 shows that F-ratio of 1.755 with 1 degree of freedom and p-value of 0.191 was obtained for gender on students' academic achievement mean scores when taught Basic Electricity using constructivism teaching method. Since the p-value of 0.191 is greater than 0.05 level of significance. This shows that there is no significant difference between the academic achievement mean scores of male and female technical college students taught basic Electricity using constructivism teaching method. The null hypothesis was therefore accepted.

**Null Hypothesis 2:** Significant difference does not exist between the academic achievement mean score of male and female technical college students taught Basic Electricity using meta-learning teaching method.

To test this hypothesis, the achievement mean scores of male and female students taught Basic Electricity using meta-learning teaching method were analyzed using ANCOVA and the result of the analysis is summarized in Table 6.

**Table 6. ANCOVA summary of gender on students' academic achievement mean scores in Basic Electricity using meta-learning teaching method.**

| Source | Sum of squares | df | Mean of squares | F-cal | Sig. | Remark |
|---|---|---|---|---|---|---|
| Gender | .026 | 1 | .026 | .000 | .984 | Accepted |
| Error | 3163.927 | 48 | 65.915 | | | |
| Total | 294227.00 | 51 | | | | |

Table 6 shows that F-ratio of 0.000 with 1 degree of freedom and p-value of 0.984 was obtained for gender on students' academic achievement mean scores when taught Basic Electricity using meta-learning teaching method. Since the p-value of 0.984 is greater than 0.05 level of significance. This shows that significance difference does not exist between the achievement mean scores of male and female technical college students taught Basic Electricity using meta-learning teaching method. The null hypothesis was therefore accepted.

**Null Hypothesis 3**: There is no significant difference between the retention mean scores of male and female technical college students taught Basic Electricity using constructivism teaching method.

To test this hypothesis, the retention mean scores of male and female students taught Basic Electricity using constructivism teaching method were analyzed using ANCOVA and the result of the analysis is summarized in Table 7

**Table 7. ANCOVA summary of gender on students' retention mean scores in Basic Electricity using constructivism teaching method**

| Source | Sum of squares | df | Mean of squares | F-cal | Sig. | Remark |
|---|---|---|---|---|---|---|
| Gender | 17.804 | 1 | 17.804 | .808 | .373 | Accepted |
| Error | 1189.536 | 54 | 22.028 | | | |
| Total | 339206.00 | 57 | | | | |

Table 7 shows that F-ratio of 0.080 with 1 degree of freedom and p-value of 0.373 was obtained for gender on students' retention mean scores when taught Basic Electricity using constructivism teaching method. Since the p-value of 0.373 is greater than 0.05 level of significance. This shows that there is no significant difference between the retention mean scores of male and female technical college students taught Basic Electricity using constructivism teaching method. The null hypothesis was therefore accepted.

**Null Hypothesis 4:** Significant difference does not exist between the retention mean scores of male and female technical college students taught Basic Electricity using meta-learning teaching method.

To test this hypothesis, the retention mean scores of male and female students taught Basic Electricity using meta-learning teaching method were analyzed using ANCOVA and the result of the analysis is summarized in Table 8.

**Table 8.ANCOVA summary of gender on students' retention mean scores in Basic Electricity using meta-learning teaching method.**

| Source | Sum of Squares | df | Mean of squares | F-cal | Sig. | Remark |
|---|---|---|---|---|---|---|
| Gender | .035 | 1 | .035 | .000 | .983 | Accepted |
| Error | 3437.191 | 48 | 71.608 | | | |
| Total | 290832.00 | 51 | | | | |

Table 8 shows that F ratio of 0.000 with 1 degree of freedom and p-value of 0.983 was obtained for gender on students' retention mean scores when taught Basic Electricity using meta-learning teaching method. Since the p-value of 0.983 is greater than 0.05 level of significance. This shows that significant difference does not exist between the retention mean scores of male and female technical college students taught Basic Electricity using meta-learning teaching method. The null hypothesis was therefore accepted.

## 4. Discussion of Findings

The data presented in table 1 provided answer to research question one. Findings revealed that male students exposed to constructivism teaching method had a mean gain of 53.93 while the female students had a mean gain of 52.31. Table 2 shows that male students exposed to meta-learning teaching method had a mean gain of 43.08 while female students had a mean gain of 43.50. This shows that male students exposed to constructivism teaching method had a higher mean gain than their female counterparts. Also, that female students exposed to meta-learning teaching method had a higher mean gain than their male counterparts. However data in table 5 and 6 indicated that gender differences were not significant since the p-values of 0.191 and 0.984 for the two tables respectively were greater than 0.05 level of significance. This implies that there is no significant difference in the academic achievement mean scores of male and female technical students taught basic electricity using constructivism and meta-learning teaching method. This result is in line with the findings of Abbas and Habu (2014) who reported that gender has no significant effect on students' academic achievement.

The result in table 3 revealed that male students exposed to constructivism teaching method had a retention mean loss of 0.84 while their female counterparts had a retention mean gain of 0.15. In table 4, the findings revealed that both male and female students exposed to meta-learning teaching method had the retention mean loss of -0.48 and -0.50 respectively. This means that female students exposed to constructivism teaching method had a retention mean gain while their male counterpart had a retention mean loss. However, both male and female students of basic electricity who were exposed to meta-learning teaching method had retention mean loss.

Data in table 7 and 8 indicated that gender differences were not significant in students' retention mean scores of male and female students, since the p-value of 0.373 and 0.983 for the two tables respectively were greater than 0.05 level of significance. This implies that significant difference does not exist between the retention mean scores of male and female students' taught basic electricity using constructivism teaching method and those taught using meta –learning teaching method. The finding is in agreement with the findings of Yusuf, Gambari and Olumorin (2012) which reported that gender has no significant effect on students' retention ability. The finding is in disagreement with the findings of Owodunni and Ogundola (2013) which revealed that there is significant difference in retention ability of male and female students. The disagreement with the present study could be as a result of students' disposition to learn. Both male and female students had equal opportunity to participate actively.

## 5.Conclusion

Based on the findings of the study, it was concluded that both teaching methods are effective for improving academic achievement of technical college students in basic electricity but constructivism teaching method is more effective for enhancing retention ability of technical college students in basic electricity. Also there is no significant difference in the mean achievement and retention scores of male and female students in the teaching of basic electricity in technical colleges.

## 6. Recommendations

Based on the findings of this study, the following recommendations were made

1. Since gender is not a significant factor in students' academic achievement and retention in Basic Electricity, emphasis should therefore be on adopting the teaching method that incorporates constructivism and meta-learning teaching methods in the teaching of basic electricity in order to enhance students' academic achievement and retention.
2. Since constructivism teaching method has been found to be more effective in improving students' retention in basic electricity, teachers of basic electricity should train, encourage and motivate students on how to apply constructivism strategies in learning basic electricity so as to improve their retention ability.
3. All students should be given equal opportunity, the same level of encouragement and motivation

 

irrespective of their gender in the teaching and learning of basic electricity.

4. Technical education teachers should be sensitized on the efficacy of constructivism and meta-learning teaching methods through conference, seminars and workshops.

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