

## Effect of Reciprocal Constructivist Instructional Approach on Middle Basic Science Students' Academic Achievement of Kaduna Education Zone, Kaduna State

Yunusa Idris

Received: 04 June 2022/Accepted 08 August 2022/Published online: 14 August 2022

**Abstract:** *The study investigated the effects of reciprocal constructivist instructional approach on academic achievement among middle Basic Science students (JSS II) in Kaduna Education Zone, Kaduna State, Nigeria. The population of the study consisted of seven thousand two hundred and fifty eight (7,258) students from the Junior secondary schools and two (2) Basic science students from 12 public schools. Two schools were randomly selected and assigned as experimental and control groups. A sample of 70 students (59 male and 11 female) was used for the study. A quasi experimental pretest and posttest design were employed. The two groups were pretested to determine their equivalence. The experimental group was taught some Basic Science concepts using reciprocal constructivist instructional approach while the control group was taught same concepts using lecture method. A Validated instrument, Basic Science Achievement Test (BSAT), with reliability co-efficient of 0.71 was used to generate data after treatment. Two research questions and two null hypotheses were formulated. The data were analyzed using t-test. The results obtained showed that the group exposed to the reciprocal constructivist instructional approach achieved better and significantly higher when taught the concepts than their counterparts exposed to lecture method. It also revealed a significant difference in academic achievement among gender in favour of male after treatment. Based on the results, several recommendations were made among which reciprocal constructivist instructional approach should be employed as*

*a teaching strategy by Basic Science teachers in teaching Basic Science subjects in Junior Secondary Schools.*

**Keywords:** Reciprocal constructivist instructional approach, academic achievement, basic science, education zone

**Yunusa Idris**

Department of Integrated Science, School of Secondary Science Education, Federal College of Education (Technical) Gusau, Zamfara State, Nigeria

**Email:** [iyunusaidris20202@gmail.com](mailto:iyunusaidris20202@gmail.com)

**Orcid id:** 0000-0002-2713-9841

### 1.0 Introduction

Science by its nature is a discipline of questioning and thinking. Ado (2012) and Ojimba (2013) stated that science education since mid-twentieth century has experienced deep transformation in Nigeria and other countries of the world, especially between the early sixties and seventies. In recent times, several modifications have been incorporated into the teaching of sciences in our schools.

According to Eze (2012), for learning to be meaningful and effective, the teacher should be able to select the appropriate teaching strategies that will be able to stimulate the interest of the learners and get them actively engaged in the process. Consequently, a change in the trend of educational practice is expected, once assessment and implementation of standard teaching practice methods are made. Such trends as a daily occurrence may be a positive reflection associated with a migration from the transmission view towards knowledge

construction based, which is vital for alliance in the current world realities such as technological development. The National Policy on Education (2006) emphasizes paradigm shift in educational practices from teacher to learner centeredness, to enhance conceptual learning in science and in the development of positive attitude towards learning of science.

Researchers have found that conventional practices such as lecture method and expository approach have limited efficiencies in the provision of the learning outcomes among students (Umoren and Aniashi, 2007; Atomatofa, 2013). The search for alternative variables has led to the exploration of instructional strategies that are based on constructivism. Construction in education is defined by Orji and Ekpo (2013) as a learning theory on knowledge that argues that humans generate knowledge and meaning from an interaction between their experiences and ideas. Consequently, in the constructivist instructional approach, learners interpret and process the incoming information through senses which create knowledge that is personally constructed and reconstructed using their prior knowledge or experience.

Reports published by Trickling, (2011) designed a reciprocal teaching using an interactive instructional model that provoked novice learners to engage into meaningful learning. He recognized that scaffolding learners are to be active in the transfer of learning while long term sustainability is more likely to be achieved. Reciprocal teaching is an instructional activity that complies with the creation of knowledge based dialogues between teachers and students using text segmentation approach for the construction of text. Reciprocal teaching is also an intervention in which a student provides instruction or academic assistance to another student. It is a form of cooperative technique for increasing students' academic achievement (Sharman, 1991; Slavin 1991). This process can transform

learning from a private to social activity by encouraging learners to be responsible for their learning. In this process, students function reciprocally as both tutors and tutees. This role is beneficial because it enables students to gain from both preparation and instruction in which tutors are engaged and from the instructions that tutees received (Griffin & Griffin, 1997). Reciprocal teaching focuses on four (4) thinking strategies namely: (i) predicting (ii) clarifying (iii) questioning and (iv) summarizing

Adedoyin (2010) and Danmole *et al.* (20014) also submitted that instructional approaches that involve the active participation of students may be more effective in the teaching of Basic Sciences that requires the use of instructional strategies to enhance meaningful learning and acquisition of skills as many activities and concepts are involved.

Basic science, therefore, is a fundamental science that cuts across subject boundaries that offers the learners experiences in helping them to develop an operational understanding of the structure of science that could enrich their lives and make them responsible citizens. It occupies a central position in the teaching and learning of science education by exposing the learners or students to some Basic Science process skills. Okebukola (2007) noted that when one acquires the science process skills, such an individual becomes specially equipped with tools required for scientific investigations. The science process skills are also required to facilitate the pursuit of a profession or higher education which would make the individual self-reliant and independent economically (FME, 2004)

Science educators have advanced several factors to account for the poor achievement among Nigerian Students in science subjects (including basic science), among which include students inability to understand and apply science concepts, poor quality of instruction, and lack of professional teachers (Dike and Ndakwo, 2007).



Orji (2007) also indicated that achievement entails the extent to which tasks have been carried out successfully especially using their own skills. The achievement level in the junior secondary school is determined through the evaluation of mock and JSCE examination results.

Teaching approach such as the constructivist approach that involves the active participation of learners could lead to the development of a positive attitude to the learning of scientific concepts which may depend on gender of students. The learning efficiency of male and female students may be different; hence, the issue in our educational system. Ajayi and Osoko (2013) indicated from their studies that gender can influence students' achievement in process skills acquisition in science subjects while on the contrary Maikano, Bichi and Shaibu (2016) examined gender related differences in ecology and discovered that there was no disparity in the academic achievement of male and female exposed to indoor and outdoor instructional strategies.

Ezeudo and Obi (2013) affirm from their studies that science is a male dominated subject because female students tends to shy away from scientific discipline and tend to perform low in sciences. The study seeks to investigate the effects of a reciprocal constructivist instructional approach on students in Basic Science using gender as an intervening variable.

### **1.1 The Problem**

The Federal Government of Nigeria (FGN, 2014) clearly explains that the teaching of Basic Science and technology at the junior secondary school levels should be in an integrated manner to promote students' practical application of skills and ideas in science and to provide solution to problems. It is also to be activity-based as it will instill in the students creative minds and critical thinking. Basic Science as a fundamental science and activity-based subject should be taught using diversified strategies to enhance

the understanding and achievement of students. However, literatures confirm that Basic Science is not being taught the way it should in Nigeria schools (Brent, 2003) because most teachers teach the students to memorize facts and give them no room to effectively know and apply the fundamentals of science in the real life. James (2000) also showed that 70% of scientific information and principles are passed to students via lecture method. However, to bring about improvement in students achievement in Basic Science in our schools, teachers' trends in the use of teaching approaches as well as strategies should be well focused. Hence, the study attempts to investigate the effects of reciprocal constructivist instructional strategy on the academic achievement of middle Basic Science students in Kaduna Education Zone, Kaduna state.

### **1.2 Objectives of the study**

The purpose of the study is to determine the effect of reciprocal constructivist instructional approach on students' achievement in Basic Science concepts at junior secondary school level in Kaduna Education Zone of Kaduna state. Specifically, the study is expected to achieve the following objectives:

- (i) Determine the effect of reciprocal constructivist instructional approach on students' academic achievement in Basic Science concepts.
- (ii) Find out if there is any gender difference in academic achievement among students when taught Basic Science concepts using reciprocal constructivist instructional approach.

### **1.3 Research questions**

The following questions were formulated to guide the study:

- (i) What is the difference in the mean achievement of scores of students taught Basic Science concepts using a reciprocal constructivist instructional



approach and those taught using the lecture method?

- (ii) What possible difference exists in the mean achievement scores of male and female students taught Basic Science concepts using a reciprocal constructivist instructional approach?

**1.4 Hypotheses**

The following null hypotheses were tested at 0.05 level of a significance:

**H01:** There is no significant difference in the mean achievement scores of Basic Science students taught using reciprocal constructivist instructional approach and those taught with lecture method of teaching.

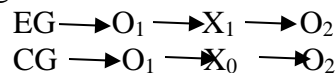
**H02:** There is no significant difference in the mean achievement scores between male and female Basic Science students taught using reciprocal constructivist instructional approach.

**2.0 Methodology**

The design of this study is quasi-experimental with two pretested and post-tested groups to investigate the effects of exposing the experimental group (EG) to treatment conditions and comparing their academic achievement after the treatment with that of

control group (CG) which did not receive the treatment.

The design is illustrated as follows:



where, EG is the experimental group, CG is the controlled group, O<sub>1</sub> is the pretest, O<sub>2</sub> is the posttest., X<sub>1</sub> is the reciprocal constructivist instructional approach (treatment) and X<sub>0</sub> is the conventional lecture method of teaching.,

The population of the study consisted of all middle Basic Science students in Kaduna Education Zone, Kaduna State, Nigeria. It was drawn from 12 public secondary schools which operate same academic calendar and curriculum. It however contains 7,258 students that comprise 3649 male and 3,609 female with an average age of 16 years. Two schools were randomly selected and used as sample with an enrolment of 87 students but 17 students absconded leaving 70 students who were subjected to pretest as the sample of the study. One of the two sampled schools was assigned as an experimental group consisting of 34 students and the other school as a control group (CG) having 36 students. In both experimental and control groups, 59 students were males and 11 students were females. Table 1 illustrates the sample of the study.

**Table 1: Sample of the study**

S/No	School	No. of students	No pretested	M	F	Groups
1	X	42	34	28	6	Experimental
2	Y	45	36	31	5	Control
<b>Total</b>	2	87	70	59	11	2

Two methods of instruction, the conventional lecture method and the reciprocal constructivist instructional approach were used. In the conventional lecture method, the Basic Science concepts were taught through verbal explanation using chalk and board while students write notes. But, in the reciprocal constructivist approach, the teacher introduced every concept carefully within a short period of

time, then allowed the students in different small groups to in a collaborative way discuss exhaustively, engaged in critical thinking among themselves, and freely interact with each other mutually to provide support to one another. More so, several teaching aids were used to illustrate the lesson in order to enhance understanding and effective reasoning towards arrival at a meaningful answer.



The experimental group (EG) was taught some Basic Science concepts using the reciprocal instructional approach. Six weeks were used for the whole teaching using a period of 80 minutes.

The same week and duration of the lesson were also used in teaching the control group (CG) the same concepts. At the end of the treatment, a post-test was administered to both the experimental and control groups. In fact, during the teaching of the two groups, objectives, contents, instructional aids and evaluation techniques were essentially the same. This is to ensure that, any difference in students' achievement if any after treatment could be attributed to the difference in the instructional strategy or method employed.

An instrument called Basic Science Achievement Test (BSAT) was used to collect

data. The BSAT was constructed by the researcher. It was a 30-item multiple choice instruments used in both pretest and posttest. The instrument was validated by a team of experts in the Department of Science Education, Educational Statistics and Practicing Basic Science teachers. The instrument was pilot tested and the result was used in determining the reliability co-efficient which was found to be 0.71.

### 3.0 Results and Discussion

Two types of data were obtained; the achievement scores from the pretest and posttest. The data were then analyzed using statistical tools. The pretest means scores of the experimental and control groups were subjected to t-test statistics and the results are presented in Table 3.

**Table 2: t-test of the pretest mean scores of the experimental and control groups**

Group	N	Mean scores( $\bar{x}$ )	S.D	S.E	t-cal	t-crit	df	p-value
Experimental	34	44.13	14.94	2.56	1.10	1.96	68	0.30
Control	36	43.17	15.38	2.56				

\*\*Not significant at  $p < 0.05$

In Table 2, the p-value of 0.30 is greater than  $p < 0.05$  with  $df = 68$ . This means that there is no significant difference between the pretest scores of the experimental and control groups. This implies that the experimental and control groups were equivalent concerning their knowledge of Basic Science concepts at the beginning of the study.

**Table 3: Posttest mean scores of experimental and control groups**

Group	N	Mean score( $\bar{x}$ )	Variance	S.D	Mean Gain
Experimental	34	50.76	318.3	17.7	
control	36	46.17	296.53	17.22	4.59

Table 3 revealed that the mean score for the experimental group is 50.76 and that of the control group is 46.17. Therefore, the mean gain is 4.59. This means that the experimental group taught using the reciprocal constructivist instructional approach has a higher mean than the control group taught using the lecture

method. This finding answers research question 1.

#### 3.1.2 Research question 2:

Is there any meaningful difference in achievement scores among male and female Basic Science students taught using a



reciprocal constructivist instructional approach?

The mean score of the male students is 51.06 while that of the female is 46.31. Thus, the

mean gained is 3.57. This means that the male students achieved higher than the female ones. This answers research question 2

**Table 4: Gender mean scores exposed to reciprocal constructivist instructional approach**

Group	N	Mean score( $\bar{x}$ )	Variance	S.D	Mean Gain
Male	28	51.06	437.40	20.91	
Female	6	46.31	300.78	17.34	3.57

**3.2 Hypotheses testing**

The data obtained from the posttest were analyzed to test the null hypotheses.

**H0<sub>1</sub>:** There is no significant difference in the

academic achievement of Basic Science students exposed to reciprocal constructivist instructional approach and those exposed to the lecture method. The results are presented in Table 5.

**Table 5: t-test analysis of the posttest mean scores of the experimental group taught using reciprocal constructivist instructional approach and control group taught with lecture method.**

Group	N	Mean scores( $\bar{x}$ )	S.D	S.E	t-cal	t-crit	df	p-value
Experimental	34	50.76	17.70	3.04	4.59	2.01	68	0.001
Control	36	46.17	17.22	2.87				

From Table 5, the p-value of 0.001 is less than the critical p-value of 0.05 with df = 68. This means that there is a significant difference between the mean scores of the experimental group and control group is in favour of the experimental group. Thus, the hypothesis is rejected. This implies that the experimental group taught Basic Science concepts using reciprocal constructivist instructional approach have achieved significantly higher than the control group. Therefore, the null hypothesis earlier stated is rejected.

**H0<sub>2</sub>:** There is no significant difference among male and female Basic science students taught

using reciprocal constructivist instructional approach.

In testing this hypothesis, the posttest data were subjected to t-test statistic. Summary of the analysis is given in Table 6.

From Table 6, p – value of 0.001 less is than the critical P-value of 0.05 with df = 68. This means that there is a significant difference between the posttest means scores among gender. This implies that the male Basic Science students achieved higher than their female counterparts. So, the null hypothesis which stated that there is no significant difference is therefore rejected.

**Table 6: t-test analysis of the posttest mean scores of male and female students**

Group	N	Mean score( $\bar{x}$ )	S.D	SE	t-cal	t.crit	df	p-value
Experimental	28	51.06	20.91	3.59	4.75	2.01	68	0.001
Control	6	46.31	17.34	2.89				



The results obtained from the analysis of data in Table 5 show that the subjects in the experimental group (EG) who were taught the Basic Science concepts using a reciprocal constructivist instructional approach achieved significantly higher than their counterparts in the control group (CG) who were taught same concepts using the traditional lecture method. The significant difference in the academic achievement in favour of the experimental group suggests a greater strength and effectiveness reciprocal constructivist instructional approach over the lecture method. This finding conforms with those of Lazarus (2014) and Ogunyebi (2018), who showed in their studies that the reciprocal constructivist instructional approach is superior and more effective in improving students' academic achievement than the traditional lecture method.

The posttest results in the Table 6 showed that the male Basic Science students in the experimental group exposed to the reciprocal constructivist instructional approach achieved significantly better than their female counterpart. It revealed the posttest mean score of 51.06 while their female counterparts have a mean score of 46.31. Therefore, the statistically significant difference between male and female mean scores suggests that the reciprocal constructivist instructional approach is in favour of male Basic Science students. The results also agree with the earlier findings of Ajinwa (2000) and Ezeudo and Obi (2013) each of them reported the effectiveness of the constructivist approach where they both investigated its effects on the academic achievement of the some science concepts among gender with male achieving higher than female.

#### 4.0 Conclusion

The study confirmed the superiority of reciprocal constructivist instructional approach over the traditional lecture method in the teaching of Basic Science. Therefore, since findings from our researches are to guide our

activities in the class rooms, then, science teachers should give attention to those instructional strategies that appear to be effective and fruitful in teaching-learning process.

Based on the findings of the study, it is recommended that Basic science teachers should develop skills of reciprocal constructivist instructional approach to practice them in their teaching styles.

#### 5.0 References

- Adedoyin, O. (2010). An investigation of the effects of teachers' classroom question on the achievement of students in mathematics: case study of Bostwana Community Junior secondary schools. *European Journal of Educational Studies*. 2, 3, pp. 313- 328.
- Ado, S. (2012) *History and philosophy of integrated science in Usman, A.I (Ed), Introduction to Science Education*. Zaria, E. Watch Print Media.
- Ajayi, O.A & Osoko, I.V. (2013). Effect of practical assisted instructional strategy on student achievement in biology, *Journal of Resourcefulness and Distinction* 6, 1, pp.17-32
- Ajinwa, C.A. (2000). Acquisition of physics process skills by secondary school students. Unpublished Ph.D Thesis, University of Nigeria, Nsukka.
- Atomatofa, R. (2003). Effect of Advance Organizers on Attainment and retention of students' concept of gravity in Nigeria, *International Journal of Research Studies in Educational Technology*, 2,1 pp.81-90
- Danmole, B.T. (1992). The influence of teacher preparation and use of instructional material in primary school pupils performance in basicscience. *Ilorin journal of Education*. 12, pp. 56-64.



- Dike, N. & Ndokwo, K.J (2007). Issue on human resources development for science, technology and mathematics education in Nigeria. STAN proceeding, pp.19-24 HEBN Publishers
- Eze, G.N. (2012). *Effect of Target Task approach on students achievement and interest in senior secondary school physical chemistry. An Unpublished PhD dissertation university of Nigeria Nsukka*
- Ezeoudu, F.O. & Obi, T.N. (2013). *Effect of Gender and Location On Students Achievement in Chemistry in Secondary Schools in Nsukka Local Government Area of Enugu State. Nigeria Journal of Research on Humanity and Social science. 31 pp.50-55.*
- Federal Ministry of Education (FME). (2004): *Nigerian National Policy on Education. NERDC Press.*
- Griffin, B.W. & Griffin, M.M, (1997) The effects of reciprocal peer tutoring on Graduate students Achievements Test Anxiety and Academic Self-Efficiency. *Journal of Experimental Education* 65,3, pp. 297- 312
- Femi-Adoye, K.O. (2004). Effect of concept mapping technique on senior secondary school student' achievement and retention of ecological concepts. *Journal of the Science Teachers Association of Nigeria.* 39, 1, 2 pp. 32-38
- James, T. (2000). Effect of combined reflective writing with concept mapping and lecture method on pre-service nce teachers attitude and achievement of biology. *Ph.D Thesis, ABU Zaria*
- Lazarus, K. (2014) Effect of Peer Tutoring and Cooperative learning instructional strategies on mathematics achievement of students with learning disabilities in Oyo State, Nigeria". *African Journal for the Psychological Status Social Issues.* 17, 1, pp 354 - 365
- Maikano, S. Bichi S.S. & Shaibu, A.A.M (2016). Gender related differences in academic achievement of students taught ecology using the indoor and outdoor laboratory structional strategies. *Journal of Educational Research Development,* 10,1, pp. 036-041
- Moston, M. & Ashworth, S. (2002). *Teaching Physical Education ( 5<sup>th</sup> Edition), Benjamin Cummins, San Francisco, C.A.*
- Ogunyebi, T.H (2018). Effects of Reciprocal Instructional Strategy on Junior Secondary School Students' Performance in Basic Science in Ekiti State, Nigeria. *International Journal of Advanced Academic Research Arts, Humanities and Education* 4, 6, pp.105 -121
- Ojo, R.O. (2000). A Comparative Effectiveness of Real practical methods of Teaching Basic Science in Nigeria. *Ikere journal of science Education.* 3,1, pp.162-168.
- Ojimba, D.P. (2013) Science Education Reforms in Nigeria. Implication for Science Teachers Global Advanced Research. *Journal of Peace, Gender and Development Studies ARJPGDS),* 2,5, pp.086-090
- Okebukola, P.A. (2007). Attaining meaningful learning of concepts in genetics and ecology. an examination of the potency of concept mapping technique. *Journal of Research in Science Teacher Education* 27,5, pp. 493 - 504
- Orji, A.B.C & Ekpo, C.G. (2013) Constructivist Based Instructional Approaches and Students Learning Outcomes in Environmental Education. *International Journal of*





*Education, Science Humanities, Mathematics and Environmental Studies.* 5,1, pp. 1 -4

Sherman, L.W. (1991) Cooperative learning in post-secondary education: implication from social psychology for active learning experiences. paper presented at the 29<sup>th</sup> Annual Meeting of the American Education Research held from 12 – 15 April, 1991

Slavin, R.E. (1991) *Synthesis of Research on Cooperative Learning. Educational Leadership.* 48,5, pp.495-510

Umoren, G.U. & Aniashi, S.O. (2007). Prior presentation of behavioral objectives and students' performance in biology. *Educational Research and Review.* 2,2, pp. 22-25.

#### **Consent for publication**

Not Applicable.

#### **Availability of data and materials**

The publisher has the right to make the data public.

#### **Competing interests**

The authors declared no conflict of interest.

This work was carried out in collaboration among all authors.

#### **Funding**

There is no source of external funding.

#### **Authors' contribution**

The work was solely carried out and written by Yunusa Idris

