

# COMPARATIVE EFFECTS OF LONG WAIT TIME AND SHIFTING INTERACTION QUESTIONING TECHNIQUES ON BASIC ELECTRICITY STUDENTS ACADEMIC ACHIEVEMENT IN TECHNICAL COLLEGES

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## ABSTRACT

This study was designed to investigate the effects of two questioning techniques on students' achievement in basic electricity in all the technical colleges in Federal Capital Territory, Abuja using quasi experimental Pretest posttest non-equivalent research design. To achieve this objective, two research questions were developed and answered while three null hypotheses were formulated. The population for the study consisted of 165 year I basic electricity students. The instruments used for data collection was Basic Electricity Achievement Test (BEAT). The instrument was validated by three experts in basic electricity and measurement and evaluation. BEAT was trial-tested to determine its reliability coefficient and the reliability coefficient of BEAT was found to be 0.81 using Pearson Product Moment Correlation coefficient. Mean was used to answer the research questions; while ANCOVA was employed to test the hypotheses at 0.05 level of significance. The results of the data analyzed, showed that shifting interaction questioning technique is more effective in enhancing students' achievement in basic electricity than long wait time questioning technique. The study further revealed that Shifting Interaction Questioning Technique was more effective in enhancing female students' achievement than male students in Basic electricity than Long Wait Time Questioning Technique. The result also showed that there was no gender by treatment interaction in the study. Based on the findings of the study, it is recommended among other things that Basic electricity teachers should practice the use of shifting interaction questioning technique as part of their teaching techniques to encourage female participation in technology education.

**Key words: Long wait time questioning technique, shifting interaction questioning technique, basic electricity, gender and achievement**

## 1.1 INTRODUCTION

Technology educators are sometimes disenchanted with the conventional pedagogy of transmission of knowledge without inculcating in the students the ability to think for themselves and use problem-solving skills to handle novel situations. In technology education classroom, most teachers still adhere to the traditional methods of teaching (Oranu, 2003). This adherence to traditional methods such as lecture and expository methods led to the evolution of what looks like "Critical thinking movement" in America (Schrag, 1992), Sequel to this also, the widely spreading programme,

"Questioning and Understanding for Improving Learning and Thinking" (QUILT) sprang up in the United States of America (Orletsky, 1997).

Nigeria was not left out in the aforementioned development. In technical colleges the use of constructivist and reflective inquiry methods of teaching is emphasized in order to inculcate in students the ability to think for themselves and also to move away from the highly criticized traditional methods (Owoso, 2009; Owodunni, 2011). The Authors asserted that the constructivist and reflective inquiry approaches has recorded many successes in technology education domains and many technology educators now advocate for their use in the technology classroom. Any behaviour, practice or techniques that will enable students develop thinking skills will help them to acquire technology concepts, which will lead to better achievement. The technology teacher is therefore expected not only to know what to teach but also how to teach it. Hurd in UNESCO (1995) pointed out that the methodology for teaching must enable students to think and ask questions during classroom lesson. One way of developing students' thinking skill is to ask questions in the classroom to facilitate discussion and to get the students to think (Adsit, 2002). There is therefore a good link between teaching methods and questioning. Questioning therefore fits closely into the matrix of the pedagogy of science and technology subjects of which basic electricity is one.

Basic Electricity is one of the Electrical/Electronic courses offered in Nigeria Technical Colleges (Federal Republic of Nigeria (FRN), 2004). It provides students with basic conceptual understanding of basic electrical concepts including basic electrical measurements, basic electrical theory and understanding of how common electrical components work. A good questioning technique if properly used will stimulate students' interest and enhance their achievement in basic electricity.

A question is a statement that seeks to provoke thinking so as to elicit an answer. Questioning is therefore the act of asking questions. Classroom questioning has been the focus of many education researchers for over a century. Research has shown that verbal questions used in the classrooms are more effective in fostering learning than written questions (Cotton, 2001). Though, it is popularly believed that oral questioning in classroom enhances students' thinking and learning, research shows that the current classroom practice falls far short of this notion (Orletsky, 1997). In other words, the type of questioning we do in our classrooms today does not really enhance students' thinking and learning.

Kissock and Syortsuun (1982) advocated for research to be carried out by teachers on issues like "what is the effect of increasing wait-time in questioning?" "What percentage of the class time does the teacher talk and what percentage does students talk?" They opined that by so doing better ways of making use of questions in teaching can be discovered. Asking questions in classroom has the great potential for facilitating learning, but can also turn a child off from learning if it is done incorrectly (Brualdi, 1998). Lee (2000) also stated that classroom research consistently finds a large gap between typical questioning and effective questioning that can affect students' achievement. Typical questioning is the type of questioning where the teacher uses routine questions in the classroom without following some clearly defined techniques of questioning.

According to Sprinthall and Oja (1994) it is called "rapid-fire" questioning which elicit robot-like answers. These authors clearly expressed that "rapid-fire" questions do not promote achievement.

Effective questioning is the reverse of typical questioning. This is where the teacher makes use of techniques of questioning which have been proved to improve the efficacy of classroom interactions and learning outcomes. According to Urbanoski (2002), research has shown that effective questioning techniques have a positive impact on students' overall performance. This may have been why Okonkwo and Suleiman (2001) called for the review of effective questioning techniques if we must produce future citizens who through questions will develop critical thinking skills needed for advancement in technology.

There are many techniques of questioning, but how effectively they are applied to achieve the desired goal is not clear. Common questioning techniques include; clarity of questions, wait-time in questioning, shifting interaction, cognitive level of teacher's questions and frequency of questioning. Clarity of questions expresses how clearly a question communicates to the students what the teacher intends it to communicate. There is no controversy in the literature report on this technique as it is expressed that questions should be stated in simple terms devoid of ambiguity (Wilson, 1975; Iloh, Famiwole and Eze, 1996; and Lar, 1997).

Wait-time is the amount of time a teacher allows after asking a question before getting response from students (wait-time I). It is also a period of uninterrupted silence allowed by the teacher after receiving a student's response and before he/she comments or asks another question (wait-time II). Research has shown that for both wait-time I and II, teachers typically wait for an average of one second or less (Kissock and Iyortsuun, 1982; Ouyang, 2000; Cotton, 2001 and Camp, 2002). Increasing wait-time to three seconds or more has been found to increase students' achievement and interest (Stahl, 1994; Rowe as cited in Lee, 2000 and Cotton, 2001).

Shifting Interaction is the redirection of classroom questions from one student to another and probing each student's answer, rather than the teacher answering any question he/she asked immediately one student or two fail to provide the right answer. Here the teacher is very reluctant in providing the answer to his question until all available opportunities of eliciting the right answer from students have been utilized and they failed to get it. Redirection and probing are positively related to achievement (Cotton, 2001).

Classroom lessons are timed and always guided by a strict timetable. This puts the teacher in a straitjacket and makes the teacher frugal with time. Moreover, looking at the volume of work to cover within a certain limited time frame, the teacher is more or less coerced to adopt teaching skills that will not be time-consuming. Questioning has been identified as a major teaching skill, which can hardly be left out of the teaching paraphernalia of any teacher. Techniques of using questioning skill that will be time-effective and at the same time enhance students' performance will be beneficial. Long wait time and shifting interaction have time management with a view to finding an answer to a question as a common factor. Long wait-time and shifting interaction have positive effect on students' achievement. But it is observed that it is difficult for a teacher to use long wait-time and shifting interaction concurrently in one lesson and yet conserve time. Most teachers who use shifting interaction hardly gives students long wait-time and vice versa. For this study, long wait-time involves the teacher waiting for five seconds or

more before taking a response from any student. This wait-time of five seconds is deduced from research findings and recommendations of notable educationists. Ali (1998) recommended 5-6 seconds, Kissock and Iyortsuun (1982) recommended 5-10 seconds, Rowe as reported in Lee (2000) recommended 3-5 seconds, Maduewesi (1998) stated that long wait-time should be over three seconds. Stahl (1994) observed that three seconds is the threshold point in wait-time when positive effects on students' behaviour start, therefore for wait-time to be termed long it has to be above the threshold point and that is why the researcher adopts five seconds. In long wait-time the teacher is concerned with the student's being able to think out an answer to the question within the period of uninterrupted silence given by the teacher.

In shifting interaction the teacher does not give long period of uninterrupted silence rather he/she uses the time to redirect a question from one student to the other ensuring adequate participation of the students in arriving at the right answer. From the foregoing analysis it was therefore necessary to make a comparative study of the effectiveness of these two questioning techniques with a view to finding out which of them will better enhance students' achievement in basic electricity.

Achievement refers to the degree of success reached or attained in some general or specified area (Enyi, 2004). In other words, achievement is the extent of success attained by an individual on a task he has earlier been exposed to. Mbah (2002) remarked that achievement is dependent upon several factors among which are instructional techniques, the learning environment, the learner, motivation for stimulating students' interest in learning and gender.

Gender is a parallel and socially unequal division into masculinity and femininity (Marshall, 1998). Gender is therefore, the different socially constructed roles and responsibilities expected of women and men. Gender is a factor that has dominated many educational research efforts the world over. Akinsola and Igwe (2002) stated that gender issue is an important factor in educational setting and could be a militating factor to high achievement of learners in basic electricity. There is also the long held view that gender differences in achievement in technology education in favour of the males is caused primarily by biological inheritance (Nkpa, 1999), but Okeke (1999) proved that so far there is no biological evidence that boys have innate superior intellectual abilities over girls. Therefore, if differences in achievement exist, they must be caused by other factors. Recent studies show that women and men respond differently to specific teaching methods, questions and to discussion (West Virginia University for Women Studies (W V U), 1997). This is in line with Okeke's (2001) assertion that instructional strategies are known to produce different effects on learners. Schwartz and Hanson (1992) expressed that boys volunteer more than girls in response to teacher's questions. This is supported by Okeke (2001), who stated that women are unlikely to volunteer to answer questions. Schwartz and Hanson (1992) stated that females prefer to use a conversational learning style that fosters group consensus and build ideas on top of each other. Therefore, any instructional strategy that sticks to calling just the volunteers to answer questions would put women learners at disadvantage. Men tend to answer questions more confidently and quickly regardless of the quality of their responses, formulating their answer as they speak. On the contrary women choose their words carefully, wait longer to respond to a question in class (Women Science Students (WSS), 1996). This may be why it is alleged that in coeducational schools, boys dominate class discussions. Learners are likely to learn better if the teacher-

student questioning interaction patterns are suitable to them. It appears from the discourse on gender that different questioning techniques may affect the boys and the girls differently. There was therefore the need to investigate gender interaction, with long wait-time and shifting interaction techniques in classroom questioning.

## **1.2 Statement of the Problem**

Many technology educators have over the years been concerned about the problem of students' low achievement and interest in technology subjects. One of such factors that affect student's achievement and interest in technology subjects is the non-stimulating ways of teaching the subject in technical colleges due to lack of relevant teaching skills by the teachers. If instruction is not presented in a stimulating way to students, the degree of learning may not be high. The criticism of our conventional pedagogy that emphasizes mere transmission of knowledge places the onus on teachers to find better ways of teaching that would de-emphasize mere transmission of knowledge. It is widely believed that in order to teach well, one should be able to question well. Questioning has been reported to have greater potential than any other teaching skills for stimulating thinking in students (Kissock and Lyortsuun, 1982). Fortunately, for over one century, classroom questioning has been the focus of many education researches. But consistently research finds a large gap between typical questioning which is normally obtained in our classrooms and effective questioning, which is stimulating. Questioning is made effective by employing the right kind of questioning techniques. Effective questioning is an instrument of motivation to raise the interest of students in what is being learnt (Eze, 2008). Raising students' interest helps them to learn better and most likely retain what is learnt for a longer period and subsequently, achievement would be enhanced. The relative effectiveness of some of these questioning techniques in enhancing achievement and interest in basic electricity was not clear; it has also been known that boys and girls respond differently to different questioning techniques (WVU, 1997). The interaction of gender with the questioning techniques in enhancing achievement in basic electricity was also not yet clear. The main concern of this study was to investigate the comparative effects of two questioning techniques on students' achievement in basic electricity.

## **1.3 Purpose of the Study**

The study sought to determine:

1. The comparative effects of long wait time and shifting interaction techniques in classroom questioning on students' achievement mean scores in basic electricity.
2. The effect of gender on students achievement when exposed to long wait time and shifting interaction questioning techniques in basic electricity.

## **1.4 Research Questions**

The following research questions were answered in the study.

1. What are the comparative effects of long wait-time and shifting interaction in classroom questioning on students' achievement mean scores in basic electricity?

2. What is the effect of gender on students' achievement mean scores when exposed to long wait time and shifting interaction questioning techniques in basic electricity?

### 1.5 Hypotheses

The following null hypotheses were tested in this study at the 0.05 level of Significance.

- HO<sub>1</sub>: There is no significant difference in the mean achievement scores of students exposed to long wait time questioning technique and those exposed shifting interaction questioning technique in basic electricity concept
- HO<sub>2</sub>: There is no significant mean difference in the mean achievement scores of male and female students in basic electricity when exposed to long wait time and shifting interaction questioning techniques
- HO<sub>3</sub>: There is no significant interaction effect of treatments given to students and their gender with respect to their mean scores on the basic electricity Achievement Test.

### 1.6 Research Methods

The research design that was used for this study is a quasi- experimental design. Specifically, pre-test, post-test, non randomized comparison groups design. This design was used because the researcher used intact classes. The design is symbolically represented as follows:

Group I	O <sub>1</sub> X <sub>1</sub> O <sub>2</sub> ,
Group II	O <sub>1</sub> X <sub>1</sub> O <sub>2</sub> ,

Where O<sub>1</sub> = Pre-test

O<sub>2</sub> = Posttest

X<sub>1</sub> = Long wait-time in classroom questioning (treatment 1)

X<sub>2</sub> = Shifting interaction in classroom questioning (treatment 2)

The population of this study comprises 165 (121 boys and 44 girls) year II students of basic electricity in all the technical colleges that offer basic electricity in Federal Capital Territory, Abuja. The entire population was used for the study. Two intact classes of 81 and 84 were used for the study.

The instrument used was Basic Electricity Achievement Test (BEAT) developed by the researcher. The instrument was designed to measure the cognitive achievement of the students before and after treatment in Basic electricity (See Appendix). The instrument was validated by three experts in basic electricity and measurement and evaluation. The reliability coefficient of BEAT was found to be 0.81 using Pearson Product Moment Correlation coefficient formula.

Before beginning the experiment, both treatment groups were pre-tested. The pre-testing involved administration of BEAT to the subjects. After pre-testing, the experiment began and it lasted for five weeks. This experiment was done during the normal 'school periods. The wait time in questioning was measured using a wristwatch with liquid crystal display (LCD), which displays time in seconds.

Group I subjects were exposed to long wait- time of five seconds or more during questioning. One or two responses from the students were taken and where they did not get the correct answer the teacher immediately

provided the right answer. Here the teacher did not probe the students' responses; he rather looked for correct answer within the long period given to the students to answer the question. He took only those who volunteered to answer the questions. Where there were no volunteers, it was assumed that nobody knew the answer and the teacher produced the answer.

Group II subjects were exposed to shifting interaction in questioning. Redirection of questions from one student to the other while probing each student's response was the crux of the matter here. The emphasis here was on using the students to get the right answer and ensuring the participation of as many students as possible within a certain frame. Whether a student was willing to answer a question asked or not was not important here. The teacher made sure that almost all the students had an opportunity to answer question in class by asking both willing and non-willing students. He did not give the students long time of silence to think but he was patient enough to probe any answer supplied by a student whether right or wrong. The teacher developed more questions from one student's answer, which he distributed to other students thereby giving almost every student a fair opportunity to attempt one question or the other in a lesson. The teacher built ions on top of each other in such a manner that will lead the students to arrive at an answer to a question by themselves without the teacher supplying the answer. At the end of the five weeks of experiment, the students of the two treatment groups were post-tested which also involved administering BEAT to the students. Data collected from pre and post were used to answer the research questions and test the hypotheses stated. The research questions were answered using mean and standard deviation while the hypotheses were tested using ANCOVA at 0.05 level of significance.

## 1.7 Results

The results of the analyzed data are presented and interpreted in line with the Research questions and hypotheses that guided the study.

### 1.7.1 Research Question 1

What are the comparative effects of long wait-time and shifting interaction in classroom questioning on students' achievement mean scores in basic electricity concepts?

**Table 1.7.1: Achievement Mean Scores of Students Exposed To LWT And SI Questioning Techniques.**

Group	N	Pretest	Posttest	Mean Gain
		$\bar{X}$	$\bar{X}$	
LWT GROUP	81	6.22	13.32	7.10
SI GROUP	84	8.10	17.80	9.70

Key

LWT = Long wait time

SI = Shifting interaction

N = Number of subjects

$\bar{X}$  = Mean

The data presented in Table 1.7.1 revealed that LWT group had a mean score of 6.22 in the pretest and 13.32 respectively in the posttest. The SI group had a mean score of 8.10 in the pretest and 20.12 respectively in the posttest.

From the result presented above, it could be seen that both techniques improved students' achievement as shown by the mean gain scores. This shows that the variability of scores in both questioning techniques is almost the same. It should be noted however that SI group got higher mean gain score (9.70) than that of the LWT group (7.10), suggesting that possibly SI has more positive effect on the achievement mean scores of students

### 1.7.2 Research Question 2

What is the effect of gender on academic achievement of students studying basic electricity using the questioning techniques?

**Table 1.7.2: Achievement Mean Scores of Students Exposed to LWT and SI Questioning Techniques by Gender.**

Gender	LWT Group				SI Group			
	N	Pretest	Posttest	<i>Mean Gain</i> $\bar{X}$	N	Pretest	Posttest	<i>Mean Gain</i> $\bar{X}$
<b>Male</b>	62	7.05	14.35	7.30	59	8.45	18.12	9.67
<b>Female</b>	19	6.01	9.97	3.96	25	6.98	16.69	9.71

Key

- LWT = Long wait time
- SI = Shifting interaction
- N = Number of subjects
- $\bar{X}$  = Mean

Table 1.7.2 further revealed that male students of the LWT group had a mean gain score of 7.30, which was derived from a pretest, mean of 7.05 and a post test mean of 14.35. Female students of the same group had a mean gain score of 3.96, which was toed from a pretest mean of 6.01 and a posttest mean of 9.97. The higher mean gain score of male students suggests that possibly LWT has more positive effect on the achievement of male students. Moreover, male students of SI group had a mean gain score of 9.67, which is lower than the mean gain score of 9.71 of the female students. This higher mean gain score of female students suggests that possibly SI has more positive effect on the achievement of female students. But it can be observed from Table 1.7.2 that male students got higher achievement mean scores in both pretest and post test than female students.

### 1.7.3 Hypotheses

HO<sub>1</sub>: There is no significant difference in the mean achievement scores of students exposed to long wait time questioning technique and those exposed shifting interaction questioning technique in basic electricity

HO<sub>2</sub>: There is no significant mean difference in the mean achievement scores of male and female students in basic electricity when exposed to long wait time and shifting interaction questioning techniques

HO<sub>3</sub>: There is no significant interaction effect of treatments given to students and their gender with respect to their mean scores on the basic electricity Achievement Test.

**Table 1.7.3:** Summary of Analysis of Covariance (ANCOVA) for Test of Significance between the Mean Scores of LWT and SI 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 basic electricity Achievement Test

Source	Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	967.589	4	500.213	28.003	.000
Intercept	802.345	1	802.345	43.357	.000
Pretest	41.212	1	41.212	.2145	0.137
Group	1425.28	1	1425.28	131.135*	.000
Gender	202.243	1	202.243	12.003*	.001
Group * Gender	71.342	1	71.342	3.812	0.57
Error	1203.120	4	283.321	16.005	
Total	2692.212	151	19.003		
Corrected Total	3895.332	153	302.324		

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

The data presented in Table 1.7.3 shows F-calculated values for mean scores of LWT and SI groups in the achievement test, gender and interaction effect of treatments and gender on students' achievement in basic electricity. The F-calculated value for Group is 131.135 with a significance of F at .000 which is less than .05. The null-hypothesis is therefore rejected at .05 level of significance. With this result, there is a significant difference between the mean achievement scores of students exposed to LWT questioning technique and those Exposed to SI questioning technique in basic electricity. The F-calculated value for gender is 12.003 with a significance of F at .001 which is less than .05. This means that there is significant difference between the effects of Gender on students' achievement in basic electricity when exposed LWT and SI questioning techniques. Therefore, the null hypothesis of no significant difference between the effect of gender (male and female) on students' achievement in basic electricity is rejected at .05 level of significance. The interaction of treatments and gender has F-calculated value of 3.812 with significance of F of 0.57. Since 0.57 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 basic electricity Achievement Test.

## 1.8 Discussion of findings

Table 1.7.1 showed that the SI group had higher achievement mean gain score than the LWT group. At the same time, Analysis of covariance was used to test the first hypothesis, Table 1.7.3, at the calculated F-value (131.135), Significance of F (.000) and confidence level of .05 there was a statistically significant difference between the main effect of the two questioning techniques on students achievement in basic electricity confirming that the difference between the main effect of LWT questioning technique and SI questioning technique was statistically significant. Since there is a significant difference in the achievement mean scores of the groups' subjects, one out of the two questioning techniques compared had a more positive effect on students' achievement mean scores than the other. As earlier stated, shifting interaction had a more positive effect on students achievement in basic electricity.

The significant difference in achievement mean scores obtained in favour of shifting interaction faction may be as a result of the fair distribution of questions in class. This is in agreement with the submission of Brualdi (1998) who asserted that fair distribution of questions in the classroom enhanced students' participation and stimulate student interest in the lesson. In shifting interaction both the higher achieving students and the lower achieving students had equal chances of attempting questions asked in class. The result of this study is in line with the findings of Cotton (2001), who stated that redirection of questions and probing are positively related to achievement. This also suggests that shifting interaction-technique enhanced students' thinking skill more than the Song wait time technique. The fair distribution of questions keeps the students alert as the question can get to any of them anytime. Before it gets to anybody's turn, the person would have been thinking about the answer to the question and because the teacher digs deeper, the students are faced with more challenges which help to sharpen their thinking skills. However, literature did not contain information on a comparative study such as this. The result of this study suggests that students understanding and learning were enhanced more by the use of shifting interaction questioning technique in teaching than the use of long wait time (Maduewusi, 1998; Camp, 2002).

Table 1.7.2 showed that in LWT group, the male students had higher mean gain score than their female counterparts. This suggests that LWT had more positive effect on the achievement mean scores of male students. But in SI group, female students had higher mean gain score than their male counterparts. This also suggests that possibly SI had more positive effect on the achievement mean score of female students. This higher mean gain score recorded by female students of SI group seems to support the view of Okeke (2001), that any instructional strategy that sticks to calling just the volunteers to answer questions put women learners at disadvantage. The fair distribution of questions may have given the female students edge over the males since females do not rush to raise their hands up and be thinking while already answering the question. While males are struggling to dominate the class discussion, they take the opportunity to think through the answer to the question. Shifting interaction frees females from male dominance in class discussion and enhances their interest in what is being studied since questions are distributed irrespective of whether you raised your hand or not. At the same time, Analysis of covariance was employed to

test the second hypothesis, Table 1.7.3, at the calculated F- value (12.003), significance of F (.001) and confidence level of .05, there was a significant difference between the main effects of gender (male and female) on students' achievement in basic electricity which confirmed that the difference between the achievement of male and female students in basic electricity was statistically significant favouring boys in LWT questioning technique and girls in SI questioning technique. The obvious implication of this finding is that there was an effect attributable to gender on achievement of students in basic electricity. However, the ANCOVA result on Table 1.7.3 showed that the interaction effect ( $P < 0.05$ ) between gender and the questioning techniques on students' achievement in basic electricity is not significant.

## 1.9 Conclusion

The following conclusions were made based on the results of the data analysed.

- (1) There was a significant difference in the achievement mean scores of students exposed to LWT and SI questioning techniques in favour of those exposed to SI.
2. There was significant difference between the effects of Gender on students' achievement in basic electricity when exposed LWT and SI questioning techniques
- (2) There was no significant interaction between gender and treatment on students' achievement mean scores in basic electricity.

Basic electricity teachers have a role to play in using classroom interaction patterns that would make teaching and learning process more effective. Shifting interaction questioning technique has been shown to be one of such effective interaction terms and the onus lies on the basic electricity teacher to use it in class. This is because the result of this study has shown that students exposed to shifting interaction achieved better than those exposed to long wait time. Since this study has shown that there was no interaction effect between gender and treatment on students' achievement, both male and female interests should be exposed to SI questioning technique. Enhancement of students' interest or rather rising and sustaining students' interest is a necessary condition for classroom teaching. On this note, the use of SI has been shown to enhance students' interest in basic electricity more than LWT. This perceived strength in SI should be led by basic electricity teachers while teaching seemingly difficult basic electricity topics that may be dampening the interest of students in learning basic electricity. Basic electricity teachers in schools should try to exclusively use shifting interaction technique because of its positive effects on female learners.

## 1.10 Recommendations

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

- (1) Teachers, especially basic electricity teachers should practice the use of shifting interaction questioning technique as part of their teaching techniques since this study has shown that shifting interaction questioning technique is a better questioning technique to use than long wait time for effective classroom teaching.
- (2) Basic electricity teachers in girls' schools should try to exclusively use shifting interaction questioning technique in classroom interaction since it has been shown to favour female learners.

- (3) The State and Federal Governments should from time to time organize workshops and seminars to sensitize teachers to effective teaching techniques. This would enable teachers to increase their knowledge base on such teaching techniques.
- (4) Basic electricity textbook authors and publishers while preparing teachers' guide-textbooks should emphasize the use of shifting interaction as an effective technique of conducting classroom questioning. This is to always draw the attention of teachers to the importance of such effective questioning technique.
- (5) Professional associations like National Association of Teachers of Technology (NATT), Association for Promoting Quality Education (APQE), should also undertake to organize periodic training sessions in the form of workshops or seminars for basic electricity teachers on the use of effective questioning techniques like shifting interaction to improve classroom teaching and learning.
- (6) Faculties of Education in Universities, Colleges of Education and other teacher education institutions should emphasize the use of effective questioning techniques like shifting interaction while training the would-be classroom teachers. This would enable the student-teachers to be armed with the necessary competencies needed to make a good teacher.

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## APPENDIX

### BASIC ELECTRICITY ACHIEVEMENT TEST

#### Pretest/Post-Test Items

#### Instruction

Answer all questions.

Each question is followed by five options lettered A-D.

Identify the correct option for each question and write on the answer sheet provided the letter that bears the same answer of option you have chosen.

Time: 15 minutes.

1. The first two bands of a resistor is known as
  - A First and third digit
  - B Third and first digit
  - C Second and first digit
  - D First and second digit
  
2. Which of the following formula is used for calculating Inverse square law?
  - A  $I = \frac{E}{d^2}$
  - B  $E = \frac{I}{d^2}$
  - C  $d^2 = \frac{I}{E}$

D  $E = \frac{d^2}{I}$

3. The fourth band colour in a resistor is called

- A temperature
- B multiplier
- C tolerance
- D percentage

4. What is the value of a resistor that has the first three colours of its band gray, red and gold?

- A  $82\Omega$
- B  $0.82\Omega$
- C  $82.0\Omega$
- D  $8.2\Omega$

5. Illumination is defined as.....

- A the density of Luminous
- B the density of the flux
- C the Luminous working plane
- D the density of Luminous flux falling on a working plane.

6. Which of the following symbols represents Luminous flux?

- A I
- B E
- C  $\Phi$
- D  $d^2$

7. Inverse Square law is defined as.....

- A When the illumination falling on a working plane varies inversely as the square of the distance from the light source.
- B When the illumination is directly proportional to the square of the distance from the light source.
- C When the illumination is proportional to the square of the distance from the light source.
- D When the illumination is square from the light source.

8. The unit of Luminous Intensity is

- A Lumen
- B Candela
- C  $\text{Lumen /m}^2$

- D Flux
9. Calculate the Illumination on a working plane at a point A 2m, vertically below a lamp emitting 720cd. The surface is at right angle to the light.
- A  $180/\text{m}^2$
  - B  $150/\text{m}^2$
  - C  $120/\text{m}^2$
  - D  $118/\text{m}^2$
10. What are the two numbers that define the numerical value of the resistor?
- A the last two bands
  - B the middle two bands
  - C the first two bands
  - D the first and last bands
11. Which of the following correctly defines electromagnetism?
- A Electromagnetism is a magnetic field that oppose by electric current
  - B Is a magnetic field that is created by electric current
  - C Is a magnetic field that separated by electric current
  - D Is a force field that accept electric current
12. Magnets can be manufactured from various alloys elements EXCEPT
- A Copper
  - B Nickel
  - C Aluminum
  - D Silver
13. The force of magnetism is referred to as
- A Magnetic line
  - B Magnetic intensity
  - C Magnetic field
  - D Magnetic flux
14. The invisible lines of force that make up the magnetic fields are known as
- A Magnetic charge
  - B Magnetic loss
  - C Luminous
  - D Magnetic flux
15. Like magnetic poles
- A Create a force of attraction

- B Repel each other  
 C Divide each other  
 D Pull each other
16. Which of the following correctly defines unlike magnetic poles?  
 A Create of force of dislike  
 B Create a force of unity  
 C Create a force of repel  
 D Create a force of attraction
17. When a magnetic material is put in the magnetic field of a magnet, it becomes  
 A Solid  
 B Liquid  
 C Magnetized  
 D Demagnetized
18. Which of the following is the symbol of Luminous intensity?  
 A I  
 B E  
 C  $\Phi$   
 D  $d^2$
19. In a resistor that has four band schemes, the bands are always read from  
 A The end that has a bound closest to it  
 B The end that has a bound far to it.  
 C Bottom end of the bands  
 D Before the ends of the bands
20. Calculate the illumination when falling on a working plane 2m from a light source at 64cd.  
 A  $15 \text{ m/m}^2$   
 B  $12 \text{ m/m}^2$   
 C  $17 \text{ m/m}^2$   
 D  $16 \text{ m/m}^2$

**SCORING GUIDE FOR BASIC ELECTRICITY ACHIEVEMENT TEST**

- |      |       |
|------|-------|
| 1. C | 2. B  |
| 3. C | 4. C  |
| 5. D | 6. C  |
| 7. A | 8. B  |
| 9. A | 10. C |

- |     |   |     |   |
|-----|---|-----|---|
| 11. | B | 12. | D |
| 13. | C | 14. | A |
| 15. | B | 16. | D |
| 17. | A | 18. | A |
| 19. | A | 20. | D |
| 11. | A | 26. | C |