

Effect of Collaborative Instructional Strategy on Male and Female Students' Interest Ratings in Secondary School Chemistry in Benue State, Nigeria

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Abstract: This study investigated the Effect of Collaborative Instructional Strategy (CIS) on Students' Interest Ratings in Secondary School (SS) Chemistry in Benue State, Nigeria. A non-randomized pretest/posttest quasi-experimental design of equivalent groups was used. The population was 6,400 Senior Secondary School two (SSS 2) students offering Chemistry in all the 301 government approved co- educational secondary schools in Benue State for the 2015/16 academic year. The sample for the study was 216 students from 4 schools within the three Educational Zones of the state. Sampling technique used was multi-stage. Purposive sampling was used to select 4 out of 6 schools. Random sampling, with the tossing of a coin, was used to sample 2 schools which served as the experimental group while the other 2 schools acted as the control group. Two research questions and two hypotheses were formulated to guide the study. Instrument used for the collection of relevant data was Chemistry Interest Inventory (CII), which was developed by the researcher. It was validated by an expert, and its reliability, Cronbach Coefficient Alpha, was 0.83. The data obtained were analyzed and interpreted using means (X) and standard deviations (SD) to answer the research questions while analysis of covariance (ANCOVA) was used to test the hypotheses. The study found that students who were taught with CIS had a significantly higher mean interest rating than those who were taught with the Traditional Lecture Method (TLM) and there was no significant difference in the mean interest ratings of the male and female students who used CIS. Based on the result of this study, it was concluded that CIS was more effective in enhancing students' interest than TLM, in Secondary School Chemistry, and CIS was gender friendly. Thus, it was recommended, that in-service training, in the form of workshops, seminars, symposia and conferences, be organized for teachers occasionally by school administrators, government and professional bodies on the use of CIS, as an instructional strategy, to enhance students' interest in Secondary School Chemistry.

Keywords: Chemistry, Interest, Collaborative instruction strategy, Gender

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Introduction

The importance of science and technology education to national development cannot be overemphasized in this 21st century. Iji (2010) described this era as that of science and technological development in which the intelligence of the people would contribute in a great and meaningful way to the society's ability. Agogo and Otor (2013) consider chemistry as the central science and the mother of all sciences. According to Atamonokhai (2017), the level of science, technology and mathematics education (STME), including chemistry, determines the level of national development.

Hence, the present Nigerian educational system has a lot of challenges as there are consistent reports of poor performance of students in chemistry in external examinations such as the West African Examinations Council (WAEC) and the National Examinations Council (NECO) (Ogunleye, 1999). Ogunkunle and Gbamanja (2006) noted that the major contributory factor to poor interest in the sciences is the ways and means of teaching the students. Furthermore, several researchers agreed that there is a high demand for a paradigm shift in the curriculum content and in the ways of teaching and learning of these subjects (Odubunmi, 2005; Oke, 2005; Kolawole, 2007; Njoku, 2007; Okeke, 2007 and Adeyemi, 2008).

Hence, a necessary paradigm shift from the conventional or traditional mode of imparting knowledge by the teacher is that of *knowledge construction* by the learner. This model, in which the learners construct their own understanding of concepts, is known as constructivism (Epstein, 2002). Constructivism is an instructional model that focuses on the learners' ability to construct their own understanding from their own experiences and, by so doing, making more meaning out of what they learn (Igboko and Ibeneme, 2006). Collaborative instructional strategy (CIS) which is a socio-cultural approach evolved from constructivism.

CIS involves the use of small groups in which students work together to maximize and gain from one another (Johnson and Johnson, 2007). Studies of Johnson, Johnson and Holubec (2006), Johnson and Johnson (2007) and Panitz (2008) reveal several positive results in the use of collaborative instructional strategy which assist students to learn more meaningfully. Their findings indicate that students learn more of the materials, as their interest is kindled through motivation, team spirit and collaboration with one another.

According to Imoko and Agwagah (2006), interest is an important variable in learning because when one becomes interested in an activity, one is likely to be more deeply involved in that activity. Harbor-Peters (2010) defined interest as a subjective feeling of concentration or curiosity over something. Imoko and Agwagah (2006) saw interest as the preference for particular types of activities; that is, tendencies to seek out and participate in certain activities. It can be expressed through simple statements made by individuals of their likes and dislikes. Learners are likely to do well in disciplines of their interest.

Hopefully, teaching chemistry in an interesting manner will elicit students' interest and enhance better learning by the students. Therefore, there is a need to adopt pedagogical strategies that would engender students' interest in the subject. In search of such a strategy or technique, this study is focused on using the Collaborative Instructional Strategy (CIS).

Gender issues, which have come into prominence in the international arena and in science education, are indicated to be fostered by CIS. Johnson, Johnson and Holubec (2006) reveal that CIS helps to reduce gender stereotyping, as groups are usually made as heterogeneously

as possible consisting of both male and female students. Their studies indicate that girls as well as boys participate actively in collaborative groups. They carry out class work, assignments, homework and projects without any form of discrimination or segregation. The traditional lecture method has been shown to favor the male students more to the disadvantage of the female students owing to its competitive and individualistic nature (Imoko and Agwagah, 2006). But CIS tends to provide a more conducive socio-cultural environment, as learners work together and help one another in their groups as siblings. This study considered gender as a subsidiary variable in order to ascertain CIS effect on differences in mean interest ratings of male and female students.

Materials and Method

Purpose of the Study

This study investigated the effect of collaborative instructional strategy on the interest of students in Secondary School Chemistry in Benue State, Nigeria. Specifically, the objectives of the study were to:

1. Determine the effect of collaborative instructional strategy on students' interest in secondary school chemistry;
2. Investigate the effect of collaborative instructional strategy on the interests of male and female students in secondary school chemistry.

Research Questions

The following questions guided this study.

1. What is the effect of collaborative instructional strategy on students' mean rating in secondary school chemistry?
2. What is the effect of collaborative instructional strategy on the mean interest ratings of male and female students of secondary school chemistry?

Hypotheses

The following null hypotheses were formulated to guide the study. They were tested at 5% level of significance:

1. There is no significant difference in the interest ratings of secondary school students taught chemistry with the collaborative instructional strategy and those taught with the traditional lecture method.
2. There is no significant difference in the mean interest ratings of male and female secondary school students taught chemistry with the collaborative instructional strategy.

Method and Procedure

Quasi-experimental design of non-randomized equivalent groups was used for this study. This is because the subjects who participated in the research could not be manipulated, by randomization, as in pure experimental study. The nature of the study did not allow for random assigning of subjects for treatment as the students learned in intact classes and according to their school master timetables.

This study was carried out in Benue State, Nigeria. The state is located in the north-central geo-political zone, which is part of the middle belt, of Nigeria. The entire population of the study consisted of all the 6,400 Senior Secondary School two (SSS 2) students who offered Chemistry in the 301 government approved co-educational secondary schools in Benue State in the 2015/16 academic year. The total population comprised 3,528 boys and 2,872 girls.

The sample size of the study was 216 students. It consisted of 134 males and 82 females from four schools. A multi-stage sampling method was used. Purposive sampling technique was used to choose two schools from each of the three Educational Zones A, B and C in the State, (making 6 schools) to participate in the pretest. Students in the six purposively sampled schools were administered the Chemistry Interest Inventory (CII) in a pretest. Then four, out of the six schools, with the closest mean scores and standard deviations, were selected for treatment and to participate in the posttest of the study. Using the random sampling method (by tossing of a coin) two of the four selected schools were made to serve as the control group while the other two served as the experimental group. All the students of these four schools (216) formed the sample for the study.

The instrument used for data collection was Chemistry Interest Inventory (CII), which was adapted from Strong Interest Inventory (SII), also called Strong-Campbell Interest Inventory. CII encompassed all the current subtopics of Food Chemistry in the Senior Secondary School (SSS) chemistry curriculum of the Federal Ministry of Education (FME) and the Chemistry syllabi of both the West African Examinations Council (WAEC) and the National Examinations Council (NECO). CII has the options and weights of Strongly Interested (4), Interested (3), Uninterested (2) and Strongly Uninterested (1), where the rating scale weights are in parenthesis. It contains items which the respondents were to tick (✓) at the various options to indicate their level of interest. Its reliability was calculated to be 0.83 using Cronbach Coefficient Alpha.

Descriptive statistics using mean and standard deviations were used to answer the research questions. Inferential statistics of analysis of covariance (ANCOVA) was used to test the hypotheses at 5% level of significance.

Results and Discussion

Results of the study were organized around the research questions and their corresponding hypotheses. They are as follow:

Research Question 1

What is the effect of collaborative instructional strategy on students' mean interest rating in secondary school chemistry?

Table 1. Mean Interest Ratings of Students in Chemistry in the Pretest and Posttest

Group	N	Pre-Test	S.D.	Post-Test	S.D.	Mean Gain
Collaborative Instructional Strategy (CIS)	102	2.14	0.233	3.17	0.360	1.03
Traditional Lecture Method (TLM)	114	2.12	0.289	2.58	0.383	0.46
Mean Diff. Total	216	0.02		0.59		0.57

N = Number of Students; S.D. = Standard Deviation and Diff. = Difference

Table 1 shows that the experimental group, which was exposed to the Collaborative Instructional Strategy (CIS), gained more interest rating, in chemistry, than the group that was exposed to the Traditional Lecture Method (TLM). CIS group had a pretest/posttest gain in mean interest rating of 1.03 while the TLM group had 0.46.

Hypothesis 1: There is no significant difference in the mean interest ratings of secondary school students taught chemistry with the collaborative instructional strategy and those taught with the traditional lecture method.

Table 2. ANCOVA Table of Mean Interest Ratings of Students in Chemistry

Source of Variation	Df	SS _X	SS _Y	SS _{X.Y}	SS _{Y.X}	MS _{Y.X}	F _{cal} value	F _{tab} value	Result
Between Groups	1	-30.602	18.527	-22.304	96122.81	96122.81	419.09	3.89	Sig. Null hypothesis rejected
Within Groups	214	45.546	29.631	1495.62	49083.22	229.36			
Total	215	14.944	47.888	1473.32	145206.04				

NB: 1 degree of freedom was lost, from a total of 216, to give a total of 215, due to regression of Y on X.

Df = Degree of freedom; **SS_X** = Sum of squares of X; **SS_Y** = Sum of squares of Y; **SS_{X.Y}** = Sum of products of X and Y; **SS_{Y.X}** = Adjusted sum of squares for Y on X; **MS_{Y.X}** = Mean of adjusted sum of squares for Y on X; **F_{cal}** = F calculated value and **F_{tab}** = F value from table. X and Y are the interest ratings of the students in the pretest and posttest respectively. Sig. = Significant.

The calculated F value (419.09) is higher than the F critical value (3.89). Hence the null hypothesis was rejected. This shows that there is a significant difference in the mean interest ratings of students taught Chemistry with the Collaborative Instructional Strategy (CIS) and those taught with the Traditional Lecture Method (TLM).

Research Question 2

What is the effect of collaborative instructional strategy on the mean interest ratings of male and female students of secondary school chemistry?

Table 3. Pre-test and Post-test Mean Interest Ratings of Male and Female Students of the Control (TLM) and Experimental (CIS) Groups in Chemistry

Group	Gender	N	Pre-Test	S.D.	Post-Test	S.D.	Mean Gain
Collaborative Instructional Strategy (CIS)	Male	60	2.16	0.249	3.16	0.364	1.00
	Female	42	2.12	0.209	3.18	0.358	1.06
	Mean Diff. Total	102	0.04		-0.02		-0.06
Traditional Lecture Method (TLM)	Male	74	2.13	0.319	2.75	0.317	0.62
	Female	40	2.11	0.225	2.27	0.287	0.16
	Mean Diff. Total	114	0.02		0.48		0.46

N = Number of students; S.D. = Standard deviation and Diff. = Difference

Table 3 shows that the collaborative instructional strategy increased the interest of both male and female students in the learning of chemistry more than the traditional lecture method. However, CIS favored the female students (with mean gain of 1.06) in interest rating more than their male counterparts (with mean gain of 1.00).

Hypothesis 2: There is no significant difference in the mean interest ratings of male and female secondary school students taught chemistry with the collaborative instructional strategy.

Table 4. ANCOVA Table of Mean Interest Ratings of Male and Female Students in Chemistry in the Pretest and Posttest of the Experimental Group (CIS)

Source of Variation	Df	SS _X	SS _Y	SS _{X.Y}	SS _{Y.X}	MS _{Y.X}	F _{cal} value	F _{tab} value	Result
Between Groups	1	0.167	0.017	0.0532	0.015	0.015	0.115	3.94	Not Sig. Null hypothesis not rejected
Within Groups	100	55.59	13.08	0.8588	13.068	0.131			
Total	101	55.76	13.10	0.9120	13.083				

NB: 1 degree of freedom was lost, from a total of 102, to give a total of 101, due to regression of Y on X.

Df = Degree of freedom; **SS_X** = Sum of squares of X; **SS_Y** = Sum of squares of Y; **SS_{X.Y}** = Sum of products of X and Y; **SS_{Y.X}** = Adjusted sum of squares for Y on X; **MS_{Y.X}** = Mean of adjusted sum of squares for Y on X; **F_{cal}** = F calculated value and **F_{tab}** = F value from table. X and Y are the interest ratings of the students in the pretest and posttest respectively. Sig. = Significant.

The calculated F value (0.115) is less than the F critical value (3.94). Hence the null hypothesis is not rejected.

Discussion of Findings

This section describes the highlights and details of the major findings of this study. The major findings are as follow:

1. CIS increased students' mean interest rating in Chemistry more than TLM;
2. CIS was found to be more gender friendly than TLM in enhancing interest of the students in Chemistry.

Details of the findings are as discussed below. Using the research questions with their corresponding hypotheses, as a guide, they are discussed in relation to previously reviewed studies. The CIS group had a greater interest in chemistry than the group that used TLM. The calculated F value (419.09) being greater than the F critical value (3.89) indicated a statistically significant difference.

This result is in consonance with Abakpa (2011) who described interest as the energizer of learning without which meaningful learning may not take place and Mtsem (2011) who posited that any teaching method that considers students' interest is likely to increase their success in their learning tasks. It agreed with Imoko and Agwagah (2006) who showed how

innovative methods elicit students' interest in the learning of concepts in science, technology and mathematics education (STME).

Furthermore, the study showed, generally, that CIS benefited the female students more than the male students, unlike TLM which benefited the male students more. The girls had more pretest/posttest mean gain, in interest rating, (1.06) than the boys (0.82) with CIS. But with TLM, the boys had more mean gain (0.33) than the girls (0.16).

However, in spite of the more mean gain in interest ratings, by the females than the males, the mean difference was not statistically significant (F calculated value 0.115 being less than F table value of 3.94). In other words, CIS was more gender friendly, as it did not significantly affect the differences in their mean interest ratings. Thus, the study agreed with Johnson, Johnson and Holubec (2006); Slavin (2007) and Kolawole (2008) who found that students involved in activity oriented lessons within a collaborative instructional environment usually had the girls being at par with their male counterparts cognitively with respect to interest, achievement and retention, while boys usually do better than the girls with the lecture method.

Conclusion

Based on the findings of this study, it can be concluded that the use of the Collaborative Instructional Strategy (CIS) significantly enhanced the interest in chemistry of the students more than the Traditional Lecture Method (TLM). Also, CIS was found to be more gender friendly than TLM.

On the basis of the findings of this study, it was recommended that in-service training, in the form of workshops, seminars, symposia, conferences and long vacation courses, on the implementation of CIS, should be organized for chemistry teachers. This can be conducted occasionally by school heads, professional bodies (such as the Science Teachers' Association of Nigeria (STAN), Chemical Society of Nigeria (CSN), Teachers Registration Council of Nigeria (TRCN)), institutions and Ministries of Education.

Also, science teacher educators should utilize CIS in teaching would-be teachers during their training programmes. This would equip them to be able to apply this instructional strategy in their classrooms to elicit students' interest in Chemistry.

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