



Effects of Students' Team Achievement Division (STAD) on Students' Achievement in Selected Secondary Schools Chemistry Concepts in Umuahia Education Zone of Abia State

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Abstract:

This study investigated the effect of Students' Team Achievement Division (STAD) on Students' Achievement in Selected Secondary Schools Chemistry Concepts in Umuahia education zone of Abia State using a non-randomized pre-test, post-test quasi experimental design. The population consisted of 1665 SS1 chemistry students. Purposive sampling technique was used to obtain a sample size of 230 SS1 Chemistry students in intact classes. Data was generated through Chemistry Achievement Test (CAT). A reliability coefficient was calculated to be 0.92 using (K-R₂₀) method. The research questions were analyzed using mean and standard deviation while ANCOVA was used for testing the null hypotheses at 0.05 level of significance. The result showed that there was a significant difference in the achievement of male and female students' taught selected chemistry concept using STAD. Consequently, it is recommended that Chemistry teachers should use STAD strategy in the classroom to avoid students' age long passiveness and poor achievement.

Key words: Chemistry, Secondary Schools, STAD and Students' achievement

Introduction:

Chemistry as a subject offered at senior secondary schools in Nigeria is central to the expansion of science and technology. It is the pivot on which the wheel of science rotates (Nwani, 2018). It is a subject that studies the properties, composition, structure, interactions, transformations and the energy consequences of matter. Eze (2021) defined chemistry as the science that investigates the properties of matter and its applications for the good of man. Chemistry, as a subdivision of science is very important in modern societies due to its requirement as a prerequisite to the study of numerous other science oriented courses like agriculture, pharmacy, medicine, nursing, food science, biochemistry, chemical engineering and so on. The study of chemistry has been and will remain of great significance to mankind because chemistry is capable of explaining natural phenomena and everyday occurrences. Chemistry has made food more plentiful by improving agricultural production, providing clothing through chemically treated synthetic and natural fibres by making them resistant to stain, wrinkles and water.

Despite the importance of chemistry, Akpoghol, Samba & Asemave (2015) reported that students' achievement in chemistry is very low and attributed the reason to the way chemistry is being taught by the teachers. This is buttressed by the poor performance of students' in the West African Senior School Certificate Examination (WASSCE). According to Chief examiners report of May/June 2018 WASSCE in Nigeria, candidates' performance was below average and was worse than 2017 WASSCE with a raw mean score of 47.0 and standard deviation of 16.0 compared to a raw mean score of 29.0 and standard deviation of 13.78. Students' poor academic achievement as reported by the chief examiners in 2018 was attributable to the several factors which include Inability to show basic understanding of simple concepts in chemistry, non-adherence to instructions as they relate to each question, poor communication skill, poor mathematics background and in-effective teaching methods adopted by the chemistry teacher. Researchers such as Chikendu (2022), Agu and Samuel (2018), Eriba and Samuel (2018) observed that

poor instructional strategies employed in the teaching of the subjects by teachers contribute to students' under-achievement. Chinda and Ekpote (2023) acknowledged that interactive innovative strategies could enhance students' achievements. One of the interactive innovative strategies to teaching and learning STM that will be the focus of this study is the students' team achievement division (STAD).

STAD is the instructional use of small groups in such a way that students' work together to achieve common goals. In STAD, the teacher teaches the whole class and gives the material to the students to learn in a group. The groups are tested and scored individually and collectively. The team obtaining high scores is rewarded. STAD encourages students to work together in diverse, mixed-ability teams where they support each other's learning process. It provides opportunities for students to enhance interpersonal skills such as communication, collaboration and conflict resolution through structured group interactions. It encourages individual accountability whereby each student is held responsible for their learning and is expected to contribute meaningfully to the team's overall success. It was observed that STAD has been commonly investigated in mathematics, biology, basic science and chemistry for example Wisdom, Longinus and Sopuruchi (2018) reported that STAD does not only enhance academic success; but also encourage positive social relationships among members of the group. Jack & Yawe (2021) found out that STAD improved attitude and achievement for both male and female students. Aliyu and Ibrahim revealed that significance difference existed between the performances of students with varied ability in 3D shape taught using STAD and those taught using conventional method. However, there is limited empirical evidence on its effectiveness in enhancing students' academic achievement in selected secondary schools chemistry concepts in Nigeria, the gap which the present study seek to fill.

Academic achievement can be described as the level of success or adeptness attained by a student in their pursuits of education. It is a determinant of the efficacy and efficiency of a given instruction (Kabutu, Oloyede and Bandele, 2015). It helps the teachers to verify the aptness of their teaching technique and learning materials. It is used to identify students' growth or lack of growth in acquiring desirable knowledge, skills and social values. One of the factors influencing students' achievement in chemistry at senior secondary school level has been recognized as gender.

Gender is the classification of a person into masculine and feminine based on sex and socially ascribed roles. Jack & Yawe (2021) reported that male students' taught chemistry with STAD gained in achievement more than their female counterparts. Eze, Egbo and Omeje (2018) found a significant difference in favour of female students when taught kinetic theory and gas laws using programmed instruction. On the other hand, Oluwanife and Olajumoke (2021) reported that gender had no effect on academic achievement of students' taught mathematics with STAD. Following the above, further studies are required to clarify whether the effect of Students' Team Achievement Division (STAD) will enhance the academic achievement of male and female students better than conventional lecture method.

Research Questions

The following research questions were raised to guide the study,

1. What are the mean achievement scores of students taught selected chemistry concepts using STAD and those taught with conventional (lecture) teaching method?
2. What are the mean achievement scores of male and female students taught selected chemistry concepts using STAD teaching method?

Hypotheses

The study was guided by the following null hypotheses tested at 0.05 level of significance.

- HO1: There is no significant difference between the mean achievement scores of students taught selected chemistry concepts using STAD and those taught with conventional (lecture) teaching method.
- HO2: There is no significant difference between the mean achievement scores of male and female students taught selected chemistry concepts using STAD teaching method.

Methods

This study adopted a non-randomized pre-test, post-test quasi experimental design. The population consists of 1665 SS1 Chemistry students in the 56 Secondary Schools in Umuahia Education zone of Abia State. Purposive sampling technique was used to obtain a sample size of 230 (105 males and 125 females) senior secondary one (SS1) Chemistry students in intact classes from four co-educational secondary schools. The reason for the purposive

sampling technique was because the researcher needed experienced chemistry teachers and the school administration which is ready and willing to allow their students and teachers to take part in the study. Two schools were assigned to the experimental group while the other two schools were assigned to the control group through random sampling technique. The students in two different groups of the intact classes were taught using STAD and lecture methods. Thus, the control group was exposed to conventional (lecture) method while the treatment group was exposed to STAD strategy. For the treatment group, the students were placed in diverse teams of 4-5 members with mixed abilities, genders and ethnic background. The regular chemistry teachers who were used as research assistants employed the whole components of STAD but the researcher prepared a

detailed lesson note which the class teachers used for the study.

The instrument for data collection, Chemistry Achievement Test (CAT) was made up of 50 multiple choice questions adapted from WAEC past questions papers. The CAT was face and content validated by three experts in Science Education Department, Michael Okpara University of Agriculture using face validity check list and strict adherence to test blue print. The internal consistency of the test item was calculated to be 0.92 using Kuder-Richardson formula ($K-R_{20}$) method. The data obtained was analyzed using mean and standard deviation to answer the research questions and analysis of covariance (ANCOVA) for testing the null hypotheses at 0.05 level of significance such that if p-value is less than 0.05, the null hypothesis is rejected but if p-value is greater than 0.05 the null hypothesis is not rejected.

Results

Table 1 Mean and standard deviation of achievement scores of students taught selected chemistry concepts using STAD and those taught using lecture method

Variables Teaching methods	N	Pre-test		Post-test		Mean gain
		Mean	SD	Mean	SD	
STAD	138	35.75	13.30	55.75	16.77	20.00
Lecture	92	27.59	12.56	38.26	14.30	10.67

Table 1 shows that the students who were taught chemistry using STAD had pre-test mean achievement score of 35.75 and post-test mean achievement score of 55.75 with standard deviation of 16.77 while those who were taught using lecture strategy had pre-test mean achievement score of 27.59 and post-test mean achievement score of 38.26 with standard deviation of 14.30. For each of the groups, the post achievement mean score was greater than the pre-test mean score with the students taught chemistry using STAD teaching strategy having the higher mean gain. However, the mean achievement gain scores of 20.00 and 10.67 for the two groups respectively imply that the students who were exposed to STAD achieved

higher than their counterpart who were taught using lecture strategy with mean gain difference of 9.33 in favour of those taught using STAD. Moreover, the posttest standard deviations of 16.77 and 14.30 for the STAD and lecture students respectively indicate that the variation in the individual scores of STAD students is higher than that of the lecture students in their group mean. This means that their scores became more spread out after intervention suggesting that the students taught with STAD method benefited more than their counterpart. Thus, the result is subjected to hypothesis testing to see if the difference is significant or not.

Table 2 Analysis of covariance of the achievement scores of students taught selected chemistry concepts using STAD and those taught using lecture method

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Squared	Eta
Corrected Model	69050.003 ^a	2	34525.001	1575.514	.000	.933	
Intercept	3401.366	1	3401.366	155.218	.000	.406	
Pretest	52159.000	1	52159.000	2380.223	.000	.913	
Group	3223.917	1	3223.917	147.120	.000	.393	
Error	4974.362	227	21.913				
Total	620780.000	230					
Corrected Total	74024.365	229					

a. R Squared = .933 (Adjusted R Squared = .932)

The result in table 2 shows that the F-value (147.120) is significant at .000 for the teaching method. Since .000 is less than .005 significant level set for the hypothesis, the null hypothesis (H_{01}) which states that there is no significant difference between the mean achievement scores of students taught selected chemistry concepts using STAD and those taught using the conventional (lecture) strategy was rejected.

Thus, there is a significant difference between the mean achievement scores of students taught selected chemistry concepts using STAD and those taught using the conventional (lecture) method. Besides, the effect size of (0.393) indicates that (39.3%) improvement in the achievement of students in selected Chemistry concept is attributed to the effect of STAD.

Table 3 Mean and standard deviation of achievement scores of male and female students taught selected chemistry concepts using STAD

Variables			Pre-test		Post-test		Mean gain
Teaching method	Gender	N	Mean	SD	Mean	SD	
STAD	Male	73	35.53	12.83	57.53	16.29	22.00
	Female	65	36.00	13.91	54.22	17.02	18.22

Table 3 shows that male students had pre test mean achievement score of 35.53 and post-test mean achievement score of 57.53 while their female counterparts had pre-test mean achievement score of 36.00 and post-test mean achievement score of 54.22. Mean gain scores of 22.00 and 18.22 for the male and female students respectively may have also indicated that male students achieved higher than their female counterparts. Although the difference is relatively small suggesting that STAD is effective for both genders. Also, the posttest standard deviations of 16.29

and 17.02 for the male and female students respectively indicate that both groups show variability, but female students have a slightly higher standard deviation. This suggests that after learning with STAD some female students achieved much better than others, creating a wider spread of scores. Male students' scores were also spread out but not as much as the females. Thus the result is subjected to hypothesis testing to see if the difference is significant or not.

Table 4 Analysis of covariance of the achievement scores of male and female students taught selected chemistry concepts using STAD teaching strategy

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Squared	Eta
Corrected Model	35275.346 ^a	2	17637.673	733.030	.000	.916	
Intercept	2694.473	1	2694.473	111.984	.000	.453	
Pretest	34897.476	1	34897.476	1450.356	.000	.915	
Gender	515.909	1	515.909	21.441	.000	.137	
Error	3248.278	135	24.061				
Total	467492.000	138					
Corrected Total	38523.623	137					

a. R Squared = .916 (Adjusted R Squared = .914)

Table 4 shows that the F-value (21.441) for the achievement scores of male and female students taught selected chemistry concepts using STAD teaching strategy is .000. Since the value .000 is less than 0.05 level of significance set for the hypothesis. The null hypothesis was rejected. Thus there is a significant difference in the mean achievement scores of male and female students taught selected chemistry concepts using STAD. Additionally, the partial eta squared value of .137 (13.7%) suggests a large effect size, implying that gender had a considerable impact on students' academic achievement in chemistry when taught using STAD teaching strategy.

Discussion of Findings

The result indicated that STAD teaching strategy had more effect on students' achievement in selected chemistry concepts than conventional (lecture) method. Since the data revealed that the post-test mean achievement score of the students taught using STAD teaching method had the higher mean gain than those taught using the conventional (lecture) method. The above finding further confirmed that there was a significant difference in the mean achievement scores of students taught selected Chemistry concepts using STAD and conventional (lecture) method with those taught using STAD having a higher mean gain than those taught using conventional (lecture) method. In the researcher's opinion, STAD strategy adopted in teaching is significant in enhancing students' achievement due to the students' active participation, their interaction in groups and the teacher's role as facilitator of thought provoking questions. This finding is in line with the findings of Jack and Yawe (2021), Agu and Samuel (2018), Yaduvanshi and

Singh (2018), Anaduaka, Olatoye, and Sunday (2020), whose studies in various subjects like chemistry, basic science and technology, biology, mathematics and physics respectively also indicated a significant difference between the mean achievement scores of students taught with STAD over those taught with conventional method in favour of those taught with STAD. The present study also implies that the two instructional methods; STAD and conventional (lecture) methods are not equally effective.

The result also revealed that male students taught selected chemistry concepts using STAD teaching method achieved higher than their female counterparts and the confirmatory analysis also showed that there was a significant difference in the mean achievement scores of male and female students taught selected Chemistry concepts using STAD teaching method. This implies that gender is a significant factor affecting students' achievement in chemistry when taught using STAD. The result of this study is in agreement with the submission of Fantevie (2023) who observed that male students achieved higher than their female counterparts in chemistry when taught using STAD. From the present study, one can deduce that gender has effect on students' achievement in selected chemistry concepts.

Conclusion

The use of Students' Team Achievement Division (STAD) strategy in the teaching and learning of Chemistry was more effective and successful in increasing students' achievement than the conventional method.

The male students taught chemistry using STAD instructional strategy had higher achievement than



their female counterpart indicating that gender is a significant factor affecting students' achievement towards chemistry. However, all students irrespective of their gender benefited in about the same margin from the use of STAD instructional strategy; hence the strategy could be used for both male and female;

Recommendations

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

1. Chemistry teachers should use STAD for teaching chemistry in order to solve the problem of students' passiveness and poor achievement.
2. Teachers should incorporate gender-responsive instructional strategies, to ensure equitable participation and targeted support for female students thus enhancing the effectiveness of STAD and students' achievement regardless of gender.
3. Curriculum developers in their efforts to improve the effectiveness of chemistry should encourage the use of STAD.

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