ASSESSMENT OF TEACHING EFFECTIVENESS OF COMPETITIVE STRATEGY ON SECONDARY SCHOOL STUDENTS' CHEMISTRY ACHIEVEMENT AND RETENTION IN IMO STATE

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Abstract
The study examined teaching effectiveness of competitive strategy on secondary school students' achievement and retention in Chemistry in Imo State. Three research questions were asked, while three hypotheses were formulated and tested at 0.05 level of significance. Quasi-experimental pre-test, post-test non-equivalent group design was adopted. The population of the study was 94,412 senior students in 296 schools in six education zones in Imo State. A total sample size of 77 (Seventy seven) students participated in the study. There was pretest before the treatment and post test after treatment followed by retention test after two weeks of the study. The instrument used for data collection was Chemistry Achievement Test (CAT). Kuder Richardson 20 (K-R20) statistics were used to establish the reliability index of 0.85. For data collection, the instrument was administered at pre-test and post-test and recorded with the help of the research assistants. For data analysis, the research questions were answered with mean and standard deviation while Analysis of Co-variance (ANCOVA) was used to test the hypotheses at 0.05 level of significance. Findings of the study revealed that: the group taught with competitive teaching strategy (CoTS) did better than the other group taught without competitive teaching strategy (CoTS; there was no significant CoTS by gender interaction effects on students' achievement in Chemistry; the mean retention scores of the students exposed to CoTS is greater than the mean retention scores of the students not exposed to the CoTS. It was recommended among others that; Chemistry teachers should employ CoTS in teaching the students since the teaching strategy was effective in improving students' achievement in Chemistry. They should also feel free to choose CoTS since it enhanced students retention of the concepts learnt and since the teaching strategy was not gender biased, thus should be used irrespective of gender.

Keywords: Chemistry, Teaching, Competitive teaching strategy, Achievement, Assessment

Introduction

The performance of students in chemistry in the senior school certificate examinations (SSCE) has been below expectation. The West African Examination council (WAEC) Chief Examiner's 2021 reports showed that the poor achievement of the students in chemistry can be traceable to methods and strategies of teaching. Chemistry as a science subject remains a central subject that is useful in academic and vocational training. Thus, there is no gain saying that no meaningful industrial and national developments could be achieved without a thorough understanding of the subject as it aids in the synthesis of new substances, and in refining and upgrading of the raw materials the nature has endowed man with. Ajewole and Ivowi as cited in Goje (2014) stressed that over the years, results of studies have shown that students have continued to perform poorly in science, chemistry inclusive. The poor academic achievement of students in chemistry as a subject has implications on tertiary institution admission because schools no longer produce adequate number of students that passed chemistry at credit level for admission into tertiary institutions. To improve students' achievement in chemistry, students must be more active in the classroom and must creatively acquire knowledge, especially in understanding and solving problems in chemistry.

Teaching is an integral part of the process of learning. It is a system intended to introduce learning. Its special role is to impact knowledge, develop understanding and relevant skills. In teaching, an interaction occurs between the teachers and the students, by which the students are directed towards their goal. Thus, the sole element of teaching is the mutual relationship or the interaction between the teacher and students which leads towards the actualization of the stated goals. According to Mbakwem and Ike (2017) teaching involves the shaping and making a permanent change in the behaviour, attitude, skills and the feelings of those subjected to it. Similarly, Akudolu cited in Mbakwem and Ike, (2017), notes that teaching is a systematic activity deliberately engaged in by somebody to facilitate the learning of intended knowledge, skills, values and attitude which are worthwhile by another person and also get the necessary feedback.

Different innovative approaches to teaching Chemistry have been proposed by educators and the knowledge of these methods may help in working out a better teaching strategy. It is not appropriate for a teacher to commit to a particular method without incorporating a strategy in order to make learning active. Expectedly, when a teacher chooses a topic to teach, the next thing is to sit down and plan how to teach it. Planning to teach involves choice of methods and strategies that will serve best in communicating the content to the learners. Many methods and strategies are there but the choice depends on the nature of the content, the ability of the class members, the size of the class, the resources available and above all the desires to make the lesson participatory. The approach adopted by the teacher must ensure maximum participation of the students, proceed from concrete to abstraction and provide knowledge at the understanding level (Merchant,2010). Several competencies are

expected of the teacher in order to achieve this goal. Some of the competencies include ability to use appropriate instructional strategies in teaching.

Competitive teaching exists when students work separately on a project, with solutions assessed with the same criteria and the results available for comparisons among students. Competitive teaching can be interpersonal (between individuals), or intergroup (between groups), where a group setting is appropriate. This strategy has been described as the most appropriate when students need to review learned material (Griffiths & Podirsky as cited in Sunday, Olaoye & Audu 2021). Okereke and Ugwuegbulam (2014) opined that competitive learning strategy is about teaching students how to learn without fear of failure or letting their ego become too involved and students catch fun during learning process when they see the competition as a game. Teaching is most suitable when students are viewing the learned materials. However, the following ways can help to encourage student's participation in competition in a classroom setting: (i) Positive competition (ii) Create varied lesson plan (iii) Offer rewards (iv) Set goals (v) Be Enthusiastic (vi) Know your students (vii) Team work (viii) Mix fun into the lesson. Achievement outcomes indicate the extent to which a person has accomplished specific goals that were the focus of activities in instructional environments, specifically in school, college, and university (Richardson et al. (2012). Academic achievement therefore, should be considered to be a multifaceted construct that comprises different domains of learning.

Retention refers to the ability of the learners to recall information, ideas or learning activities at a later time which he/she may be ask to mention, write or remember after sometimes. The process of remembering those important principles, information, skills and habits learnt in the past so as to apply them is retention (Ikemezie 2016). Paraphrasing Bichi, Yusuf & Umar (2019) defined retention as the ability to maintain and later recall information or knowledge gained after learning. Alake (2015) sees retention as the ability to store information which can be easily recalled from the short term memory and long term memory.

Assessment is the process of gathering and discussing information from various sources and activities in order to develop a deep understanding of what students know, understand, and can do with their knowledge as a result of their educational experiences (Omer, 2020). Assessment in this study means to collect data, analyze and interpret data regarding competitive teaching strategies with the hope of taking decision on its usefulness in teaching and learning. This will expose the level at which competitive strategies are effective in teaching and learning of chemistry. Through assessment it can be established whether competitive strategies are gender selective or neutral. Test instrument was used as the assessment tool.

Gender is one of the factors that might affect students' achievement in chemistry. Gender is defined by Bassow cited in Gupta, Pasrija and Kavita (2015) as a psychological term describing behaviour and attributes expected of individuals on the basis of being born either a male or a female. Changeiywo (2002) writing on the embrasive nature of gender observed that, it is a cultural construct developed by

society to distinguish the roles, behaviours, mental and emotional characteristics between male and female. Dike and Abimbola (2010) asserted that gender is obvious from birth and children are socialized very early into appropriate sex-typed-occupations. Hence gender differential valuation of male and female has been viewed as an integral part of the educational process and the development of the male and female personalities.

Experience has shown that students' achievements are affected by many factors. Among the several factors identified to account for this poor achievement in chemistry, poor teaching method and strategy seems to be a major contributory factor. The neglect of activity-oriented method of teaching has led to abstractness which makes the students less active (passive learners) and more prone to rote memorization. All these factors that affect students' achievement in chemistry have been an area of interest to researchers over the years. These researchers therefore are intrigued to ascertain whether innovative teaching strategy like competitive teaching strategy is a way forward for the improvement of students' achievement in Chemistry. This is the focus of the study.

The main purpose of this study is to examine the assessment of teaching effectiveness of competitive strategy on senior school students' achievement and retention in chemistry in Imo State. Specifically, the study seeks to ascertain:-

1. mean achievement scores of the two groups of students, one group taught Chemistry with competitive teaching strategy (CoTS) the other taught without using competitive teaching strategy (CoTS) in the post-treatment test;
2. the interaction effect of CoTS and gender on students' achievement in Chemistry;
3. mean retention scores of the two groups of students, one group taught Chemistry with competitive teaching strategy (CoTS) and the other group taught without competitive teaching strategy (CoTS) in the retention test.

Research Questions

The following research questions were asked to guide the study.

1. What are the mean achievement scores of the two groups of students, one group taught Chemistry with competitive teaching strategy (CoTS) the other taught without competitive teaching strategy (CoTS) in the post-treatment test?
2. What are the mean retention scores of the two groups of students, one group taught Chemistry with competitive teaching strategy (CoTS) and the other group taught without competitive teaching strategy (CoTS) in the retention test?
3. What are the mean scores in Chemistry in four Treatment (CoTS) by gender subgroups?

Research Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance.

H_{o1}: The mean achievement scores students taught Chemistry with competitive teaching strategy (CoTS) and the other group taught without competitive teaching strategy (CoTS) in the post-treatment test do not differ significantly.

H_{o2}: The mean retention scores of students taught Chemistry with competitive teaching strategy (CoTS) and the other group taught without competitive teaching strategy (CoTS) in the retention test do not differ significantly

H_{O3}: There is no significant CoTS by gender interaction effects on students' achievement in Chemistry.

Methodology

The study adopted the quasi experimental pre-test, post-test non-equivalent group design. The study was conducted in two schools in Imo State, Nigeria which has six educational zones. The population of the study is made up of all the 94,412 SS2 students in the 296 schools in six education zones in Imo State. All the 77 senior secondary year two (SS II) students who offered Chemistry in two schools were involved. Purposive and cluster sampling techniques were used. The SSII students were chosen because they were the next senior class after SSIII who were busy preparing for their external examinations. Specifically, 35 students are in the treatment group I and 42 in the treatment group II. Male and female students made up the sample size (14 male and 21 female students in the treatment group I and 20 male and 22 female students in the treatment group II). Intact classes were used in order not to disrupt the school arrangement. There was one science class in each of the schools and all the members of the class were part of either the treatment group I or treatment group II.

Four lessons were prepared and taught on the following concepts; Solubility, Electrolysis, Charles law and Boyles law. Treatment group I was taught using lecture method and competitive teaching strategy while the treatment group II was taught with lecture method alone. The teaching was done by two regular teachers who have been teaching the students but this time they were trained in line with needs of the researchers. They were trained on the contents, methodology and the procedural design. Detailed notes of lessons were prepared and given to the teachers to forestall variations in lesson delivery. The researchers administered the pre-test to both the treatment group I and treatment group II with the help of trained research assistants (chemistry teachers) on the first day. After the pre-test, the regular teachers (chemistry teachers) started the treatment in their respective schools. The treatments were conducted during the normal school time table, reasons being that the content scope was in line with the school scheme of work. At the end of the treatment which lasted for 4 weeks, the chemistry teachers administered the post-treatment test to both treatment groups.

The instrument used for the collection of data for this study is a researchers' developed achievement test titled, Chemistry Achievement Test (CAT). The instrument was used to elicit information on the performance of students in chemistry subject both at pre-test and post-treatment test. Reliability was ascertained using Kuder-Richardson formula 20 (K-R 20) which yielded an index of 0.85.The test is made up of 50 items of multiple choice questions with four response options (lettered A to D) each, out of which only one option is the correct answer.

In the competitive teaching group, the total numbers of participants were thirty five (35) and students were divided into seven subgroups of five members each. Members of each group were instructed to compete with each other and seek to perform better than others in given tasks. They were told not to seek help from themselves but from the teachers as the best student in each of the subgroup will be rewarded. The students were evaluated based on their individual contributions and their scores were always compared in order to determine the best ones. The students in the treatment group II were not given any special treatments. The teachers taught the students the content of the lesson over a period of 4 weeks with the lecture approach used by most of the secondary school teachers in Imo state. Thus, the lessons were predominantly teacher-centered with the teachers talking while the students paid attention, contributed minimally, and jotted points in their notebooks. The researchers occasionally supervised the lessons in each of the groups to ensure that the teachers effectively implemented the instructions. At the end of the treatment, a posttest was administered to all the students. Also items of the test were reshuffled and modified for the various tests before administering the subsequent tests in order to change the arrangement of the items of the test.

After two weeks, retention test was also administered to the students which contained the same items but were rearranged in such a way that the students would not easily discover that the instruments were the same. The whole research processes lasted for 6 weeks. Research questions were answered using mean and standard deviation. Analysis of covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance.

Results

Research Question One: What are the mean achievement scores of the two groups of students, one group taught Chemistry with competitive teaching strategy (CoTS) the other taught without competitive teaching strategy (CoTS) in the post-treatment test?

Table 1: Mean of Scores of Students exposed to Competitive Teaching Strategy (CoTS) and the other group not exposed to Competitive Teaching Strategy (CoTS).

		Pre-test		Post-test	
Group	**n**	$\bar{X}$	**Sd**	$\bar{X}$	**Sd**
CoTS	35	19.71	2.73	36.29	1.86
LTM	42	20.24	2.14	22.24	1.72

From Table 1, the mean achievement scores of the students exposed to the competitive teaching strategy (CoTS) and those taught without CoTS) in the pre-treatment test are 19.71 and 20.24 respectively. Their respective standard deviations are 2.73 and 2.14. On the other hand, in the post-treatment test the mean achievement scores of secondary school students taught Chemistry using competitive teaching strategy (CoTS) and those taught without CoTS are 36.29 and 22.24 respectively. Their respective standard deviations are 1.86 and 1.72. The mean achievement scores of the students taught with CoTS is greater than the mean achievement scores of the students taught without CoTS. This may suggest that competitive teaching strategy (CoTS) improved students' achievement in Chemistry.

Research Question Two: What are the mean retention scores of the two groups of students, one group taught Chemistry with competitive teaching strategy (CoTS) and the other group taught without competitive teaching strategy (CoTS) in the retention test?

Table 2: Mean of Scores of Students exposed to Competitive Teaching Strategy (CoTS) and those exposed to Lecture Teaching Method (LTM) only in the retention test.

		Post-test		Retention test	
Group	**n**	$\bar{X}$	**Sd**	$\bar{X}$	**Sd**
CoTS	35	36.29	1.86	35.74	2.02
Without CoTS	42	22.24	1.72	22.50	1.88

From Table 2, the mean retention scores of secondary school students taught Chemistry using competitive teaching strategy (CoTS) and those taught involving only lecture teaching method (LTM) are 35.74 and 22.50 respectively. Their respective standard deviations are 2.02 and 1.88. The mean retention scores of the students exposed to CoTS is greater than the mean retention scores of the students taught without using CoTS. This may suggest that competitive teaching strategy (CoTS) improved students' retention in Chemistry.

Research Question Three: What are the mean scores in Chemistry in four Treatment (CoTS) by gender subgroups.

Table 3: Mean Achievement Scores in the Post-treatment Test of Students in the Treatment (CoTS) by Gender Subgroups

Gender	**With** CoTS			**Without** CoTs		
	n	$\overline{X}$	S	n	$\overline{X}$	S
Male	14	36.36	1.98	20	22.35	1.95
Female	21	36.24	1.81	22	22.14	1.52

The mean achievement score of male and female students exposed to CoTS as presented in Table 3, are 36.36 and 36.24 respectively. Their respective standard deviations are 1.98 and 1.81. The mean achievement score of male students exposed to CoTS is slightly higher than that of their female counterparts. For the male and female students taught without using CoTS, their respective mean achievement scores are 22.35 and 22.14. The mean achievement score of male students taught without using CoTS is slightly higher than that of their female counterparts in the same group.

Hypothesis One: the mean achievement scores of the two groups of students, one group taught Chemistry with competitive teaching strategy (CoTS) the other taught without competitive teaching strategy (CoTS) in the post-treatment test.

Table 2: ANCOVA Summary

Table Tests of Between-Subjects Effects

Dependent Variable: Post test

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	3825.060[a]	4	956.265	380.356	.000	.955
Intercept	521.269	1	521.269	207.335	.000	.742
Pretest	57.147	1	57.147	22.730	.000	.240
Treatment	3737.000	1	3737.000	1486.397	.000	.954
Gender	.047	1	.047	.019	.892	.000
Treatment * Gender	.667	1	.667	.265	.608	.004
Error	181.018	72	2.514			
Total	67092.000	77				
Corrected Total	4006.078	76				

a. R Squared = .955 (Adjusted R Squared = .952)

Table 2 showed that the calculated F-ratio is 1486.397 had a p-value of 0.000 which is less than the hypothesized probability (p-value) value of 0.05. Based on the results, the researcher rejects the null hypothesis one which states that "the mean achievement scores of the two groups of students, one group taught Chemistry with

competitive teaching strategy (CoTS) and the other group taught without competitive teaching strategy (CoTS) in the post-treatment test do not differ significantly" and instead accept the alternative hypothesis. Therefore, the mean achievement scores of students taught Chemistry with competitive teaching strategy (CoTS) and those taught without CoTS in the post-treatment test differ significantly.

Hypothesis Two: the mean retention scores of the two groups of students, one group taught Chemistry with competitive teaching strategy (CoTS) and the other group taught without competitive teaching strategy (CoTS) in the retention test do not differ significantly.

Table 4: ANCOVA Summary Table
Tests of Between-Subjects Effects
Dependent Variable: Follow UP

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	3598.645[a]	4	899.661	1988.447	.000	.991
Intercept	.187	1	.187	.413	.523	.006
PostTest	249.446	1	249.446	551.330	.000	.884
Gender	.087	1	.087	.191	.663	.003
Treatment	1.442	1	1.442	23.187	.008	.042
Gender * Treatment	3.907E-6	1	3.907E-6	.000	.998	.000
Error	32.576	72	.452			
Total	66260.000	77				
Corrected Total	3631.221	76				

a. R Squared = .991 (Adjusted R Squared = .991

Table 4 showed that the calculated F-ratio is 23.187, which is greater than the critical F-ratio 3.92. Also, the observed probability (p-value)value of 0.008 is less than the hypothesized probability (p-value) value of 0.05. Based on the results, the researcher fails to accept the null hypothesis three which states that "the mean retention scores of the two groups of students, one group taught Chemistry with competitive teaching strategy (CoTS) and the other group taught without competitive teaching strategy (CoTS) in the retention test do not differ significantly" and instead accept the alternative hypothesis. Therefore, the mean retention scores of the two groups of students, one group taught Chemistry with competitive teaching strategy (CoTS) and the other group taught without involving competitive teaching strategy (CoTS) in the retention test differ significantly.

Hypothesis Three: There is no significant CoTS by gender interaction effects on students' achievement in Chemistry.

Table 6: Summary ANCOVA F-ratio and p-value Table for the Test of Hypothesis Two

MS	df1	df2	Fcal	P– value	Fcrit	Decision
0.667	1	30	0.265	0.608	3.92	H_{07} is accepted

As shown in Table 6 above, the calculated F-ratio for interaction effect of gender and treatment on mean achievement score was 0.265 against the F-critical value of 3.92, while the observed p-value 0.608 greater than the set probability value 0.05. Therefore, the null hypothesis three of no significant CoTS by gender interaction effects on students' achievement in Chemistry was upheld. This means that there is no significant CoTS by gender interaction effects on students' achievement in Chemistry.

Discussion of findings

The finding of the study revealed that the mean achievement scores of the students exposed to CoTS is greater than the mean achievement scores of the students taught without CoTs . The test of hypothesis carried out revealed that the mean achievement scores of students taught Chemistry with competitive teaching strategy (CoTS) and those taught without CoTS in the post-treatment test differ significantly. This shows that the students taught Chemistry with competitive teaching strategy performed significantly better than their counterparts taught the same contents without CoTS. The result also suggests that competitive teaching strategy (CoTS) improved students' achievement in Chemistry significantly. This is not surprising because competitive teaching strategy is a student-centered strategy, while lecture teaching method is more of teacher-centered. Also, competitive strategy is attributed to a classroom environment where students work in subgroups with members of each subgroup working strictly on his/her own and striving to be the best in the subgroup for price or reward. In this type of setting, students may become competitive with each other for the best grades and for recognition. This kind of learning environment is not seen in lecture teaching method classroom. When handled well, the competition experienced in competitive teaching strategy classroom can make the students work harder and which in turn improve their performance. The finding is in agreement with the finding of Contandor and Conde (2010) who in their study found that competitive teaching strategy is effective in teaching students. The finding by Anwsa et al. (2016) is also similar to the finding of this study but however in a different subject area.

Also, the finding of the study revealed that the mean retention scores of the students taught using CoTS is greater than the mean retention scores of the students students taught without CoTs. The statistical test of hypothesis carried out revealed that the mean retention scores of students taught Chemistry with competitive teaching strategy (CoTS) and those taught without CoTS in the retention test differ significantly. This shows that the students taught Chemistry using competitive teaching strategy significantly retained their knowledge better than their

counterparts taught the same contents without CoTS. The result also suggests that competitive teaching strategy (CoTS) improved students' retention in Chemistry significantly. This is not surprising because competitive teaching strategy is a student-centered strategy, while lecture teaching method is more of teacher-centered. When well handled, the competition experienced in competitive teaching strategy classroom can make the students work harder and which helps them not to forget what they learnt. The finding is in agreement with the finding of Contandor and Conde (2010) who in their study found that competitive teaching strategy is effective in retention after teaching.

Finally, the finding of the study revealed that there is no significant CoTS by gender interaction effects on students' achievement in Chemistry. This shows that gender of the students did not significantly influence the effect competitive teaching strategy on students' achievement in Chemistry in secondary school. Any interaction effect was not significant and may be due to error and not attributed to variance. Treatment interaction generally implies that different learners with different characteristics may profit more from one type of instructional method or teaching strategy than from another. Since interaction was not significant, the effect of Competitive Teaching Strategy would enable male and female students to perform well at the same pace. This finding is in agreement with the findings of Audu (2018) and Veselinovska (2011) who reported that there was no significant difference in the interaction effect of learning strategies and gender on students' achievement.

Conclusion

This study ascertained the assessment of learning effectiveness of competitive strategy on secondary school student's achievement and retention in science (chemistry). It was found out that the effect of competitive strategy was not gender bias. However, continued use of this teaching strategy is bound to close the gap in differences in achievement between male and female students thereby encourage the female to achieve their potentials and contribute optimally to national development. Teachers are by this result expected to incorporate competitive strategy in their methods of teaching science subjects to enhance understanding and achievement.

Recommendations

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

1. Teachers in secondary schools should adopt competitive teaching strategy as an effective teaching strategy for teaching Chemistry since it was found to be effective in teaching the subject.
2. Since competitive teaching strategy was not gender biased in improving students' achievement in Chemistry, the secondary school Chemistry teachers could use the teaching strategy to teach students irrespective of their gender.
3. The researchers recommend that competitive teaching strategy be used in teaching Chemistry to secondary school students to enhance their retention of the concepts learnt.

4. Finally, the curriculum planners should include CoTS in senior secondary chemistry curriculum for teachers and students.

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