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RESEARCH ARTICLE

COMPARATIVE EFFECTS OF SCAFFOLDING AND COLLABORATIVE INSTRUCTIONAL STRATEGIES ON SCIENCE AND TECHNICAL COLLEGE STUDENTS' ACHIEVEMENT IN BASIC ELECTRONICS IN NASARAWA STATE, NIGERIA

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ABSTRACT

This study compared the Effects of Scaffolding and Collaborative Instructional Strategies on Science and Technical Students' Achievement in Basic Electronics in Nasarawa State, Nigeria. Two research questions and three hypotheses were formulated for the study. The study adopted a quasi-experimental research design; specifically, the pre-test post-test non-equivalent control-group experimental design was used. A sample of 63 (35 males and 27 females) from two schools were drawn using purposive sampling technique from all the 157 senior secondary school year two (SS II) students of Basic Electronics in the three science and technical colleges offering Basic Electronics in Nasarawa State, Nigeria. Basic Electronics Achievement Test (BEAT) was used as instrument for data collection. Reliability testing of BEAT was carried out with the use of Kuder-Richardson 20 (K-R 20) and a reliability coefficient of 0.82 was obtained. Data collected were analyzed using mean and ANCOVA at 0.05 level of significance. Findings of this study revealed that; students taught Basic Electronics using the scaffolding instructional strategy achieved better than those taught with the collaborative instructional strategy. It also revealed that; gender had no significant effect on students' achievement in Basic Electronics. Based on the findings of this study, it was recommended that collaborative and scaffolding instructional strategies should be utilized by teachers to teach basic electronics in Science and Technical Colleges.

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INTRODUCTION

Basic Electronics is one of the vocational courses offered at the upper level of the Nigerian secondary school system. It is a branch of science and technology which deals with the study of the flow and control of electrons in electrical circuits and their behaviour and effects in vacuums, gases, and semiconductors. The objectives of the curriculum as enunciated by the Federal government of Nigeria (FRN, 2007) include to:

- support understanding of the basic electronic components in addition to circuits;
- lay a good foundation for communication and control systems;
- provide a foundation for creativity and technological development in electronics; and
- stimulate, develop and enhance entrepreneurial skills in electronics.

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In order for these objectives to be realized, teachers of electronics, apart from being versed in the subject matter, need to be skilled in the selection of appropriate instructional methodologies, as well as effectively put them to use in the classroom. This will greatly determine their instructional success, which is measured by the academic achievement of the students they teach (Ofojebe, 2010). Essentially, the Nigerian post-primary school is structured into two systems namely; secondary schools and technical colleges. For a student to be admitted into any of the two, he/she must have completed the six years of the primary school as well as the first three years of secondary education (Federal Republic of Nigeria, FRN, 2014). This is why there are two main curricula for secondary education in Nigeria: the conventional secondary school curriculum developed and controlled by the Nigerian Educational Research and Development Council (NERDC), and the technical college curriculum, developed and controlled by the National Board for Technical Education (NBTE). However, there are schools in Nigeria that operate the two curricula. Such schools are science and technical colleges, and they exist in almost every state of the Federal Republic of Nigeria, and are owned by either government or private

entities. Such schools that operate the two curricula are of particular interest to this study. Literature from examination bodies in Nigeria (National Examinations Council, NECO, 2018) show that the academic achievement of the students in science and technical schools is a source of concern. In recent times, there have been reports that the academic achievement of students has been below expectation (Animasahun, 2014). According to Ogundola, Abiodun, and Jonathan (2010) the failure to meet expected standards is attributable to the continuous use of unsuitable instructional methodologies (mostly the traditional didactic instructional approach) by teachers.

Teachers of courses like Basic Electronics are therefore faced with the challenge of presenting relevant classroom activities that can facilitate conceptual change, allow understanding, and recognize individual differences amongst students. Constructivist-based instructional approaches have these qualities. The goal of instruction is to make the learner see the world through her/his own eyes, and not through the eyes of anyone else, much less the teacher's. Ertmer and Newby (2013) submitted that, in order to help learners, see things based on their own conceptualization, a more learner-centred strategy needs to be adopted. This is the central focus of the constructivist theory of learning. In the constructivist theory of learning, students are assisted to develop and construct their own understanding of the material based upon their own knowledge, beliefs and experiences, in concert with new knowledge presented in the classroom. The theory is a branch of cognitivism since both of them conceive learning as a mental activity. But the constructivist theory of learning differentiates itself from traditional cognitive theories in a number of ways. For instance; most cognitive psychologists think of the mind as a reference tool to the real world; constructivists believe that the mind filters input from the world to produce its own unique reality (Ertmer & Newby, 2013). This suggests that learners do not transfer knowledge from the real world into their memories but, rather, build personal interpretations of the world based on their experiences and interactions. This makes their interpretation of knowledge open to constant modification. Hence, within the context in which knowledge is relevant, new meaning surfaces. Basically, to constructivists, both the learner and environmental factors are crucial, because the interaction between the two creates knowledge. Every action is viewed as an interpretation of the current situation based on an entire history of previous interactions (Husa & Ron, 2010). Thus, in constructivism, it is impossible to isolate units of information or divide knowledge domains according to a hierarchical analysis of relationships.

The constructivist theory of learning was preferred in this study because it specifies instructional methods that assist learners to actively explore complex topics/ environments (Wyer, 2014). In Basic Electronics, students can be assisted into thinking as an expert user of that domain might think. This is in tandem with McNaught (2014) who noted that having to cope with an uncertain future calls for a variety of intellectual, interpersonal and personal capabilities. Some of these capabilities are critical thinking, creative thinking, self-managed learning, adaptability, problem solving, communication skills, interpersonal skills and group work, and computer literacy. Harasim (2017) opined that 'directed instruction' may be useful in many specific situations but our ultimate goals in education are 'constructivist'.

Since, knowledge is not abstract but is linked to the context under study and to the experiences that the participants bring to the context. Essentially, learners are supported to construct their own understandings and then to validate, through social negotiation, these new perspectives. The constructivist theory of learning underpins a number of important approaches, which include: situated learning, concept mapping, collaborative instructional approach, anchored instruction, problem-based learning, cognitive apprenticeship, discovery learning, and scaffolding (Elander & Cronje, 2016; Cholewinski, 2009; Jackson, 2006; Jia, 2010; Lai-chong & Ka-ming, 1996; Rowe, 2006; Wu, Hwang, Su, & Huang, 2012). This study focused on scaffolding and the collaborative instructional approach. Scaffolding refer to the process by which a teacher, an instructor or a more knowledgeable peer assists a learner, altering the learning task so the learner can solve problems or accomplish tasks that would ordinarily be impossible for him and to learn from the experience (Reiser, 2004). While McNamara and Brown (2008) defined the collaborative instructional approach as a successful teaching strategy in which small teams, each with students of different levels of ability, use a variety of learning activities to improve their understanding of a subject. If the potentials of scaffolding and collaborative instructional approach are fully utilized, the academic achievement of students in subjects like Basic Electronics could improve. In line with Bloom's taxonomy of educational objectives and from past question papers of the examination bodies testing students at the secondary level in Nigeria, the type of testing employed for a subject like Basic Electronics, measures both cognitive and psychomotor achievements.

LITERATURE REVIEW

Casem (2013) studied the effects of scaffolding strategy on students' performance in Mathematics. The study revealed that the students taught mathematics concepts through scaffolding performed better than those taught through lecture method. Equally, Olatubosun (2013) investigated the effects of using scaffolding strategy on the academic achievement of students in integrated science in Junior secondary school (JSS). Results showed that students exposed to scaffolding strategy performed significantly better than their counterparts who were exposed to the traditional method. Akani (2015) conducted research on the effects of instructional scaffolding on the achievement of senior secondary students in Chemistry. The result obtained revealed that there is a significant difference in the mean score of students exposed to instructional scaffolding strategy and conventional method of instruction. Ibritam, Udofia, and Onweh (2015) conducted a study to determine the difference in students' achievement in Block-laying and concreting using Scaffolding and Demonstration instructional methods in technical colleges. The result showed that there is no significant difference in the mean achievement scores of the students taught using scaffolding instructional strategy and those taught using conventional demonstration method. Uduafemhe (2015) undertook a study to determine the comparative effects of scaffolding and collaborative instructional approach on secondary school students' psychomotor achievement in Basic Electronics. Findings revealed that instructional scaffolding and collaborative instructional approaches are effective in improving students' achievement in Basic Electronics. However, the collaborative instructional approach was more effective than instructional scaffolding strategy.

Adamu (2017) studied the effects of Analogy and scaffolding instructional strategies on senior secondary school Physics students' academic achievement. The two experimental groups were taught using Analogy and Scaffolding instructional strategies while the control group was taught using the lecture method. The finding of the study showed that there is a significant effect of treatment on students' academic achievement. Atsumbe, Owodunni, Raymond and Uduafemhe (2018) carried out a study to determine the effects of scaffolding and collaborative instructional approaches on students' achievement in Basic Electronics. Results revealed that a collaborative instructional approach is more effective in improving students' achievement in Basic Electronics than a scaffolding instructional approach. Also, gender had no significant influence on students' achievement in Basic Electronics when taught using scaffolding and collaborative instructional approaches. It was concluded therefore, that the collaborative instructional approach is a viable teaching method for improving students' achievement in Basic Electronics. Joda (2019) carried out a study to determine the effect of instructional scaffolding strategy on senior secondary school Biology Students' academic achievement and retention of concepts. The findings show that the students taught with instructional scaffolding strategy have significantly higher academic achievement than those taught with lecture method.

However, this study focused only on cognitive achievement. Cognitive achievement reveals how well the educational objectives in the cognitive domain have been realized by a student. It is measured using cognitive achievement tests. When designing achievement tests, whether it is product or process assessment, care should be taken so that there is no gender bias. Gender refers to state of being male or female. For a long time, gender was listed by researchers as one of the factors that influenced the academic achievement of the child (Abubakar & Oguguo, 2011; Gupta, Sharma, & Gupta, 2012). Some researchers believed that boys often out-perform their female counterparts in most subject areas, while some conclude the other way round (Jabor, Machtmes, Kungu, Buntat & Nordin, 2011; Maliki, Ngban & Ibu, 2009). Current trends show that the gap that once existed between genders is fast closing (Abubakar & Bada, 2012). This suggests that females are getting more exposure to educational activities.

STATEMENT OF THE PROBLEM

Despite the huge resources expended by Nigerian stakeholders in the educational sector, mass failure in public examinations, especially in science- and technology-related areas which include Basic Electronics, is still being recorded every year (Animasahun, 2014). Recent statistics of academic achievement among students of Basic Electronics over a period of five years (2013–2018) corroborates this. During this period 2,854 candidates sat for examination in the subject in Nigeria. Out of this number, only 771 candidates scored a credit grade or higher, representing a low 35.4% success rate (NECO, 2018). It was observed by chief examiners of Basic Electronics (NECO, 2018) that this mass failure could be attributed to teachers' use of unsuitable instructional methodologies, especially traditional teacher-centred methods, in teaching the subject. Hence, teachers need to adopt a learner-centred instructional approach, which will emphasize contextualized and constructive processes, and equip the students with higher-order thinking skills for easy adaptability and flexibility. Moreover, studies carried out by many researchers have indicated that constructivist approaches are very effective teaching techniques in modern-day teaching. Since constructivist-based approaches are learner-centred, they emphasize contextualized and constructive processes, and equip the students with higher-order thinking skills (Cholewinsky, 2009). Therefore, the problem of this study is, since constructivist based instructional approaches are found to be effective than traditional approaches, but have not been used in teaching Basic Electronics, would they be effective for improving student overall achievement in Basic Electronics? Hence, the present study was designed to find out the comparative effects of scaffolding and collaborative instructional strategies on science and technical college students' achievement in Basic Electronics in Nasarawa State, Nigeria. The specific objectives of the study were to compare the effect of:

- Scaffolding and collaborative instructional strategies on students' achievement in Basic Electronics.
- Gender on students' achievement in Basic Electronics when taught with scaffolding and collaborative instructional strategies.

RESEARCH QUESTIONS

The following research questions guided the study;

- What are the mean achievement scores of students taught Basic Electronics using scaffolding and collaborative instructional strategies?
- What are the mean achievement scores of male and female students taught Basic Electronics using scaffolding and collaborative instructional strategies?

HYPOTHESES

The researchers tested three null hypotheses at 0.05 level of significance as stated below:

H_{O1}: There is no significant difference in the mean achievement scores of students in Basic Electronics when taught using scaffolding instructional strategy and those taught with collaborative instructional strategy.

H_{O2}: There is no significant difference in the mean achievement scores of male and female students when taught with scaffolding and collaborative instructional strategies in the Basic Electronics.

H_{O3}: There is no significant interaction effect of treatments given to students and their gender with respect to their mean achievement scores in the Basic Electronics.

METHODOLOGY

The study adopted a quasi-experimental research design; specifically, the pre-test post-test non-equivalent control-group experimental design was used. A quasi-experimental design was considered suitable because the study is an experiment where random assignment of subjects to experimental and control groups is not possible, hence intact classes were used. The researchers randomly assigned intact classes to treatment groups, in order not to interrupt the normal classes of the

students and the school time-table. A sample of 63 (35 males and 27 females) from two schools were drawn using a purposive sampling technique from all the 153 senior secondary school year two (SS II) students of Basic Electronics in the three science and technical colleges offering Basic Electronics in Nasarawa State, Nigeria. Two sets of lesson plan for teaching of the six Basic Electronics topics selected for the study were prepared by the researchers in line with both scaffolding and collaborative instructional strategies. Each set contained six lesson plans that were used to teach the students. Each contact lasted for 80 minutes (a double period). Six topics were used to form the content of this study, the topics were: electrical conduction properties of elements, majority and minority charge carriers, p-n junction diode, diode parameters, electrical rectification and dc power supplies (NERDC Basic Electronics curriculum, 2007).

Basic Electronics Achievement Test (BEAT) was used as instrument for data collection. BEAT has 50, four-option multiple-choice items, generated using the test blue-print drawn on six Basic Electronics topics selected. BEAT was validated by three people with Industrial and Technology Education background. Two of them were lecturers of Electrical and Electronics Technology Education drawn from Department of Industrial Technology and Education (ITE), Federal University of Technology, Minna; and the second was an experienced staff of the Department of Examination Development, National Examinations Council, who was a teacher of Basic Electronics before joining the council as a Basic Electronics examination officer. Since the BEAT items are multiple-choice, reliability testing of BEAT was carried out with the use of Kuder-Richardson 20 (K-R 20) and a reliability coefficient of 0.82 was obtained.

The study took place during the normal school setting. The timetable of each school and lesson duration was followed without alteration. Detailed instructions with lesson plans for the six selected topics were given to the four research assistants during the one-week training that was conducted for them. The training pack included detailed lesson plans on the six Basic Electronics topics for the instructional approach to be undertaken by each research assistant; as well as the procedural steps for implementing the instructional approach on which they were trained. Treatment group A was taught using the Collaborative Instructional Strategy. In this treatment group, the research assistants divided the students into group of threes and explained to each group about how they will work together, sharing ideas and solving the given problems as a team. Also, the scoring of assignments was on a group basis. The think-share-pair strategy was used. On the other hand, Treatment group B was taught using the Scaffolding Instructional Strategy. In this treatment group, the research assistants simply used series of scaffolds, such as flash cards, visual (pictorial) scaffolds and question cards to facilitate the lessons. The influences of extraneous variables were checked as follows: firstly, the influence of Hawthorne effect was addressed by using each school's regular Basic Electronics teacher. These teachers were grouped into two and trained in isolation of each other. Secondly, the influence of pre-test sensitization was addressed by retrieving all pre-test question papers and by rearranging the post-test questions in such a way that the first question in the pretest became the last in the post-test. Thirdly, the influence of initial group differences was addressed by the use of analysis of covariance (ANCOVA) for the data analysis.

Fourthly, the influence of subjects' interaction was controlled by the use of intact classes for each treatment group in each school used for the research, so that subjects (students) from one treatment group did not introduce biases in the results by crossing to a treatment group they were not originally assigned to. In the first week, BEAT was administered to both the Treatment Groups A and B. This was followed by a six-week period of treatment of the two groups. Each lesson lasted for 80 minutes (a double period). At the end of the treatment period, a post-test was administered on both groups with BEAT containing the same questions, but rearranged such that the last item in the pre-test became the first item in the post-test. The scores that were obtained from both groups were compared to determine if there was any significant difference in students' achievement. Therefore, the scores were collected and kept in the custody of the researchers for use in further analyses. The data collected for the study were analyzed using mean statistics and analysis of covariance (ANCOVA). Mean statistics was used to answer the two research questions of the study. While the null hypotheses were tested using ANCOVA at 0.05 level of significance. ANCOVA was considered suitable because the study involved two independent variables (teaching methods and gender), a dependent variable (post-test scores) and a covariate (pretest scores).

RESULTS

Research question one: What are the mean achievement scores of students taught Basic Electronics using scaffolding and collaborative instructional strategies?

Table 1 shows that Treatment Group A (group treated with the Collaborative Instructional Strategy) had a pre-test mean score of 12.09 and a standard deviation (SD) of 0.61. Post-test mean score was 30.50 and a standard deviation of 0.96. These yielded a pre-test, post-test mean gain of 18.41. However, Treatment group B, (group treated with the Scaffolding Instructional Strategy) had a pre-test mean score of 12.25 and a standard deviation of 0.64. In the same vein, treatment group B had a pre-test mean score of 12.25 and a standard deviation of 0.64. Post-test mean score was 35.66 and a standard deviation of 1.19, giving a pre-test, post-test mean gain of 23.41. With these results, the students in Treatment Group B performed better in the cognitive achievement test than the students in Treatment Group A. Hence, scaffolding instructional strategy appears to be more effective than collaborative instructional strategy in Basic Electronics.

Research question two

What are the mean achievement scores of male and female students taught Basic Electronics using scaffolding and collaborative instructional strategies? Table 2 reveals that the pretest scores of male and female students in the CIS group is 11.09 and 11.51 respectively with a standard deviation of 0.79 and 0.88. The post-test scores for the same group is 18.11 and 20.01 respectively with a standard deviation of 1.00 and 1.15. The mean gain for male and female students in the CIS group is 7.02 and 8.50 respectively. It also reveals that the pretest scores of male and female students in the SIS group is 12.11 and 11.59 respectively with a standard deviation of 0.84 and 0.98. The post-test scores for the same group is 22.08 and 23.13 respectively with a standard deviation of 1.14 and 1.34. The mean gain for male and female students in the SIS group is 9.97 and 11.54 respectively.

Table 1. Mean Achievement Scores of Treatment Groups Taught Basic Electronics with Scaffolding and Collaborative Instructional Strategies Using BEAT

Groups	Number	Pre-test Mean	SD	Post-test Mean	SD	Mean Gain
CIS (A)	33	12.09	0.61	30.50	0.96	18.41
SIS (B)	30	12.25	0.64	35.66	1.19	23.41

CIS = group with Collaborative Instructional Strategy, SIA = group with Scaffolding Instructional Strategy.

Table 2. Mean Achievement Scores of Male and Female Students Taught Basic Electronics with Scaffolding and Collaborative Instructional Strategies Using BEAT

Group	Gender	Number	Pre-test Mean	SD	Post-test Mean	SD	Mean Gain
CIS	Male	18	11.09	0.79	18.11	1.00	7.02
	Female	15	11.51	0.88	20.01	1.15	8.50
SIS	Male	17	12.11	0.84	22.08	1.14	9.97
	Female	12	11.59	0.98	23.13	1.34	11.54

CIS = group with Collaborative Instructional Strategy, SIA = group with Scaffolding Instructional Strategy.

Table 3. ANCOVA Test of Significance of Three Effects: Treatment, Gender and Interaction on Students' Achievement in Basic Electronics

Source of Variation	Sum of Square	Df	Mean Square	F	Sig (p-value)
Corrected Model	4892.342	4	4892.342	143.113	.000
Intercept	189.327	1	189.327	15.309	.000
Pretest	178.106	1	178.106	10.231	.000
Groups	1815.621	1	1815.621	521.134	.000
Gender	1.172	1	1.172	0.101	.523
Groups*Gender	1.416	1	1.416	0.131	.524
Error	1235.321	54			
Total	8313.305	63			

Hypotheses

H_{O1}: There is no significant difference between the mean achievement scores of students in Basic Electronics when taught using scaffolding instructional strategy and those taught with collaborative instructional strategy.

H_{O2}: There is no significant difference between the mean achievement scores of male and female students when taught with scaffolding and collaborative instructional strategies in the Basic Electronics.

H_{O3}: There is no significant interaction effect of treatments given to students and their gender with respect to their mean achievement scores in the Basic Electronics.
Data to test the three hypotheses is represented in Table 3.

Table 3 shows the F-calculated values for three effects: treatment, gender and interaction on students' achievement in Basic Electronics. The F-calculated value for treatment is 521.134 with a significance of F at 0.000 which is less than 0.05. This result shows that there is a significant difference between the mean achievement scores of students in Basic Electronics when taught using the scaffolding instructional strategy and those taught with the collaborative instructional strategy. The null-hypothesis one is therefore rejected at 0.05 level of significance. The F-calculated value for gender is 0.101 with a significance of F at 0.53 which is greater than 0.05. This result shows that there is no significant difference between the mean achievement scores of male and female students when taught with scaffolding and collaborative instructional strategies in Basic Electronics. The null-hypothesis two is therefore not rejected at 0.05 level of significance. Also, the interaction of treatments and gender has an F-calculated value of 0.131 with significance of F of 0.524. From this, 0.524 is obviously greater than 0.05. Hence, there is no significant effect of treatments given to students on their gender with respect to their mean achievement scores in Basic Electronics. The null hypothesis three is therefore accepted at 0.05 level of significance.

RESULTS AND DISCUSSION

- There was a significant difference between the mean achievement scores of students taught Basic Electronics using the scaffolding instructional strategy and those taught with the collaborative instructional strategy, in favour of the scaffolding instructional strategy.
- There was no significant effect of gender on students' achievement in Basic Electronics.
- There was no significant interaction effect of treatments and gender on students' mean achievement scores in Basic Electronics.

The finding revealed that scaffolding and collaborative instructional strategies are effective for improving students' achievement. However, the scaffolding instructional strategy was more effective than the collaborative instructional strategy. This indicated that there was a significant difference between the mean achievement scores of students in Basic Electronics when taught using the scaffolding instructional strategy and those taught with the collaborative instructional strategy, in favour of the scaffolding instructional strategy. These imply that scaffolding and collaborative instructional strategies are effective for teaching Basic Electronics. However, the scaffolding instructional approach is more effective than collaborative instructional approach. This finding is similar to that of Adamu (2017); Atsumbe, Owodunni, Raymond and Uduafemhe (2018); Akani (2015); Uduafemhe (2015); Olatunbosun (2013); Casem (2013) who found that students who participated in a Scaffolding

instructional strategy performed significantly better on a critical-thinking test than students who studied individually as in collaborative. The findings of this study are at variance with that of Ibritam, Udofia, and Onweh (2015) who found out that there is no significant difference in the mean achievement scores of students taught through instructional scaffolding strategy and other methods of teaching. Similarly, Joda (2019) and Pandhu (2018) discovered that, in the scaffolding instructional strategy, students actively exchange, debate and negotiate ideas within their groups, and this increases the students' interest in learning. Importantly, by engaging in discussion and taking responsibility for their learning, students are encouraged to become critical thinkers. By working in small groups, students tend to learn more of what is being taught and retain the information longer, and also appear more satisfied with their classes. Therefore, the difference observed between the two groups is as a result of the scaffolding instructional strategy being more effective in improving students' cognitive achievement in Basic Electronics than the collaborative instructional strategy. The results revealed that there was an effect of gender on students' achievement in Basic Electronics. These imply that both scaffolding and collaborative instructional strategies are not gender-biased in teaching of subjects like Basic Electronics. This finding is similar to findings of several other studies that have been conducted on effects of gender on achievement of male and female students in sciences and other fields. For instance, Nwagbo and Obiekwe (2010) affirmed that there was no significant difference between male and female students' achievement. This view was reiterated by Afolabi and Akinbobola (2009) who discovered that there was no significant gender difference in the performance of students taught with a problem-based learning technique in a physics achievement test. Abubakar and Bada (2012), and Ogbuanya and Owodunni (2013) also found that gender is not significant in the academic achievement between females and males. Hence, these findings confirmed that when males and females are exposed to academic activities in subjects like Basic Electronics, under the same environmental conditions, and taught by the same teacher using the same methodology, their performance level would be the same. The results revealed that there was no significant interaction effect of treatments and gender on students' mean achievement scores in Basic Electronics. This is in agreement with the findings of Uduafemhe, (2015); Atsumbe, Owodunni, Raymond and Uduafemhe (2018) who found out that gender had no significant influence on students' achievement in Basic Electronics when taught using scaffolding and collaborative instructional approaches.

Conclusion

The need to find the most appropriate instructional strategy to assist Basic Electronics students to enhance their academic achievement is very important. This study therefore ascertained the comparative effects of scaffolding and collaborative instructional strategies on Science and Technical College students' achievement in Basic Electronics in Nasarawa State, Nigeria. The study found out that the scaffolding instructional strategy is more effective in improving students' cognitive achievement in Basic Electronics than the collaborative instructional strategy. Also, the study revealed that, gender had no effect on students' achievement in Basic Electronics. The study also revealed that collaborative and scaffolding instructional strategies are not gender-biased and there was no interaction effect of treatments and gender on students' mean achievement scores in Basic Electronics. Students recorded higher cognitive in Basic Electronics when the scaffolding instructional strategy was used for teaching the subject, irrespective of gender. These results therefore show that collaborative and scaffolding instructional strategies are workable teaching strategies for Basic Electronics.

Recommendation

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

- Collaborative and scaffolding instructional strategies should be used by teachers of electronics in science and technical colleges teaching basic electronics.
- It is recommended that the Nigerian Educational Research and Development Council (NERDC) should consider incorporating collaborative and scaffolding instructional strategies into the teaching of subjects like Basic Electronics when next they are reviewing the curriculum;
- It is recommended that training and retraining workshops, seminars and conferences be organized the National Board for Technical Education (NABTE) along with other sister agencies in collaboration with the Ministries of Education both at federal and states levels, to enlighten teachers of technology education with a view of improving their knowledge with skills on the use of collaborative and scaffolding instructional strategies.

REFERENCES

Abubakar, R. B., & Bada, I. A. 2012. Age and gender as determinants of academic achievements in college mathematics. *Asian Journal of Natural & Applied Sciences*, 1(20), 121–127.

Abubakar, R. B., & Oguguo, O. D. 2011. Age and gender as predictors of academic achievement of college mathematics and science students. *Journal of Educational and Social Research*, 1(2), 89–93.

Adamu, J. 2017. Effects of analogy and scaffolding instructional strategies on senior secondary school physics students' academic achievement in Adamawa State, Nigeria. Unpublished M. Tech research thesis. Modibbo Adama University of Technology Yola, Adamawa State.

Afolabi, F., & Akinbobola, A. O. 2009. Constructivist problem based learning technique and the academic achievement of physics students with low ability level in Nigerian secondary schools. *Eurasian Journal of Physics and Chemistry Education*, 1(1), 45–51.

Agu, P. A., & Samuel, I. R. 2019. Comparative effects of peer tutoring and explicit instructional strategies on Science and Technical college students' achievement and retention in Nasarawa State, Nigeria. *International Journal of Research-Granthaalayah,* 7(10), 390-399. DOI: 10.5281/zenodo.3532036.

Akani, O. 2015. Impact of instructional scaffolding on students' achievement in Chemistry in Secondary School in Ebonyi State, Nigeria. *International Journal of Education, Learning and Development*, 3(7), 74-83.

Animasahun, R. A. 2014. The menace of examination malpractices in Nigeria secondary schools and remediative

measures towards attitudinal re-orientation: The counsellor's perspectives. African Journal for the Psychological Studies of Social Issues, 16(2), 300–309.

Atsumbe, B., Owodunni, S., Raymond, E., & Uduafemhe, M. 2018. Students' achievement in basic electronics: Effects of scaffolding and collaborative instructional approaches. *EURASIA Journal of Mathematics, Science and Technology Education*, 14(8), 2-17

Casem, R. Q. 2013. Scaffolding Instructional Strategy in teaching Mathematics: Its effects on students' performance and altitude. *Comprehensive Journal of Education Research,* 1(1), 9-19

Cholewinski, M. 2009. An introduction to constructivism and authentic activity. *Journal of the school of contemporary international studies Nagoya University of Foreign Studies*, 5, 283–316.

Dooly, M. 2008. Constructing knowledge together. Tele-collaborative language learning. A guidebook to moderating intercultural collaboration online, 3(1), 21–45.

Elander, K., & Cronje, J. C. 2016. Paradigms revisited: a quantitative investigation into a model to integrate objectivism and constructivism in instructional design. *Educational Technology Research and Development*, 64(3), 389–405.

Ertmer, P. A., & Newby, T. J. 2013. Behaviorism, cognitivism, constructivism: comparing critical features from an instructional design perspective. Performance Improvement Quarterly, 26(2), 43–71.

Federal Republic of Nigeria, 2014. National policy on education. Lagos. NERDC Press.

Gokhale, A. A. (1995). Collaborative instructional approach enhances critical thinking. *Journal of Technology Education*, 7(1), 22–30.

Gupta, R., Sharma, S., & Gupta, M. 2012. A study of gender difference on the measure of academic achievement in adolescent students. *Visual Soft Research Development Technical and Non-Technical Journal*, 3(1), 23–27.

Harasim, L. 2017. Learning theory and online technologies (second edition). London: Routledge. Husa, A. A., & Ron, S. 2010. An analysis and guide for the proposed redesign of the ELS

curriculum in Saudi Arabia public school using advanced organizers. Indiana University Bloomington R511 Instructional Technology Foundations. Retrieved on 30 November 2017 from http://www.husaalangari.com/styles/husa/defiles/Portfolio_ID_Report.pdf

Ibritam, K. S; Udofia, N. & Onweh, V. Z. 2015. Assessing the potency of scaffolding and Demonstration instructional methods on student's achievement in Technical Colleges in Akwa Ibom State. *Advances in Research*, 3(1), 92- 101.

Jabor, M. K., Machtmes, K., Kungu, K., Buntat, Y., & Nordin, M. S. 2011. The influence of age and gender on the students' achievement in mathematics. International Conference on Social Science and Humanity IPEDR, 5(2011), (pp. 304–308). Singapore.

Jackson, S. R. 2006. Using constructivist methods to teach social studies to special education students. Terminal Masters Project Wayne State University, Detroit, Michigan.

Jia, Q. 2010. A brief study on the implication of constructivism teaching theory on classroom teaching reform in basic education. International Education Studies, 3(2), 197–199.

Joda, F. M. 2019. Effects of Instructional Scaffolding Strategy on Senior Secondary Biology Students' Academic Achievement and Retention in Taraba State, Nigeria. In: *Education Quarterly Reviews*, Vol.2, No.2, 269-275.

Lai-chong, L., & Ka-ming, W. 1996. Implications and problems of constructivism for instructional design. Education Journal, 23(2), 73–104.

Maliki, A. E., Ngban, A. N., & Ibu, J. E. 2009. Analysis of students' performance in junior secondary school mathematics examination in Bayelsa State of Nigeria. Kamla-Raj, 3(2), 131–134.

McNamara, J., & Brown, C. 2008. Assessment of collaborative learning in online discussions. In ATN Assessment 08: Engaging Students with Assessment. Adelaide: University of South Australia. Retrieved on 15 April 2018 from https://www.ojs.unisa.edu.au/index.php/atna/article/viewFile/214/248/accessed

McNaught, C. 2014. Short paper on the revised Bloom's taxonomy and the Solo taxonomy. Centre for learning enhancement and research (CLEAR), The Chinese University of Hong Kong. Retrieved on 15 April 2018 from http://www.cuhk.edu.hk/clear/download/Learning_at_university.doc

National Examinations Council (NECO). 2018. Chief examiners' report for SSCE June/July 2018. Ilorin: NECO publication. National Examinations Council (NECO). (2013). Performance of candidates SSCE (June/July) in Electronics 2008-2012. Minna. Statistics Unit, QAD, NECO. Minna: NECO publication.

Nigerian Educational Research and Development Council (NERDC). (2007). Curriculum for basic electronics. Abuja. NERDC press.

Nonye, A. & Nwosu, B. O. 2011. Effects of Instructional Scaffolding on the achievement of male and female students in Financial Accounting in Secondary Schools in Abakaliki Urban of Ebonyi State, Nigeria. *Current Research Journal of Social Sciences*, 3(2), 66-70.

Nwagbo, C., & Obiekwe, C. 2010. Effects of constructivist instructional approach on students' achievement in basic ecological concepts in biology. Journal of Science Teachers Association of Nigeria, 45(1 & 2), 26–35.

Nworgu, B. G. 2006. Educational research: basic issues and methodology. Enugu. University trust publishers.

Olatubosun, E. O. 2015. Effects of scaffolding strategy on learners' academic achievement in integrated science at the Junior Secondary School level. *European Scientific Journal*, 9(19), 149-155.

Ofojebe, W. N. 2010. Teachers' Motivation and its influence on quality assurance in the Nigerian educational system. African Research Review, 4(2), 398–417.

Ogbuanya, T. C., & Owodunni, A. S. 2013. Effects of reflective inquiry instructional technique on students' achievement and interest in radio television and electronics works in technical colleges. *IOSR Journal of Engineering*, 3(11), 2250–3021.

Ogundola, I. P., Abiodun, A. P., & Jonathan, O. O. 2010. Effects of constructivist instructional approach on teaching practical skills to mechanical related trade students in western Nigeria technical colleges. *International NGO Journal*, 5(3), 59–64.

Okoro, O. M. 1999. Principles and methods in vocational and technical education. Nsukka.

University trust publishers. Reiser, B. J. 2004. Scaffolding complex learning: the mechanisms of structuring and

problematizing student work. *The Journal of the Learning Sciences*, 13(3), 273–304.

Pandhu, N. 2018. Effect of instruction with scaffolding on school students' achievement in science in relation to cognitive styles and intelligence. *Journal of Advanced Research in Psychology & Psychotherapy,* 1(1&2), 53-59

Rowe, K. 2006. Effective teaching practices for students with and without learning difficulties: Constructivism as a legitimate theory of learning and of teaching. Australian Council for Educational Research, 1–24.

Uduafemhe, M.E. 2015. Comparative effects of scaffolding and collaborative instructional approaches on secondary school students' psychomotor achievement in Basic Electronics in North-central Nigeria. *International Organization of Scientific Research.* 5(6), 23-31.

Wu, P. H., Hwang, G. J., Su, L. H., & Huang, Y. M. 2012. A context-aware mobile learning system for supporting cognitive apprenticeships in nursing skills training. *Educational Technology & Society*, 15(1), 223–236.

Wyer Jr, R. S. (Ed.). 2014. The automaticity of everyday life: Advances in social cognition. Advances in Social Cognition Series (Book 10). London: Psychology Press.

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