

Effect of Cooperative Learning Teaching Strategy on the Reduction of Students' Anxiety for Learning Chemistry

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ABSTRACT

The main purpose of this study was to investigate the influence of cooperative learning methods of teaching on Senior Secondary School students' anxiety for learning chemistry. 120 students (52 females and 68 males) randomly selected from the senior secondary schools in South-West Nigeria participated in the study. This study employed a quasi-experimental design. This implies that the design included two treatment groups – Cooperative learning method (Jigsaw II) and the conventional method (chalk-and-talk). Two lesson notes, one for cooperative learning method (Jigsaw) and the other for conventional chalk-and-talk method, and Chemistry Anxiety Scale (CAS) were the instruments used to collect the relevant data. The data collected was analyzed using one-way analysis of variance (ANOVA). Findings of this study revealed that students in both the cooperative learning group and conventional-lecture group exhibited high level of chemistry anxiety at the pretest level. However, after the treatment (posttest level), the chemistry anxiety level of the students in cooperative learning group reduced drastically while the chemistry anxiety level of the students in conventional-lecture group increased. We concluded that since cooperative learning methods of teaching reduced students' chemistry anxiety, chemistry teachers should be encouraged to incorporate cooperative learning in their methods of teaching.

Key Words: Anxiety; Chemistry; Teacher; Senior Secondary School; Cooperative Learning; Conventional-lecture Method.

INTRODUCTION

The role of science education in the lives of individuals and in the advancement of science and technology for the development of mankind and the society in general is very crucial. Scientific literacy, which is the gateway to achieve scientific and technological advancement and economic survival, is achievable through science education. The influence of science on a nation and her citizens could be seen from the production of basic human needs to social, political, educational, technological and economic advancement. The steps scientists take during scientific investigation (science process) and scientific products draw the attention of the society to the fact that science makes life comfortable. Economically advanced nations of the world are distinguished by the excellence of their educational system.

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Academic programmes of their educational institutions give special attention to science education programme.

Towards revolutionizing Nigerian educational system, the 1969 conference gave birth to the National Policy on Education which brought changes to Nigerian educational system. For instance, in Nigeria, the National Policy on Education (2004:29-32) provided educational expenditure in science and technology. However, it is apparent that many of today's teachers are caught in the midst of a change, for which they may not have been professionally prepared. Many teachers were educated in classrooms where the role of the student was to memorize information, conduct well-regulated experiments, and then be tested on their ability to repeat these tasks or remember specific facts.

As a result of this, science educators are constantly interested in how and when to optimally adopt different science instructional strategies in order to achieve stated educational objectives (Harwood & McMahon, 1997). The teaching strategies to be employed by a teacher at any given situation, according to Alebiosu (2003), depend on factors arising from: teacher and student characteristics, teaching objectives, classroom learning environment, and the nature and needs of the subject. Obviously, the traditional teacher-as-information-giver, or textbooks-guided classroom has failed to bring about the desired outcome of producing thinking students. A much heralded approach is to change the focus of the classroom from teacher-dominated to student-centered using a cooperative learning model.

Chemistry is a very important science subject in Nigerian Senior Secondary School curriculum. It is a core subject for the medical sciences, textile technology, agricultural science, synthetic industry, printing technology, pharmacy, chemical engineering, to mention just a few (Jegede, 2007). "As important as the subject is and in spite of the efforts of both the federal and state governments to encourage chemistry education, students still shun the subject" (Jegede, 2003, p. 193). It has been observed that most students fear chemistry and hence they see chemistry as difficult to understand, which may be as a result of the abstract nature of chemistry and the method (lecture method) being used by most of the chemistry teachers in Nigeria. Students' anxiety for chemistry learning can also be attributed to students' perceived difficult nature of chemistry; involvement of multitude of facts; and its disconnection from reality (Dori, 1989). Students' anxiety for chemistry learning leads to loss of interest in the sciences (Keeves & Morgenstem, 1992). In spite of the long existing fear and its effects on the subject, there is dearth of research on the effect of the use of cooperative learning strategy on Nigerian students' levels of anxiety for learning chemistry.

Conducting this present study to address this will, therefore, not only be appropriate but indeed worthwhile. It is against these backgrounds that the present research work employed one cooperative learning method for teaching – Jigsaw II.

a) Cooperative Learning

A learning environment that allows active participation of students in the learning process makes it possible for the students to have control over their learning and this leads to improvement in students' learning and retention as to both the developmental and cognitive theoretical bases (Johnson, Johnson, & Stane, 2000; Rossini & Jim, 1997; Springer, 1999), thereby prevailing classroom climate of cooperation. Cooperative learning environment assumes that students seek information and understanding through active mental search with each group mirroring the make-up of the class in terms of ability, background and gender (Armstrong, 1998). Among all the instructional strategies for enhancing science achievement, emphasis is laid on the importance of group work (Alebiosu, 1998).

Achievement anxiety has a relationship to student study behaviour and academic achievement. In traditional class, where teacher calls upon a student; he/she becomes the focus of attention of the entire class. Any mistakes or incorrect answers become subject to

scrutiny by the whole class. Such experiences produce embarrassment and anxiety in many students (Seligman, Walker, & Rossenhan, 2001). In contrast, in a cooperative learning situation, when students work in a group, the focus of attention is diffused among the group members. When an answer is presented to the class, it represents the work of the entire group; therefore no individual can be held up to criticism, hence the level of classroom anxiety is reduced.

b) Jigsaw Method of Cooperative Learning

Jigsaw was originally developed by Aronson and colleagues in 1978 (Sarah & Cassidy, 2006). Jigsaw I require students to work in group of five to six members. Each student in a group is given information to which no one else in the group has access, thus making each student “expert” on his or her section of the subject matter. After receiving their assignments, each team member reads a section.

Next, members of different teams who have studied the same sections meet in “expert groups” to discuss their sections. Then the students return to their original teams and take turn teaching their team mates what they have learnt. All students in a group are expected to learn all the subject matter assigned to members of their group. After the small group instruction, students are tested on the subject matter and receive individual grades or other rewards. This Aronson version of Jigsaw does not meet Slavin’s effectiveness requirements because it incorporates neither a group goal nor individual accountability for contributing to the achievement of a group goal.

Slavin developed a variation of Jigsaw called Jigsaw II in 1986. Like Aronson’s Jigsaw, each student in Jigsaw II, after preparing in an “expert group, teaches his/her peers a part of the subject matter. After instruction in Jigsaw II, teachers test students individually and produce team scores based on each student’s test performance.

c) Science Anxiety

Science anxiety is described as involving feelings of tension and anxiety that interfere with the manipulation of scientific equipment in a wide variety of ordinary life and academic situations. Science anxiety can also be described as a state of discomfort which occurs in response to situations involving scientific tasks which are perceived as threatening to self esteem. Such feelings are shown to lead to panic, tension, helplessness, fear, distress, shame, inability to cope, sweaty palms, nervous stomach, difficulty in breathing, and loss of ability to concentrate (Seligman, Walker, & Rossenhan, 2001).

Previous research studies have suggested that anxiety causes students generally to withdraw from participation in teaching and learning process. It has been suggested that the solution to the anxiety problem and its resulting lack of participation may be found in teaching methodologies that move away from the more traditional, teacher-centered classrooms and concentrate more on student-centered, cooperative learning techniques (Gregersen, 1999). It has been shown (e.g. Gregersen, 1999) that cooperative learning technique, when used to teach foreign language, reduced the levels of foreign language classroom anxiety and increased the frequency of classroom participation. Noh, Yeo, Jeon, Kim, & Choong (2000) corroborated Gregersen’s findings. They investigated the effects of visual organization and cooperative learning on problem-solving strategy in chemistry and they reported that cooperative learning method reduced chemistry classroom anxiety in students.

Gokce & Derin (2007) investigated the effects of cooperative learning in form of peer feedback, on the writing anxiety of Turkish prospective teachers of English. Results of the quantitative data showed that students in the cooperative learning group experienced

significantly less writing anxiety than the students in the teacher-centered group. This indicates that students in the cooperative learning group showed a significantly higher decrease in writing anxiety level than their colleagues in the teacher-centered group.

However, some researchers did not agree with the fact that cooperative learning can reduce anxiety in students. White (1997) investigated the effects of cooperative learning method and group activities on the secondary school students' mathematics Anxiety Rating Scale. The pretest and posttest scores indicated that both the control and experimental groups began and ended the study with the same level of mathematics anxiety.

Bryan & Kent (2001) examined cooperative learning between pairs of college students in the field of education. Their findings indicated that cooperative learning did not decrease students' levels of anxiety.

This study investigates the effect of cooperative learning method of teaching on students' anxiety in chemistry.

1. Is there any difference in the level of anxiety for learning chemistry between students exposed to the cooperative learning method (Jigsaw) and conventional-lecture method?
2. Is there any difference in the level of anxiety for learning chemistry between male and female students exposed to the two teaching strategies?

METHODOLOGY

This study employed a quasi-experimental design. This implies that the design included two treatment groups – Cooperative learning method (Jigsaw II) and the conventional method (lecture). The sample for this study was 120 Senior Secondary School III students (52 females & 68 males). Two Senior Secondary Schools (mixed schools) were randomly picked from the total number of senior co-educational secondary schools in Ijebu-Ode and Ijebu North – East Local Government Areas of Ogun State, south-west Nigeria. Intact class was used in each of the two schools because most of the school principals would not want distortion in their normal school timetables.

Two lesson notes, one for cooperative learning method (Jigsaw) and the other for conventional-lecture method, and Chemistry Anxiety Scale (CAS) were the instruments used to collect the relevant data. The Chemistry Anxiety Scale (CAS) was designed by the authors to measure senior secondary school students' anxiety levels. Each item on CAS was rated on a five-point likert-type anchored by No anxiety = 1 and High anxiety = 5. To validate the CAS, the instrument was given to experts in the field of psychology for their corrections and their professional input. The CAS was administered to a set of 40 students different from those used for the study. Cronbach's alpha was computed to know the reliabilities of the scores obtained and this was found to be pretest (0.94) and posttest (0.99).

There were three phases of data collection; namely, the pretest – first one week, treatment - three weeks, the posttest – one week. Three periods of 40 minutes were spent each week for the three weeks of treatment. There was no alteration on the time-table allocated for chemistry by the school, i.e. the periods were in line with the schools time-tables. Before exposing the selected students for the study to the different strategies, the students were given the questionnaire on anxiety for their responses as pretest.

There were two treatment groups. The experimental group used the cooperative learning method – Jigsaw II, while the control group used the conventional-lecture method. In the cooperative learning method, students were grouped into 4-5 member teams depending on the total number of students in the class. The control group is the conventional-lecture method group. This group uses teacher's typical method, whereby chalk and talk instructional

technique is the order of the day. The teacher provides objectives and presents information and less concern about the feedback from the students. In this group, there is nothing like learning guides and groups. The same questionnaire on chemistry anxiety, used as pretest, was administered as posttest three days after the completion of the instructions.

The data collected from the administration of the instruments were analyzed using One - way Analysis of Variance (ANOVA) method of data analysis. The analysis was computed using SPSS 14.0 package.

RESULTS

Total science anxiety scores were calculated from items on the chemistry anxiety scale (CAS) in order to critically examine the common level of chemistry anxiety among senior secondary school students. The lowest and highest scores respectively for cooperative learning method (Jigsaw II) at the pretest level were 22 and 86, which implies that the neutral point was 54. Similarly, the lowest and highest scores for lecture method at the pretest level were 75 and 83 respectively, meaning that the neutral point was 79. At the posttest level, the lowest and the highest scores were: cooperative learning method (24, 34), lecture method (72, 85) respectively. This implies that the neutral point for cooperative learning method was 29, while that of lecture method was 79. Hence higher score implies high chemistry anxiety, while lower score implies no or low chemistry anxiety.

In respect of cooperative learning method at the pretest level, it was found that 46 (77%) students had scores higher than the neutral score of 53, while 12 (20%) of students had less than the neutral score and 2 (03%) had exactly 77. This result points to the fact that more students in the cooperative learning group had high chemistry anxiety before they were taught using the cooperative learning method. Similarly for the lecture method, 42 (70%) students had scores higher than the neutral point of 79, 14 (23%) students had scores less than 79, while 4 (7%) had exactly 79. This result also indicates that more students in the lecture method group had high chemistry anxiety before they were taught using the lecture method.

At the posttest level in respect of the cooperative learning method, it was found that 15 (25%) students had scores higher than the midpoint of 29, 35 (59%) had scores less than 29, while 10 (16%) had exactly 29. Such results suggest that more students in the cooperative learning method group had very low chemistry anxiety after being taught using the cooperative learning method. For students in the lecture group at the posttest level, 40 (67%) students had scores higher than the neutral point of 79, 10 (16.5%) had scores less than 79, while 10 (16.5%) had exactly 79. This result implies that more students in the lecture group had high chemistry anxiety after being taught using the lecture method.

Table 1: Results of the ONE WAY- ANOVA on the teaching methods subscale of the CAS

	N	Mean	Std	F	Sig.
Pretest					
Coop Lng	60	65.2000	17.67580	39.698	.000
Lecture	60	79.7167	2.46392		
Posttest					
Coop Lng	60	28.3167	2.63928	8393.389	.000
Lecture	60	79.7833	3.45965		

Coop Lng: Cooperative learning, N: Number of students, Std: Standard deviation,

Sig.: level of significance.

Further analysis using one-way analysis of variance revealed that at the pretest level, the scores were $M = 65.2$; $SD = 17.68$ (cooperative learning method) and $M = 79.72$; $SD = 2.46$ (lecture method), statistically significant ($F_{1, 118} = .000$, sig.). At the posttest level, the scores were $M = 28.32$; $SD = 2.64$ (cooperative learning method) and $M = 79.78$; $SD = 3.46$ (lecture method), statistically significant ($F_{1, 118} = .000$, sig.).

Table 2. Result of the ONE WAY- ANOVA on the gender subscale of the CAS

	N	Mean	Std	F	Sig.
Pretest					
Male	68	72.4559	13.19878	.000	.998
Female	52	72.4615	16.23535		
Posttest					
Male	68	51.5735	26.13017	1.426	.235
Female	52	57.2885	25.77150		

N: Number of students, Std: Standard deviation, Sig.: level of significance.

Further analysis along gender lines revealed no statistically significant difference in the mean scores of male and female students at both the pretest and posttest levels. At the pretest level, the scores were $M = 72.46$; $SD = 13.20$ (male) and $M = 72.46$; $SD = 16.24$ (female), statistically not significant ($F_{1, 118} = .998$, not sig). At the posttest level, the mean scores were $M = 51.57$; $SD = 26.13$ (male) and $M = 57.29$; $SD = 25.77$ (female), statistically not significant ($F_{1, 118} = .235$, not sig).

DISCUSSION

The data findings from this study indicate that the mean scores of students in the cooperative learning group at the posttest level were lower than their mean scores at the pretest level, while the mean scores of students in the lecture group at the posttest level were higher than their mean scores at the pretest level and in some cases slightly different from their pretest mean scores. This implies that when cooperative learning method was used to teach the students, cooperative learning method brought about reduction in students' level of chemistry anxiety which was evidenced in the reduction of their mean scores at the posttest level.

This positive effect of cooperative learning method on students' anxiety for learning chemistry was as a result of its *Positive interdependence* attribute, which made it possible for students to see that their success is dependent on their contributions, inclusion, and success of the other students in the group. In view of this, students were able to exchange ideas on given tasks among themselves and this made it possible for students with low intellectual ability and slow learners to gain from members of their groups. Hence, they became more confident and felt secured participating actively in chemistry lessons.

On the other hand, when the lecture method was used, it did not bring about reduction in the chemistry anxiety level of the students in the group which was evidenced in their higher mean scores at the posttest level.

Consequently, as said earlier, chemistry plays an important role in the study of science-oriented courses in the nation's tertiary institutions and students' anxiety for chemistry which leads to loss of interest in the study of science-oriented courses. As said earlier, students' anxiety for learning chemistry was caused majorly by the methods of teaching, e.g. conventional lecture method, being used by most of the chemistry teachers to teach chemistry in our senior secondary school level. Since cooperative learning method has been found; to have positive effect on the reduction of students' chemistry anxiety according to the findings of this study and those of Gokce & Derin (2007); Gregersen (1999); and Noh et al. (2000), chemistry teachers should be encouraged to incorporate cooperative learning methods into their methods of teaching so that students can develop positive interest in chemistry, which will stimulate their interest in the study of science-oriented courses.

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