

EFFECTS OF COOPERATIVE LEARNING STRATEGY ON SENIOR SECONDARY SCHOOL STUDENTS' PERFORMANCE IN QUANTITATIVE CHEMISTRY IN KEBBI STATE, NIGERIA.

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Abstract.

This paper investigate the effects of cooperative learning as an instructional strategy for teaching Quantitative Chemistry .The study also investigated how other variables like sex affect students' performance in quantitative chemistry when cooperative learning was used as an instructional strategy. To guide this study, three hypotheses were formulated and tested at 0.05 level of significance. The study employed a pre-test- post-test quasi-experimental design. This means that a pre-test post-test was given to both control and experimental groups. The population of study was made up of 980 SS II chemistry students in Kebbi state, from where a sample of 200 students was purposively selected. The instruments used for the collection of data were Cooperative learning guide (CLG) and Achievement test in quantitative chemistry (ATQC). All the data collected were analyzed using t- test statistics. The major findings of the study were: the students in cooperative learning group performed higher than those in traditional classroom learning group; there is also an insignificant difference in performance between the male and female students in the cooperative learning group. Based on the findings, it was recommended that cooperative learning strategy should be adopted by all secondary school chemistry teachers as an effective learning strategy in order to improve students' performance.

Key Words: Cooperative Learning Strategy, Quantitative Chemistry and Performance

Introduction

Cooperative learning is a teaching strategy in which students work together in small teams and use a number of activities to achieve stated objectives and improve their understanding of subject matter. It takes many forms of definitions, but most cooperative approaches involve small, heterogeneous teams, usually of four or five members, working together towards a group task in which each member is individually accountable for part of an outcome that cannot be completed unless the members work together. Students learning goal may be structured to promote cooperative, competitive or individualistic efforts. In contrast to cooperative situations, competitive situations are one in which students compete with each other to achieve a goal that only one or few can attain. In competition, there is a negative interdependence among goal achievement; students perceive that they can obtain their goals if and only if the other students in the class fail to obtain their goals (Johnson and Johnson 1989.)The result is that students either work hard to do better than their classmates, or they take it easy because they do not believe they have a chance to win. In individualistic learning situations students work alone to accomplish goal unrelated to those of classmates and are evaluated on a criterion-reference basis. Students goal achievements are independent, students perceive that the achievement of their learning goals is unrelated to what other students do. Johnson and Johnson (1989).

Academic achievements of students have been found to be enhanced by the use of cooperative learning (Johnson & Johnson, 1989; Slavin, 1990, Webb, 1989. Stevens and Slavin 1995. Lampe, Rooze & Tallent-Runnels, 1998. Bulama, 2003. Bashir, 2005.) stated that, the fact that cooperative learning has been linked to increase in the academic achievement of learners at all ability levels is another reason for its use. Bramlett (1994), Megnin (1995), and Webb, Trooper, and Fall (1995) in their contributions noted that cooperative learning activity engages the student in the learning process and seeks to improve the critical thinking, reasoning, and problem-solving skills of the learner.

A synthesis of research on the influence of ability and gender on cooperative learning outcomes indicated similar findings in both males and females. Studies by, Johnson, Johnson and Stanne (1986), Glassman (1989), Crosby and Owens (1993), Bramlet (1994), Stevens and Slavin (1995), Megnin (1995) and Webb, Trooper and Fall (1995), Emma and Mary (2005), Mohammed and Zaki (2010) found that cooperative learning gains are not limited to a particular ability level or sex but to all who engage in it. Stevens and Slavin (1995), for example, linked cooperative learning to increases in academic achievement of learners at all ability levels, while studies by Glassman (1989) and Johnson, Johnson and Stanne (1986) found cooperative learning to equalize the status and respect for all group members, regardless of gender. Again the study by Crosby and Owens (1993) found that different cooperative learning strategies can be employed to help low ability students, who had difficulties making success in the traditional classroom to improve on their performance

Evidence from research works in Nigeria indicated that very little research efforts had been directed at cooperative learning. This approach has been highly recommended for teaching at all levels, as stated by the Federal Government of Nigeria (2004) in the National Policy on Education. This, therefore, tends to suggest that as most teachers are not sensitized on the advantages of the use of cooperative learning, it is believed that the manner in which most schooling occurs may not be teaching students to become aware of their own learning, to think critically and to derive their own pattern of thought and meaning from content presented through interaction as a result of cooperative learning. It was in attempt to bridge the gap on the knowledge of the effects of cooperative learning on chemistry students' achievement using Kebbi state that, this study was carried out. In the study attempt was made to find

out the effects of cooperative learning strategy on senior secondary school (SS) students' performance in quantitative chemistry and also determined whether the achievement was sex biased.

Statement of the Problem

The study is aimed at finding out the effects of cooperative learning strategy on students' performance in quantitative chemistry. For some times now, it has been observed that Nigerian Students and Kebbi State in particular have problems with Quantitative aspect of Chemistry. This may not be unconnected with the way and manner they are taught this concept. In recent years however, evidence abounds showing that cooperative learning strategy tends to give students better ways of understanding concepts especially in subjects like the social sciences. (Ibrahim, 2003) It is believed by many that when students work in group they tend to understand each other better than when a teacher teaches them.

Similarly there is growing concern in all parts of this country over a decline in the quality of students who enroll in chemistry in our tertiary institutions as well as their performance in their WAEC chemistry examination (Omoshehin 2004). Although these problems may not be rooted in the method of instruction only but the way students are taught, may perhaps greatly affect their performance. Therefore a study towards adopting an alternative method of teaching is necessary in order to contribute in searching for answer to this problem. It is in view of this therefore, the researcher decided, to investigate the effects of cooperative learning strategy on students performance in Quantitative Chemistry.

Objectives of the Study

The study was conducted with the following objectives;

- 1) To find out if there is any difference on students' performance in quantitative chemistry using cooperative learning strategy and conventional method of teaching among secondary school students in Kebbi State.
- 2) To determine if any difference exist between special science secondary school students and conventional secondary school students in terms of performance using cooperative learning strategy.
- 3) To investigate if any difference exist between male and female students in their performance in quantitative chemistry using cooperative learning strategy among secondary school students in Kebbi state

Research Questions

The study was conducted to answer the following research questions;

- 1.)What is the difference on students' performance in quantitative chemistry using cooperative learning strategy and conventional method of teaching among secondary school students in Kebbi State?
- 2) Is there any difference between students of special science secondary schools and those of conventional secondary schools in their performance using cooperative learning strategy?
- 3) Is there any difference between male and female students in their performance in quantitative chemistry using cooperative learning strategy among secondary school students in Kebbi state

Research Hypotheses

The following hypotheses were tested at 0.05 level of significance.

- 1) **H₀₁** There is no significant difference in the performance of students in Quantitative Chemistry using cooperative learning strategy and Conventional teaching method
- 2) **H₀₂**.There is no significant difference in students performance in quantitative Chemistry using cooperative learning strategy between special science secondary schools and conventional secondary school students
- 3) **H₀₃**.There is no significant difference between male and female students taught with cooperative learning strategy on their performance in quantitative chemistry.

Methodology

Research Design

The study employed a pre-test- post-test quasi-experimental design. This means that a pre-test post-test was given to both control and experimental groups. The following variables were used in the study.

- (a) Independent variable;
 - (i) Cooperative Learning strategy (experimental)
 - (ii) Conventional lecture method (control)
- (b) Dependent variable;
Achievement test in quantitative chemistry

Population, Sample and Sampling Technique

The population of the study was 980 senior secondary school two (SS II) chemistry students in Kebbi state. The SSII, are preferred because at this stage, they have covered enough topics in chemistry and are not facing any external examination like NECO or WAEC.A sample of 200 SS2 students was randomly selected from 5 senior secondary schools which were purposively selected to participate in the study. They were chosen purposively because chemistry is taught in all the schools and they all take chemistry at WAEC and NECO examinations. One school was purposively selected from each of the five zonal education offices of the state.

(Birnin-Kebbi, Bunza, Argungu, Zuru and Yauri) Four of the schools are male and the other one is a female school, also two of the schools are special science schools and the other three are comprehensive schools. Forty students were randomly selected from each of the five schools. In each school 20 students were used as control and the other 20 as experimental. All the 20 students in the experimental group in each of the 5 schools were further divided into expert groups of 4 each.

The researcher conducted the teaching in each of the 5 schools in both the experimental and control groups and gave them orientation on the basic skills of cooperative learning strategy before the commencement of the teaching.

Research Instruments

Two instruments were used for the study. They were;

1. The Cooperative Learning Guide (CLG)
2. Performance Test in Quantitative Chemistry (PTQC)

1. The Cooperative Learning Guide (CLG)

This instrument contains the roles of the teacher and the students in a cooperative learning situation. Experts in the field of educational psychology that are knowledgeable in cooperative learning techniques were invited to do the face validity while experts in English education were also invited to do the language editing of the guide. All the experts from both English and educational psychology are from the faculty of education and extension services, Usmanu Danfodio University Sokoto. After they have vetted the instrument by looking at both the face, construct and content validity, they made some comments which were effected bringing the instrument to its present standard, and it was adjudged to be acceptable for the purpose of this research.

2. Achievement Test in Quantitative Chemistry (ATQC).

This instrument consists of twenty (20) multiple choice items with four options. The questions were on quantitative aspects of chemistry contained in SS1 and SS2 syllabus. All the 20 items contained in the ATQC were drawn from the West African Examination Council (WAEC) past question papers. The selection was done within a five year range (2005-2010).

In testing for the reliability of the two instruments (ATQC and CLG), a pilot study was conducted with a representative sample of a secondary school that was not involved in the study. Pilot study sample of 40 senior secondary two were selected. A test-re-test method was used in the pilot study for each of the instruments. That is to say the instruments were administered twice to the same group of students after an interval of three weeks for each of the instruments. Kuder Richardson formula 20 was used to compute the reliability co-efficient. The reliability co-efficient of the instrument were found to be 0.75 for ATQC and 0.70 for CLG. This co-efficient were adjudged to be adequate and therefore capable of testing what they are meant to test and therefore reliable.

The procedure used for data collection was in three main phases and it lasted for six weeks. The phases were:

Pre-test for the first one week

Treatment for the next four weeks

Post- test for the last one week of the six weeks.

The participants for the study were subjected to orientation activities on cooperative learning guide. The students were also oriented on the social skills and principles of intra-team cooperation in cooperative learning.

Results

Hypothesis 1: There is no significant difference in the performance of students in Quantitative Chemistry using cooperative learning strategy and Conventional teaching method

In order to test this Hypothesis, the students' scores in Achievement Test in Quantitative Chemistry post test were correlated for both the controlled group and the experimental group. The t-test was used to determine the level of the significance. A summary of the results of the analysis for this Hypothesis is presented in table 1.

Table 1

Scores of control and experimental groups post test.

Variable	N	Mean	Std. Deviation	t-cal.	t-Critical	Remark
Contr. Group.	100	11.68	4.194	2.733	1.984	Significant
Exp. Group	100	23.16	3.404			

$\alpha = 0.05$ (two-tailed)

From table (1) it could be seen that the calculated t-value of 2.733 is greater than the critical value of t- at 0.005 level of confidence which is 1.984. and therefore the null Hypothesis is rejected This means that a significant difference was found between the group taught with the cooperative learning strategy and the group taught with the usual and traditional method of teaching

Hypothesis 2: There is no significant difference in students performance in Quantitative chemistry between specialized Science Secondary Schools students and Comprehensive Secondary Schools students in Kebbi State.

In order to test- this Hypothesis the mean of the post test for the experimental group for special Science Secondary School Students was compared with that of the Conventional Secondary School Students. The t-test statistical tool at 0,005 level of confidence was used to test the Hypothesis. A summary of the result is shown in table 2:

Table 2

Performance of special Science Secondary School Students in Quantitative Chemistry Versus Conventional secondary school students

Variable	N	Mean	Std. Deviation	t-cal	t-Critical	Remark
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Special sch Post Test	40	12.30	4.165	-15.943	-2.023	Not Significant
Conv. sch Post Test	60	23.25	3.256			

Total=100
 $\alpha = 0.05$ (two-tailed)

Results obtained from table 2 indicates that the t-critical value of -2.023 is greater than the t-calculated value of -15.943 at 0.005level of confidence. Thus the Hypothesis was not rejected. Thus it could be concluded that there is no difference in their performance.

Hypothesis 3: There is no significant difference between male and female students taught with cooperative learning strategy on their performance in quantitative chemistry.

In order to test this hypothesis, the mean of the post test of the experimental group for both male and female students was compared using the t-test statistical tool at 0.005 level of confidence. The summary of the results is shown in table 3.

Table 3
Performance of male and female students in quantitative chemistry

Variable	N	Mean	Std. Deviation	t-cal	t-Critical	Remark
Male Post Test	80	11.85	4.302	-10.092	-1.984	Not Significant
Female Post Test	20	23.20	3.750			

Total = 100
 $\alpha = 0.05$ (two-tailed)

From the results shown on table 3 the t- critical value of -1.984 is greater than the t-calculated value of -10.092 at 0.005 level of confidence thus the hypothesis was not rejected,

Discussions

This study is most significant in that it has moved studies on cooperative learning a step further. The findings of this study have demonstrated the effectiveness of cooperative learning in the teaching and learning of quantitative chemistry at the secondary school level of education. Initial research efforts on cooperative learning had been centred on the use of the subject as a whole and not some specialized areas of a subject. Again the study compared how gender and school type influenced students' scores in cooperative classes. The combination of variables helped to determine the interaction between and among the variables in influencing students test scores in quantitative chemistry.

One major finding of this study was that students taught using the cooperative learning approach scored higher marks in quantitative achievement test than those taught using the traditional classroom teaching method. This may have been achieved by the high level of students' participation in learning activities. All the students in the Cooperative learning group performed specific roles in solving problems which are presented in the classroom to the benefit of all members of the group. When learners are confronted with problems which they must solve, they are forced to reason and think critically in order to solve the problems. This finding agrees with the findings of Stevens and Slavin (1995), Lampe, Rooze and Talent-Runnels (1998) and Borich (2004) who also reported that students taught using cooperative learning strategy tend to perform better. It is believed that when properly and carefully used, cooperative learning activities engage the students in the learning process and seek to improve the critical thinking, reasoning and problem solving skill of learners (Bramlett, 1994; Megnin, 1995; Webb, Trooper, & Fall, 1995). Specifically, these research findings are hinged on certain principles which guided the studies. Bramlett (1994) hinged his study on the principle that cooperative learning enhances active engagement of students and critical thinking. Megnin (1995) based his study on the principle that cooperative learning enhances students' memory and creativity, while Webb, Trooper and Fall (1995) anchored their study on the principle that constructive activity and collaborated learning are enhanced in cooperative learning classrooms. This research is of the view that cooperative learning strategy provides the students the opportunity to know from their colleagues with ease.

The findings of this study also agree with a number of research works that have been carried out on the efficacy of Cooperative learning in Nigeria. Such studies include those of Alebiosu (1998), Esan (1999). Ukwungwu (2000). Adeyemi (2002). Omoshehin (2003) and Ibrahim,(2003) investigated the effects of a training programme in cooperative learning of pre-service teachers' classroom practice and pupils' learning outcomes in social Sciences. It was the conclusion of all these studies that cooperative learning strategies seem more useful than other instructional strategies. The research is in total agreement with these positions.

In classes where cooperative learning approach is used for teaching, students tend to gradually take responsibility for each other's learning. The better attitude exhibited by Students in the cooperative learning classroom may have been achieved because Feedback, reinforcement, and support come from students' peers in the group. Again, students in cooperative learning performing better in test of attitude towards studies may perhaps be because of imbibing of role expectations and responsibility, which are two very important features of cooperative learning.

In this study performance was not affected by gender. All students irrespective of their sexes benefited in about the same margin from the use of cooperative learning strategy. This perhaps may be the reason why no significant difference was found in performance between the male and female students on the use of cooperative learning strategy. By definition, if one group changes in a similar amount as another group, there will be no significant difference between them. What matters most in cooperative learning is

role expectations and responsibilities. Borich (2004) noted that the success of a cooperative learning activity depends on your communication of role expectations and responsibilities and modeling them where necessary. These, the teacher teaching cooperative classes with equal male and female students did by explaining the following: the assignment given, the collaborative goal to be achieved, individual student accountability, inter-group cooperation, criteria for success and specific cooperative behaviors expected. Once the students began work, the teacher observed the various groups and helped solve any problems that emerged.

Although non-significant interaction effects on achievement were found between sex and performance, sex and method, ability and method, and among sex, method and ability, it is believed that the higher thought processes as required for higher achievement, are induced by the interaction with one another more than with the traditional treatment from books and classroom teachers. This, again, may have contributed to the noticeable significant difference in performance scores between students in the cooperative classroom and those in the traditional classroom. Student-student interaction constitutes the majority of time and activity during cooperative learning. It is generally believed by researchers that an essential ingredient of cooperative learning is each learner's desire to facilitate the task performance of fellow group members.

Implications of the Study

It appears that cooperative learning, as described in this study, with strong empirical support for it and the fact that it makes sense for students' performance in quantitative chemistry, is a very viable option among other instructional methods for teaching chemistry in secondary schools. We must, however, be careful not to over generalize since the method has the potential of making students believe that instructional problems cannot be tackled independently. The research into cooperative learning does not show that having students work together in a cooperative manner is a magic device that will solve all classroom problems. What it does say is that those problems probably have a better chance of being solved in cooperative than in competitive or an individualistic setting.

The pattern of teacher-student interaction during cooperative learning has implications for the teaching and learning of chemistry in schools. The major purpose of teacher-student interaction during cooperative learning is to promote independent thinking. The exchanges between the teacher and students in the cooperative classroom focus on getting learners to think for themselves, independently of the text. This implies that chemistry teachers must model their instructions to enforce collaboration with students since cooperative learning occurs in groups that share a common purpose and task, the method again, implies that the chemistry teacher must broaden interactions to fit the zone of maximum response opportunity that is common to most group members in his classroom.

The interaction among students in cooperative learning groups is intense and prolonged. In cooperative learning groups, students gradually take responsibility for each other's learning. During cooperative learning, the feedback, reinforcement, and support come from student peers in the group. This implies that chemistry teachers dividing their students into groups of four or five, working together in physical closeness promoted by a common task, will encourage collaboration, support and feedback from the closest and most immediate source-one's peers. The implication of this in teaching and learning of chemistry is that chemistry teachers should model their instructions to enforce student – student interaction.

Conclusion

This study has proven that a cooperative learning strategy is more effective than a traditional learning method in teaching quantitative chemistry. The advantage of a cooperative learning strategy is not only to teach but also to create and enhance students' motivation, interest, and achievement. This definitely can bring about more effective learning. The Study adds to the global discussion on the effect of the cooperative learning to enhance performance and understanding, and thus motivates the interest of the learner.

Recommendations

Based on the findings, it is hereby recommended that: cooperative learning strategy should be adopted as an effective learning strategy in order to improve student's performance, social interaction skills and foster meta-cognition in students.

It is also recommended that cooperative learning strategy should be adopted as a method of teaching for both male and female students.

Chemistry teachers need to undergo further training to update their skills in teaching effectively. During training, importance of cooperative learning should be emphasized.

School administrators should create necessary time during school for cooperative learning and ensure that it is done effectively.

Government should provide adequate infrastructure and an enabling environment for cooperative learning. The government and private organizations should also sponsor these activities thereby giving out prizes and scholarships to motivate the students.

Government should incorporate cooperative learning strategy in the curriculum of teacher training institutions. So as to make them more competent in the use of the strategy.

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