



EFFECTS OF COLLABORATIVE LEARNING TECHNIQUE ON STUDENTS' ACHIEVEMENT IN CHEMISTRY

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Abstract:

This study investigated the efficacy of Collaborative Learning Technique (CLT) and gender on students' achievement in chemistry. The study adopted the post-test-only research design. The sample consisted of one hundred and eighty-six (186), senior secondary year one (SS1), students, drawn from two schools in Awka urban. The intact classes were assigned to treatment and control groups by simple random sampling. The treatment conditions which lasted for five weeks was implemented by the regular class teacher who was previously trained by the researcher on the guiding principles for the study. The teachers for the intact classes used two versions of the same lesson plan prepared by the researcher. Data were collected using Chemistry Achievement Test (CAT) which had an internal consistency reliability index of 0.86. The research questions were answered using means and standard deviation while the hypotheses were tested at 0.05 level of significance using t-test statistics. The result among others indicated that the CLT had a significant effect on the students' achievement in chemistry while gender was not a significant factor on the learning outcome. It was further recommended that CLT be adopted by teachers as complementary strategy to their conventional methods of teaching chemistry.

Keywords: Collaborative learning, Gender, Achievement, Chemistry

1. INTRODUCTION

Ordinarily, learners' conventional classroom interactions depict a competitive experience. Learners at all levels of the education system more often than not, view the classroom as a venue where one must strive to out-perform the rest and emerge

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singly as the best in the class. Teachers and School Authorities even encourage this idea through various means such as rewarding only the best students in the class to the dismay of others in the class. In some cases, particularly in primary schools, teachers display the class progress-chart in front of the class showing the learners' scores in class tests and assignments as a way of motivating them to improve in their academic achievement.

In some schools still, students are streamed into classes based on their cognitive ability. For instance, after the annual performance ranking of all the one hundred and twenty (120), students in Class 2, the first forty (40) are made to go to Class 2A, the next forty (in positions 41-80) will go to Class 2B, and the next forty (positions 81 -120) will be in Class 2C. This ability streaming engenders healthy-competition as intra and inter-stream competition is encouraged among the learners. Every student strives to out-perform the other.

The ultimate expectation of every parent/guardian is to hear that his/her ward (pupils/students) performs so creditably well that he/she comes topmost in the class. Similarly, parents are equally eager to hear that the school/institution where their ward studies are rated second to none when compared to other institutions. Again, philanthropic individuals, school authorities and government at different levels, usually award scholarships to students/pupils based on one's distinguished position in performance ranking among his/her contemporaries. These instances outrightly, shows that education system is structured to encourage competition among the learners. Although competitive classroom experience has its merits, nevertheless, over-emphasis on competition in the classroom has given rise to some learning-based misdemeanor especially with respect to examinations misconduct. Many over-ambitious learners, in a bid to excel in the class with a view to clinching fantastic rewards, are known to have ruined their career by indulging in examination misconduct, among other social vices.

In view of the shortcomings of competitive classroom experience, it has become important to explore some alternative learning strategies which would improve classroom social climate and at the same time engender learning outcomes in chemistry. This call to mind an innovative classroom interaction pattern, which although rarely practiced or encouraged in contemporary African setting, has been found to be of great value in encouraging students' achievement else-where (Johnson & Johnson, 1984). This is the Collaborative or Cooperative Learning Strategy (CLS). This is known to have engendered not only cognitive achievement but also social skills and motivation. Johnson (1976,) described the CLS as a social situation in which the goals of separate individuals are so linked together that an individual can attain his/her goal only if the other persons with whom he/she is cooperatively linked can attain theirs as well. In other words, here, the students are made to work as a team, cooperating with the group members (usually 4-6) and working in a mixed

ability group (Okebukola, 1984), whereby the brighter student in the group takes it upon him/her self to tutor (peer-tutoring), the weaker ones.

The distinctive features of CLS includes that the students:

- i. Worked in a mixed ability (high, middle, low) group of five students each
- ii. Worked as a team
- iii. Contributed ideas and suggestions together in problem solving situations
- iv. Made decisions by consensus
- v. Sought for assistance primarily from group members
- vi. Completed class assignments together

The teachers rewarded the team as a group, not on individual bases. In other words, the group score in a class assignment, would be the average of the scores made by the members in the intra group.

In addition to the pattern of interaction prevalent in the class setting, another factor that has been reported as influencing students' achievement in science, generally, is gender (Ezeife, 1990). Indeed, there is this commonly-held view that sciences are exclusive disciplines for males while the females are better in the literary fields. An improved version of this pseudo-thought, and perhaps, one that is obviously been from students' enrolment in our secondary and tertiary institutions, is that females are more in the Biological and home-management sciences while males predominate the Physical sciences and Technical courses (Anaeke & Okekeokosisi, 2018; Ishaka et. al, 2019). The effect of gender on students' achievement in sciences however, still remains inconclusive. Against this background, it could still be possible that the observed achievement pattern of students in Chemistry is a function of the combined effect of interaction pattern and gender. This study however, is not directed to the determination of the combined effect of interaction pattern and gender, as much as to investigate singly the effect of the collaborative learning style and gender, as the two independent variables on students' achievement in chemistry.

Social learning theory as propounded by Bandura (1977), emphasized the importance of observing and modeling the behaviors, attitudes, and emotional reactions of others. He stated further that : "Learning would be exceedingly laborious if people had to rely solely on the effects of their own actions to inform them what to do. Fortunately, most human behavior is learned observationally through modeling: from observing others one forms an idea of how new behaviors are performed, and on later occasions this coded information serves as a guide for action." Social learning theory explains human behavior in terms of continuous reciprocal interaction between cognitive, behavioral, an environmental influences. The component processes underlying observational learning included: (1) Attention, including modeled events (distinctiveness, affective valence, complexity, prevalence, functional value) and observer characteristics (sensory capacities, arousal level, perceptual set, past reinforcement),(2) Retention, including symbolic

coding, cognitive organization, symbolic rehearsal, motor rehearsal), (3) Motor Reproduction, including physical capabilities, self-observation of reproduction, accuracy of feedback, and (4) Motivation, including external, vicarious and self reinforcement. Interestingly, these four outlined components are operative in a collaborative or cooperative classroom climate. Learners under this strategy, are attentive to themselves and share ideas together. This engenders retention of science concepts, as they build upon the interaction and the internally-driven motivation to succeed on themselves to enhance learning. **Statement of the problem:**

The pattern of classroom interaction is fundamental to the achievement of instructional objectives. The Collaborative Learning technique has been rarely practiced in our classroom, although it is in diadem with our cultural practices, where inter-personal collaboration is fully support and encouraged. Conventionally, the competitive experience predominates in institutional library, although some students and some times, teachers have exploited this strategy to unmerited scores and a whole lot of unhealthy tendencies aimed at circumventing the spirit of consequences as our hospitals may turn into “slaughter houses”, the highways, building and bridges may turn to death traps and eventually retrogression will turn out to be our own civilization. Again, many prospective female science students would continue to be edge-out and scares from pursuing science and technology related courses, on the pseudo-belief that science is a male-dominated discipline, thereby widening the gender gap in Science and Technology courses. The problem of this study is to empirically explore the efficacy of the collaborative Learning Strategy and gender in facilitating students’ achievement in Chemistry.

2. OBJECTIVE AND HYPOTHESES

2.1 OBJECTIVE/RESEARCH QUESTION

This study was guided by two objectives and hypotheses.

- i. How different are the mean scores of the students who were taught chemistry concepts using CLS and their counterparts who were taught the same concepts using conventional teaching method?
- ii. To what extent does gender facilitate students’ achievement in chemistry vis-à-vis the Collaborative Learning group?

2.2 HYPOTHESES

- i. There is no significant difference between the mean achievement scores of students taught chemistry concepts using CLS and conventional method
- ii. The mean achievement score of Chemistry students taught using CLS will not differ significantly due to gender.

3. METHOD

The design adopted in this study was the post-test only Quasi Experimental design. This is because there was no pretest on the two intact classes, adjudged to be equivalent, which were used for this study. The sample consisted of 184 Senior Secondary one (SS1) Chemistry students streamed in two intact classes drawn from two Secondary Schools in Awka Urban. Simple random sampling was used in assigning the classes to experimental and control groups.

Experimental treatment (Cooperative Learning Strategy) and control Conventional Teaching Method (CTM) were affected by the regular classroom teachers in the two sampled schools, using appropriate versions of the lesson plan prepared by the researcher. The teacher for treatment group was trained prior to the actual treatment with a view to familiarizing the teachers with the pedagogical competencies needed to implement the treatment condition.

The students for treatment group worked in a mixed ability (high, middle and low representing upper 25%, middle 50% and bottom 25% respectively of their previous term examination's score continuum) group of five students each, worked as a team, completed class exercises, and assignments together, sought for assistance primarily from group members. The students in the control group were not restricted to any pattern of class interaction. After the treatment which lasted for five weeks, the Chemistry Achievement Test (CAT) which had an internal consistency reliability index of 0.94 was administered to both groups and the result analysed. The content areas of the CAT were based on "Techniques of Separating Mixtures and particulate Nature of Matter" all in SS 1 curriculum (FME, 1985). The research questions were answered using means and standard deviation, while hypotheses were tested at 0.05 level of significance using the t-test statistics.

4. RESULTS

The result of the study with respect to the Research Questions and Hypotheses were presented in the following tables.

Table 1: Mean score and Standard Deviation of Students' Achievement by Groups and Gender

Gender	Statistic	Group		
		CLS	Control (CTG)	Total
Male	Mean	56.60	33.40	
	S.D	9.90	6.50	93

	N	48	45	
Female	Mean	57.70	35.10	
	S.D	9.50	8.20	93
	N	47	46	
Overall	Mean	57.10	34.30	
	S.D	9.60	7.40	186
	N	95	91	

Research Question one could be answered from Table 1. The mean achievement score of students taught chemistry concepts using the CLS is 57.10 as against 34.30 for their counterparts taught the same concepts using the conventional teaching method (control). These values indicated that the difference in achievement scores was in favour of the experimental group which recorded a higher achievement score.

Similarly, table 1 presented data relevant to answering research question two. The mean achievement score of male students taught chemistry concept using CLS was given as 56.60 while that for their female counterparts was 57.70. These values indicated that the mean achievement score of the treatment group was in favour of the females who had higher mean score than their male counterparts.

Table 2: t-test of Students' Achievement Scores by Groups

Groups	Mean	S.D	N	Df	t-cal	t-criti	Decision
Treatment (CLS)	57.10	9.60	95				Reject H ₀₁
Control (CTM)	34.30	7.40	91	184	7.10	1.96	

From table 2, the calculated value of t is 7.10, while the critical value of 4, at 0.05 level of significance and 184 degrees of freedom is 1.96. since the calculated value (7.10) is greater than the critical value (1.96), we reject the null hypothesis one, as stated. This means that a significant difference was observed between the mean scores of students who were taught chemistry concepts using Cooperative Learning Strategy (treatment group) and their counterparts who were taught the same concepts using the conventional teaching method (control group).

Table 3: t-test of Students Achievement Scores by Gender

Gender	Mean	S.D	N	Df	t-cal.	t-crit.	Decision
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Male	56.60	9.90	48	93	0.55	accept H ₀
Female	57.70	9.50	47			1.98

From table 3, the calculated value of t is 0.55, while the critical value of t, at 0.05 level of significance and 93 degree of freedom is 1.98. Since the calculated value (0.55), is less than the critical value (1.98), we accept the null hypothesis two, as stated. This means that gender was not a significant factor affecting the mean achievement score of the Chemistry students who were exposed to the treatment group. In other words, the observed difference between the mean achievement score of male and female students was due to chance factor.

Discussion of Findings

From the results of this study, it is evident that the Cooperative Learning Strategy (treatment) had significant effect on students' achievement in chemistry. This finding is consistent with that of Johnson and Johnson (1984), Okebukola (1984). A possible explanation for the superior means achievement score of the Cooperative Learning group in comparison to the control group can be found from the fact that the team approach to learning makes their classroom experiences less formal and akin to natural experiences tenable in the local and informal settings. This intimate relationship to natural experiences enhances higher quality cognitive internalization and long term recall of such facts.

The result of this study also indicate that gender was not a significant factor affecting the mean achievement score of the chemistry students who were exposed to the Cooperative Learning Strategy, although the female students recorded higher mean score. This result was consistent with that of Okoye and Nzewi (2018), Danjuma and Nwagbo (2015). A justifiable explanation to this finding is the fact that chemistry students, irrespective of gender come from the same local environment and are naturally exposed to the same pattern of socialization. Therefore, the classroom experience under the Cooperative Learning Strategy proved to be intimately related to their informal environmental settings. Thus, they responded favourably to such situation, unlike the competitive experience that may tend to be unfriendly and aversive to internalization of chemistry concepts.

By implication, the result of this study has pointed to the fact that cooperation which is one of the values in African cultural setting should be explored for optimal understanding of chemistry concepts. Furthermore, given a favourable environmental condition, the pseudo belief that science concepts are difficult to female students could be systematically neglected. In other words, conducive classroom environment via Cooperative Learning Strategy could be structured as a way of closing the gender gap in students' achievement in chemistry.

Conclusion and Recommendation

The result of this study portrayed the CLS a efficacious in enhancing students achievement in chemistry. It has also pointed to the need for analysis of chemistry curriculum with a view to eliminating any/some gender bias/es which could have been hindering optimal participation and achievement of students, especially girls, in chemistry. It is believed that irrespective of gender, all students can benefit optimally from conducive science classrooms. It is also expected that professional organisations like Science Teachers Association of Nigeria (STAN), mathematical Association of Nigeria (MAN) etc, would organize workshops for both pre-service and in-service teachers as a way of popularizing the Cooperative Learning Strategy, for more result-oriented classroom instructions. When properly put into use the CLS could serve as an alternative or supplementary teaching strategy that would help to curtail the excesses of competitive classroom interaction.

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