THE EFFECTS OF REFLECTIVE – RECIPROCAL TEACHING STRATEGY ON JUNIOR SECONDARY BASIC SCIENCE STUDENTS' ACHIEVEMENT IN TARABA STATE

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ABSTRACT

The study investigated the effect of Reflective-Reciprocal Teaching strategy on achievement in Basic science among junior secondary school students in Taraba state. The study determined the mean achievement of students taught Basic science using RRTS and those taught with conventional strategy; it also determined gender differential in Basic science achievement of junior secondary school students taught using RRT strategy and; investigated the achievement gain among different ability levels taught Basic science using RRT strategy. The research design used in this study was the quasi – experimental of non-equivalent group design. The pre and posttest control was used. The sample for the study comprised of 85 students selected using the stratified random sampling technique from the population of Junior Secondary School two (JSS2) students distributed among 117 government grant- aided schools in Taraba State. The main instrument used in this study to collect data is the Basic Science Achievement Test (BAT) with items consisting of 50-item multiple choice questions and adapted from past Junior NECO question papers designed by the researcher. The instrument was validated and its reliability was coefficient of 0.74 was obtained using the Split-half reliability estimate. The research questions were answered using descriptive statistics such as the mean, variance and standard deviation while Analysis of Covariance (ANCOVA) was used to test the three hypotheses at 0.05 significance level. The study found out that mean achievement scores of students taught Basic science using Reflective Reciprocal Teaching strategy differs significantly from the mean achievement scores of those taught using the conventional strategy; Mean achievement scores of male and female students taught Basic science using Reflective Reciprocal Teaching strategy do not differ significantly and; Mean achievement scores of students with high, medium and low ability students taught Basic science using Reflective Reciprocal Teaching strategy differ significantly. The study concludes that; students taught Basic science using Reflective Reciprocal Teaching strategy performed better than those taught using the conventional strategy; achievement gains of male students do not differ significantly from that of female students taught Basic science using Reflective Reciprocal Teaching and; The study therefore recommends that; The adoption of the use of Reflective Reciprocal Teaching strategy in the teaching and learning of Basic science in junior secondary schools in Taraba State should be initiated, maintained and sustained for the benefit of junior secondary school students in Taraba State; students should be exposed to more Reflective Reciprocal Teaching strategy in mathematics to reinforce already taught materials for optimum achievement in Basic science irrespective of gender; and, periodic government sponsored In-service training, in form of long vacation training programme, workshops, conferences and seminars on the nature, scope and use of Reflective Reciprocal Teaching strategy should be organized for junior secondary school Basic science teachers in Taraba state.

Introduction

The scientific and technological development of a nation depends largely on the mathematical understanding of its citizens. Today, it is a reality that it is the creation, mastery and utilization of modern science and technology that basically distinguishes the so-called developing from the developed nations of the world. That is to say that the standard of living of a nation is dependent on the level, of science and technology of that nation. Aguele and Usman (2007) posit that science is the bedrock that provides the springboard for the growth of technology, Basic science in the gate and key to the sciences. In other words, it is the level of Basic science that determines the level of the science and technological component of any nation. The foundation of science and technology, which is the basic requirement for development of nation, is Basic science. Therefore, Basic science plays a vital role in nation building. This has necessitated the Nigeria government to make Basic science one of the core subjects in both primary and junior secondary school curricula (FRN, 2004).

Despite this importance accorded Basic science in Nigeria's quest for scientific and technological development, some students still dislike, hate and fear Basic science, leading to mass failure and consistent abysmal performance in the junior secondary school examination over a decade now (Maduabum and Odili, 2006). Many students turn out to be very miserable and inattentive in a Basic science class after being taught a topic and discover they could not memorize or recall such a concept with ease. The reason for this difficulty may vary but this could sometimes be related to the teaching method being used to explain such topics. Udeinya and Okabiah (2006) blamed poor performance of students in Basic science on poor methods and approaches to teaching which has reduced the level of students' motivation. Harbor-Peters as cited by Bello (2005) asserted that the issue of poor performance in Basic science examinations among Junior Secondary School (JSS) was due to problem of teaching methods. There has also been an increased awareness by those concerned with Basic science education that the Conventional Strategy of teaching Basic science seems not to have been very successful. For effective teaching to take place, the skillful Basic science teacher needs to use many different methods and techniques at his disposal.

As stated in NERDC (2012), the objectives of Basic Science and Technology curriculum expect the learners to: develop interest in science and technology; acquire basic knowledge and skills in science and technology; apply scientific and technological knowledge and skills to meet contemporary societal needs; take advantage of the numerous career opportunities provided by science and technology; become prepared for further studies in science and technology. However, these objectives have not been maximally achieved probably because there are problems in the teaching and learning of Basic Science. Basic Science is one of the major subjects offered by all students in junior secondary schools in Nigeria.

The number of students offering Basic Science is more than the number of teachers employed to teach the subject in various schools, and the class size is large. This increases teachers' workload, resulting in teachers' ineffectiveness. In addition, Basic Science has the problems of lack of class activities and instructional resources to teach the subject. Lemon (2011) emphasizes the importance of class activities. Class activities make the learning process successful. Teachers should allow students' creative ideas during instructional process by providing meaningful class activities. Basic Science at the Junior Secondary School (JSS) level is all about doing. An attempt to make science class all of teachers' activities but none of students' activities is making science passive to learners. Students will only be familiar with the scientific concepts but will not also be able to live in the real world of science. The importance of studying Basic Science in schools is not only meant for obtaining certificate but also meant for producing future scientists in all spheres of life that will bring about national developments in all her ramifications. The future scientists begin their scientific experience from the studying of Basic science in Junior Secondary Schools (JSS) which should be activity-based, and they continue with this experience at higher educational levels including Junior Secondary Schools (SSS).

Basic science is taught at both primary and post primary levels of our educational system. Basic science is used in everyday life situation; yet, many students dread the subject. The common reason introduced by the students for dreading Basic science usually centers on lack of computational skills or having limited background in other aspects of Basic science (Shiaki, 2006). As at now most teachers in Nigerian secondary school still use the traditional lecture method in which teachers talk and students listen. Teaching as being practiced today in Basic

science has been found to be ineffective (Oyedeji, 2005). According to Iyekekpolor (2007), Basic science teaching still follows the traditional pattern. Incidence of student's poor performance in Junior Certificate Examinations (JSCE) Basic science particularly in the last five years (2009 to 2014) as released by the Taraba State Ministry of Education corroborate the poor achievement and retention in Basic science.

Table 1

Performance of students in the Junior Secondary Certificate Examination (2009 – 2014)

Year	Total Entry	Number and % Pass at Credit Level in Basic Science
2009	1,187, 009	452,017 (38.08)
2010	1, 211,075	477,872 (39.45)
2011	1,351,301	455,430 (33.73)
2012	1,401,445	552,803 (39.44)
2013	1,598,211	722,968 (45.23)
2014	1,632,409	538,550 (32.99)

SOURCE: Ministry of Education, Jalingo Annual Report (2014)

The 2014 result is a steep decline from those of the past two years. For instance, in the 2012 result, 39.44 per cent of the candidates obtained credits in Basic science. In 2013, the percentage increased to 45.23 percent, and fell further to 32.99 in the latest examination. Statistics from WAEC also show that the declining performance also applies to the November/December WASSCE in the subjects of Chemistry, Biology and Physics, in which woeful performances were also recorded in the last three years. Certainly, these types of results cannot be said to satisfy the aspirations of the country.

This consistent mass failure and abysmal performance in Basic science over a decade has cast doubts on the country's hope of the attainment of scientific and technological development by the year 20:2020 (Usman and Nwabueze, 2011). This situation of consistently poor achievement worries the researchers, stakeholders of Basic science education, Nigeria government and all those involved in Basic science education. A number of Basic science education researchers like Usman (2003) and Kurumeh (2006) have identified some factors responsible for this mass failure

and consistent abysmal Basic science performance to include use of inappropriate and ineffective teaching approaches among others. Others include students' hatred, phobia, dislike and their perception of Basic science as a difficult subject reserved for talented students.

Ekwue and Umukoro (2011) observed that students learn, retain and understand when what they are taught is linked correctly and meaningfully to their experiences and when real life examples are used (Adekoya, 2009). Thus, success or failure in Basic science could be dependent on more factors than simply knowledge of the subject. Accordingly, teachers are now faced with the challenges of achieving effective teaching that would result to better performances of students in both internal and external examinations. Hence, there is now emphasis for a shift from traditional teaching method to active learning process in the Basic science classroom.

Also, parity and disparity in the achievement of male and female students in Basic science has formed an important focus of research for some years now. The issue of gender disparity in Basic science performance of junior secondary school students particularly was also clearly detected by Alio and Harbor- Peters (2000). It is obvious that the way students learn is as important as what they learn (Anyagh, 2006). This is to say that the selection of an adequate usage of an appropriate and most efficient and effective method are very vital to the success of any lesson (Iji, 2007). Therefore, in view of the relevance of the RRTS and in view of the abysmal performance of students particularly in external examinations, this study seeks to determine the effect of the RRTS on students' achievement in junior secondary school Basic science in Taraba State secondary schools.

Statement of the Problem

A number of studies have been carried out with respect to effects of reflective-reciprocal teaching strategy on achievement of students in school subjects including Basic science. However many of these studies did not consider specific methods of cooperative learning especially cooperative learning strategy which has the potential of making learners active participant in teaching-learning, that is, interactive. The researcher is also not aware of any study in Taraba State of Nigeria, which is relatively struggling to catch up with other states in man power production in engineering, science and technology that Basic science is the bed rock. This situation of poor performance of students in secondary schools in Taraba State in particular and

Nigeria in general if not urgently addressed could undermine the achievement of the national objectives such as the attainment of the Vision 20:2020 and Nigeria's quest for scientific and technological development through advances in science and technology. It is against these backdrops that this study sought to compare the effect of cooperative learning strategy and conventional strategy on students' achievement and retention in Basic science at the junior secondary level in Taraba State.

The major purpose of the study is to investigate the effect of RRTS on achievement in Basic science among junior secondary school students in Taraba state. In specific terms, the study:

i. determined the mean achievement of students taught Basic science using RRTS and those taught with conventional strategy

ii. determined gender differential in Basic science achievement of junior secondary school students taught using RRT strategy

iii. investigated the achievement gain among different ability levels taught Basic science using RRT strategy

Hypotheses

The following null hypotheses formulated were tested in this study at 0.05 significance level:

(i) There is no significant difference in the mean achievement scores of students taught Basic science using RRT strategy and Conventional Strategy of teaching at junior secondary school level.

(ii) There is no significant difference in the mean achievement scores of male and female students taught Basic science using RRT strategy at junior secondary school level.

(iii) There is no significant difference in the mean achievement scores of high, medium and low ability students taught Basic science using RRT strategy.

Research Questions

This study sought answers to the following questions:

i. What are the mean achievement scores of students taught Basic science using RRT strategy and those taught using conventional strategy?

ii. To what extent do the mean achievement scores of male and female students taught Basic science using RRT strategy differ?

iii. What is the effect of the RRT strategy on the mean Basic science achievement scores of students of low, medium and high ability levels?

Concept of Reciprocal Teaching

Reciprocal teaching is a cooperative learning instructional method in which natural dialogue models and reveals learners' thinking processes about a shared learning experience. Teachers foster reciprocal teaching through their belief that collaborative construction of meaning between themselves and students leads to a higher quality of learning (Allen, 2003). Students take ownership of their roles in reciprocal teaching when they feel comfortable expressing their ideas and opinions in open dialogue. They take turns articulating and "thinking out loud" – talking through their thoughts - with each learning strategy employed. The learning community is able to reinforce understanding and to see, hear, and correct misconceptions that otherwise might not have been apparent. All members of the community have shared responsibility for leading and taking part in dialogue during learning experiences (Hashey and Connors, 2003).

Reciprocal teaching is based on Vygotsky's theory of the fundamental role of social interaction (dialogue) in the development of cognition. Thinking aloud and discussion of thoughts aid in clarification and revision of thinking and learning, therefore developing cognition. Vygotsky's theory of ZPD (Zone of Proximal Development) is critical to identifying appropriate text and scaffolding activities to support student success (Vygotsky, 1978, as cited in Galloway, 2001). Text must be at a level that can be effectively shared, not too easy and not too difficult. Appropriate support and feedback must be given to facilitate learning during reciprocal teaching activities (Oczkus, 2003).

Effective reciprocal teaching lessons include scaffolding, thinking aloud, using cooperative learning, and facilitating metacognition with each step. Each strategy is taught by the teacher and is clearly understood by students before they go on to the next strategy (Hashey et al, 2003). Procedures are first modeled by the teacher. Then they are practiced and coached with peer and teacher feedback. Finally, the leadership of the group work strategy is handed over to the students (Allen, 2003). Continual teacher and student modeling of cognitive processes for each of the four strategies - predicting, questioning, clarifying, summarizing - is an integral part of the process. The teacher monitors and evaluates to determine where scaffolding is needed to help students to be successful in using strategies.

Concept of Reflective Teaching

In order to conduct a profound understanding of the concept of reflection, and to formulate the conceptual framework underlining this study, it is crucial to go back to its roots, and to review and discuss its conceptual construction and underlying philosophy in a comprehensive manner. Reflection is a cognitive inquiry in which experiences are analyzed in the context of prior knowledge for the endeavours of finding meaning that will lead to the creation of a new knowledge and to the development of new alternative ways (Bello, 2006). It is a thoughtful examination of an action considering educational knowledge, practices, and values, and the evaluation of consequences (Schön, 2003; Zeichner& Liston, 2007).

Methodology

The research design used in this study was the quasi – experimental of non-equivalent group design. The pre and posttest control was used as well as post-posttest. In this design, intact classes were used because the design is dependent upon the natural setting in which the researchers found in the schools. The students in their intact classes were assigned into groups namely the control group (C) and the experimental group (E). The research design illustration is presented in Figure 1 below:

Group	Pretesting		Treatment		Post testing
E	→ O_1	→	X_1	→	O_2
C	→ O_3	→	X_0	→	O_4

Figure 1: The Research Design Illustration

E = the group that received the RRT learning treatment

C = the group that received the conventional instruction

X_1 = the experimental treatment of teaching JS2 students Basic science with RRT for a period of six weeks

X_0 = the control condition of teaching JS2 students Basic science with conventional instruction method for a period of six weeks

O_1 = the pretest performance of group C and group E on a Basic science achievement test

O_2 = the post-test performance of group C and group E on a Basic science achievement test

O_3 = the pretest performance of group E on a Basic science achievement test

O_4 = the post-test performance of group E on a Basic science achievement test

Here the pretest and post-test are the same so that students' gain in achievement could be measured using the pretest scores as baseline data.

The target population of the study consisted of all the JSS2 Basic science students of junior secondary schools in the 117 schools of the three education zones of Taraba State for 2014/2015 academic session. The population of the study comprised 12,873 SS2 students in Taraba State for the 2013/2014 academic session (Taraba State Teaching Service Board [TSB, 2015]). These were made up of 7,724 boys and 5,149 girls.

Sample and Sampling Procedure

The sample for the study comprised of 85 students selected from the population of Junior Secondary School Two (JSS2) students distributed among 117 government grant- aided schools in Taraba State. The schools were stratified into existing Northern, Central and Southern Educational Zones of the state. The educational zones were stratified into the local government areas (LGA's) that make up each of the zones.

The main instrument used in this study to collect data is the Basic Science Achievement Test (BAT). The items were chosen from past NECO question papers by the researcher. The items in the instrument were selected based on the topics treated in accordance to the JSS 2 Basic science curriculum. The BAT consisted of 50-item multiple choice questions, then items were reshuffled in the first instance to obtain Basic Science Achievement Post-Test (POSTBAT) and on the second instance to obtain the Basic Science Achievement Post Post-Test (PPBAT). This was intended to cater for the variables in the study. The three forms of the same instrument were used for data collection in the study.

The instrument of 50 multiple-choice BAT questions for JS2 students' was deemed to have content validity. The fifty five multiple choice questions initially constructed where reduced to fifty. The instrument was subjected to face validation by two secondary school teachers who have a bachelor's degree in Science Education with a minimum of five years teaching experience. The items in the developed instruments were studied carefully and subjected to critical appraisal of three experts; two in the field of Science, Technology and Science Education and one from Educational Measurement and Evaluation from the Taraba State Universities.

A pilot test was carried out to determine the reliability of the instrument (BAT). A pilot testing was organized with a view to further validate and ensure that the instrument was suitable and also feasible for the cooperative learning instructional strategy so that the research plan went on as expected. The BAT was administered to 30 students not part of the main study in the target population. The pilot testing lasted for only five days as allowed by the school. The test-retest method was used to obtain the reliability coefficient of BAT. Using the Product Moment Correlation Coefficient, a coefficient of 0.74 was obtained. The value obtained for the instrument indicates that the instruments are suitable for the main study.

Two intact classes were used in the study for six weeks and one lesson lasted a period of 40 minutes. One class was taught using Conventional Strategy format (lectures, seat-work and a unit test) while the other one class was taught using a cooperative learning strategy. The researcher taught the experimental class using cooperative learning strategy while the control group was taught by the regular class teacher in the school using conventional method. The RRT designed as treatment in this study involved procedures which were followed to successfully accomplish the experiment in the classroom. These procedures were positive interdependence, face-to-face promotive interaction, individual accountability/personal responsibility, interpersonal small group skills and group processing.

Results

Data were presented according to the research hypotheses for the study

Hypothesis One

There is no significant difference in the mean achievement scores of students taught Basic science using the Reflective Reciprocal Teaching strategy (RRT) and those taught using Conventional Strategy (CS).

Table 2 Results of Analysis of Covariance of Methods of Teaching on Students' Achievement.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Eta Squared
Corrected Model	9876.103[a]	2	4938.052	69.803	.000	.603
Intercept	7807.497	1	7807.497	110.365	.000	.574
PreTest	4.219	1	4.219	.060	.808	.001
Method	8289.498	1	8289.498	117.178	.000	.588
Error	5800.909	82	70.743			
Total	143950.000	85				
Corrected Total	15677.012	84				

Key: * Significant, ** not significant

From Table 2, the results of the main effects on the Reflective Reciprocal Teaching strategy (RRT) and Conventional Strategy (CS) indicated by F = 117.178 at degree of freedom 1,82 (df= 1,82). This is significant at $P < .05$ when compare with p< .000. Since the value of F is significant at .005, the null hypothesis with respect to method is rejected. Therefore, there is a significant difference in the mean achievement scores of students taught using Reflective Reciprocal Teaching strategy and those taught using conventional strategy. That is, Reflective Reciprocal Teaching strategy group achieved higher in the post-test scores than the conventional group.

Hypothesis Two

There is no significant difference in the mean achievement scores of male and female students taught Basic science using Reflective Reciprocal Teaching strategy (RRT) and those taught using Conventional Strategy (CS).

Table 3

ANCOVA Results for Post Test of Method and Gender

	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	9966.333[a]	4	2491.583	34.904	.000	.636
Intercept	7429.270	1	7429.270	104.075	.000	.565
PreT	13.035	1	13.035	.183	.670	.002
Method	7295.430	1	7295.430	102.201	.000	.561
Gender	24.927	1	24.927	.349	.556	.004
Method * Gender	68.287	1	68.287	.957	.331	.012
Error	5710.679	80	71.383			
Total	143950.000	85				
Corrected Total	15677.012	84				

a. R Squared = .636 (Adjusted R Squared = .618)

Table 3 shows that the interaction of cooperative learning strategy and gender has F value of 0.957 and is significant at 0.331 which is higher than the 0.05 level of significance. The value of F is significant at 0.05 probability, therefore the null hypothesis with respect to gender and method is accepted. Hence there is no significant difference in the mean achievement scores of male and female students taught Basic science using Reflective Reciprocal Teaching strategy (RRT) and those taught using Conventional Strategy (CS). The magnitude of the differences in means is very small (eta squared = .012).

Hypothesis Three

There is no significant difference in the mean achievement scores of students with low, medium and high ability levels taught Basic science using Reflective Reciprocal Teaching strategy (RRT).

Table 4

ANCOVA Results for Post Test of Method and Ability Level

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	3161.591[a]	3	1053.864	94.378	.000	.876
Intercept	2597.331	1	2597.331	232.601	.000	.853
PreT	1.429	1	1.429	.128	.722	.003
Ability	3132.083	2	1566.042	140.245	.000	.875
Error	446.659	40	11.166			
Total	110333.000	44				
Corrected Total	3608.250	43				

a. R Squared = .876 (Adjusted R Squared = .867)

Table 4compares the achievement scores of low, medium and high ability level of students taught using Reflective Reciprocal Teaching (RRT) which shows that, the difference are statistically significant at the $p < .05$ level, since p value of 0.05 is higher than P. 0.00 ($F_{2,40}$ =140.245; p =.000). Therefore, the null hypothesis with respect to ability level and method is rejected and hence, there is significant difference in the mean achievement scores of students with low, medium and high ability levels taught Basic science using Reflective Reciprocal Teaching strategy (RRT).

Post-hoc comparisons using the Turkey HSD test indicated that the mean achievement scores for low ability level students (M = 40.00, SD = 3.95) was significantly different from medium ability level students (M = 49.50, SD = 2.15) and high ability level students (M = 59.94, SD = 3.32).

The major findings of the investigation of the effect of Reflective Reciprocal Teaching strategy on Basic science achievement among junior secondary school students of different abilities in Taraba State Nigeria are:

1. Mean achievement scores of students taught Basic science using Reflective Reciprocal Teaching strategy differs significantly from the mean achievement scores of those taught using the conventional strategy.

2. Mean achievement scores of male and female students taught Basic science using Reflective Reciprocal Teaching strategy do not differ significantly.

3. Mean achievement scores of students with high, medium and low ability students taught Basic science using Reflective Reciprocal Teaching strategy differ significantly.

Discussion

The finding of this study is in agreement with the study carried out by Samba (2003) to determine the possibility of promoting knowledge reconstruction, understanding and retention of science concepts, using a conceptual strategy. They study also investigated retention as a variable. Findings of this study revealed the superiority of Reflective Reciprocal Teaching strategy over the lecture method in enhancing students' retention ability. Also, the study of Igboko and Ibeneme (2006) have similar finding to this study whose findings showed that the retention scores obtained by the experimental group were higher than the control group. Cooperative learning strategy is a constructivist theory like the cooperative learning which allows the interplay of thought and action with a consequential development of creative and reflective thinking which could possibly enhance retention.Also, Chianson, Kurumeh and Obida (2010) investigated the effect of Reflective Reciprocal Teaching compared with the conventional learning method in order to find out the retention level of students in circle geometry. The findings of the study confirmed that students who were subjected to the Reflective Reciprocal Teaching strategy were able to retain the concepts of circle geometry more than those students who were taught using the conventional learning approach. This finding is completely in line with the finding of the present study.

Conclusion

The following conclusion was drawn.

(i) Students taught Basic science using Reflective Reciprocal Teaching strategy performed better than those taught using the conventional strategy.

(ii) Achievement gains of male students do not differ significantly from that of female students taught Basic science using Reflective Reciprocal Teaching.

(iii) Cooperative learning strategy has significant effect on the mean achievement of students with high, medium and low ability students taught Basic science.

Recommendations

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

1. The adoption of the use of Reflective Reciprocal Teaching strategy in the teaching and learning of Basic science in junior secondary schools in Taraba State should be initiated, maintained and sustained for the benefit of junior secondary school students in Taraba State.
2. Students should be exposed to more Reflective Reciprocal Teaching strategy in mathematics to reinforce already taught materials for optimum achievement in Basic science irrespective of gender.
3. Periodic government sponsored In-service training, in form of long vacation training programme, workshops, conferences and seminars on the nature, scope and use of Reflective Reciprocal Teaching strategy should be organized for junior secondary school Basic science teachers in Taraba state.

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