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STUDENT TEAM ACHIEVEMENT DIVISION (STAD) MODEL: EFFECT ON STUDENTS' ATTITUDE AND ACADEMIC ACHIEVEMENT IN CHEMISTRY

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ABSTRACT
The study investigated the effect of Student Team Achievement Division (STAD) Model on the attitude and Academic Achievement of Students in Chemistry in Jalingo Education Zone, Taraba State. Quasi-experimental design was used for the study. The population consisted of all Secondary School II (SSII) students. A total of 147 students were sampled using multiple stage sampling technique. Three intact classes were randomly selected and assigned to the experimental and control groups. Chemistry Achievement Test (CAT) and Students Attitudes towards Chemistry Inventory (SATCI) were used for data collection with the reliability index of 0.82 and 0.83respectively. The data collected were analyzed using mean and standard deviation to answer the research questions while the null hypotheses were tested at 0.05 level of significance using Analysis of Ccovariance (ANCOVA). The findings showed that there is a significant difference between the mean achievement scores of students taught chemistry with STAD model than those taught with Lecture Method. There is also a significant difference between the mean achievement scores of male and female students; but there is no significant difference between the mean attitude scores of students taught chemistry with STAD. Based on the findings, it is evident to conclude that the use of STAD model enhances performance of students in chemistry than the Lecture method. It is therefore recommended that pre-service and in-service Chemistry teachers should be trained on the use STAD since it improves attitudes and academic achievement of students.

Keywords: Student Team Achievement Division (STAD) Model, Academic Achievement, Attitude, Gender

Introduction

Chemistry is one of the compulsory subjects required for one to study science courses in institutions of learning. This implies that the importance of chemistry in the development of any nation cannot be underrated especially in Nigeria where the national income rests on petroleum and petrochemical industries. Chemistry as a branch of science therefore, deals with the study of matter, its structure, composition, properties and the changes it undergoes. It is the science that deals with the properties of different atoms, the ways in which they join together to form molecules, the interaction of various kinds of molecules with one another and the accompanying energy changes. Chemistry is one of the fundamental ingredients of technology. There is therefore the need for proper delivery of chemistry curriculum in Senior Secondary Schools so as to attain a sustainable technological development.

Unfortunately, despite the importance and relevance of the subject, indices from various examination bodies, such as the West African Examination Council (WAEC) and National Examination Council (NECO), have shown a consistent trend of low enrolment and poor achievement of students in Chemistry examinations. The statistics obtained from Taraba State Ministry of Education Resource Centre (2019) reported that between 2013 to 2018, the trend in performance of students in WAEC Chemistry is as close observation of the performance reveals that a trend of poor achievement has not changed for the better. The sum of the percentage of total failure and grades 7-8 (which is as good as total failure) far outweigh that of pass at credit level all through the years except in 2017 and 2018. Just two years out of six years.The chief examiner's report of the West Africa Examination Council

(WAEC, 2018) also showed that most chemistry candidates performed below average and was worse than that of school candidates, 2017. According to the report most candidates displayed inability to accurately write down chemical formula and balance simple equations, could not show basic understanding of simple concepts in chemistry, could not write down complete definition when required.

However, findings of the above researchers reviewed all reported that inappropriate teaching strategies are the major factor responsible for the observed poor academic achievement of students in Chemistry. Twenty century is the era of change as everything is changing at the faster pace. To satisfy the needs of students of the 21st century new experiments, creative innovations, and appropriate strategies are being developed and tried out to improve education at all levels. Cooperative learning strategy is also the new emerging strategy. Many studies have been conducted in different settings of education, using different kinds of cooperative learning strategies. Such strategies are Learning Together (LT), Jigsaw Grouping (JG), Teams-Games-Tournament (TGT), Group Investigation (GI), Students Teams Achievement Division (STAD), Team Accelerated Instruction (TAI) and Team Assisted Individualization (TAI). A series of research studies has found appreciate relationship between the higher cognitive and affective outcomes, and cooperative learning approaches (Tran & Lewis 2012).

Student Team Achievement Division (STAD Model) is the instructional use of small groups in such a way that student's work together to achieve common goals. Student Team Achievement Division (STAD) can be termed as most simple form of cooperative learning, where teacher gives material to students and they learn it as a group. The groups are tested and scored individually and collectively, the team securing high scores is termed as winning one. One strategy adopted during cooperative learning as instruction approach is STAD. Van Wyk (2011) reported its effectiveness for improving academic achievement and social skills. It also stimulate group responsibility to foster individual learning (Ocampo & Bascos- Ocampo, 2015)

However, poor academic achievement by the majority of students is fundamentally linked to application of ineffective teaching strategies used by teachers to impact knowledge to learners. Ayeni (2011), opined that teaching is a process that involves bringing about desirable changes in learners so as to achieve specific outcomes. That is to say that when a student passes a subject very well, the indication is that the academic achievement of the students is high and will in turn enhance positive attitudes of that student toward the subjects .

An attitude which is a way of feeling, thinking or behaving towards something or somebody, is acquired through learning and determines the behaviour. Also, attitude can be viewed as the disposition of students towards chemistry as a subject which may be positive or negative. Therefore, the students' attitude towards chemistry determines their positive or negative feelings about the subject chemistry and such emotions have very critical role in the teaching-learning process.

Gender has been identified as one of the factors influencing student's academic achievement at secondary school level. Research conducted on the influence of ability and gender on cooperative learning (STAD Model) outcomes indicated similar findings in both males and females. Therefore, cooperative learning most especially STAD Model have been found to equalize achievement, attitudes of students in Chemistry, regardless of gender outside the study area which is main the motivation for the study. Based on the aforementioned evidences from literatures (Akachukwu&Doye, 2018; Alabekee, Samuel&Osaat,2015; Bello, 2013; Nnorom,2015; Ocampo& Bascos-Ocampo, 2015; Sani, 2015; Serjali& Abdul Halim,2020; Tran,2014; Yaduvanshi & Singh, 2018) which there exists a gap in the study area, this study seeks to investigate the effects of Students Team Achievement Division (STAD Model) on Attitudes and Academic Achievement in

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Chemistry. The problem of the study therefore is, "Will the used of STAD Model in the teaching-learning process help in improving students negative attitudes and poor achievement in Chemistry which has been prevalent in Jalingo Educational Zone, Taraba State?"

To guide the study, the following research questions were posed:

i. What are the mean academic achievement scores of students taught chemistry with Student Team Achievement Division (STAD Model) and those with Lecture Method?
ii. What are the mean academic achievement scores of male and female students taught chemistry with Student Team Achievement Division (STAD Model) and those with Lecture Method?
iii. What are the mean attitude scores of the students taught Chemistry with Student Team Achievement Division (STAD Model) and those students taught using lecture method?

To also guide the study, the following null hypotheses was postulated and tested at 0.05 level of significance:

$H0_1$: There is no significant difference between the mean academic achievement scores of male and female students' taught chemistry with Student Team Achievement Division (STAD Model) and those with Lecture Method.

$H0_2$: There is no significant difference between the mean achievement scores of male and female students taught chemistry with Student Team Achievement Division (STAD Model) and those with Lecture Method.

$H0_3$: There is no significant difference between the mean attitude scores of the students taught Chemistry with Student Team Achievement Division (STAD Model) and those students taught using lecture method.

Research Method

The Quasi-experimental design was adopted for the study. Specifically pre-test, post-test non equivalent control group design involving SS II Chemistry students from two intact classes so as not to disrupt class lessons. The groups were assigned as the control and experimental while investigating possible cause and effect as well as relationship between two or more variables by application of treatment which cannot be resolved by observation or description". The design is conceptually presented as follows:

Group	**Pre-test**	**Treatment (X)**	**Post-test**
Experimental (STAD Model)	**O1**	**X1**	**O2**
Control Group (Lecture Method)	**O1**	**—**	**O2**

Where: O1 =Pre-test for all group X= Treatment that was given to STAD
O2= Posttest for all groups.

Population

The population consisted of all the 6,102 Chemistry Students from the 47 Public Senior Secondary Schools in Jalingo education zone of Taraba State 2019/2020 academic session. The population is heterogeneous as it contains students of different socio-economic backgrounds, genders, abilities, cultures and ethnicity. The sample of the study comprised of 147 students of Chemistry in secondary schools II (SS II) in Jalingo Education Zone, Taraba state, consisting of 77 males and 70 females drawn from two (2) schools using multistage sample technique; meaning the sample was selected at random in different stages. The first stage was a simple random sampling of one Education Zone from the nine (9) Education Zones in the State where Jalingo Education Zone was selected which comprised of Jalingo, Ardo Kola and Lau. In the second stage, stratified sample technique was used to stratify the schools within Jalingo Local Government Area into two groups. Thereafter, two co-educational schools was purposively sampled from each

stratum in order to accommodate the gender variables in the study. Based on the criteria selected, the classes of SS II Chemistry student was randomly assigned into two intact classes using hat and draw method from the schools under study, one intact class from the schools was considered as experimental group and the other control group. The instrument for this research was of two types. The first type is Chemistry Achievement Test (CAT) which consists of Fifty (50) items adapted from Standardized test conducted by West African Examination Council 2010-2019. All the 50 items that was adapted from this instrument, which are multiple choices in Chemistry with five (5) options out of which only one is the correct response to the item(s) was based on the topics selected from SS II Chemistry syllabus. CAT is made up of two sections; sections A and B, section A sought for demographic data of the respondents on gender variable. Section B on the other hand, assessed the achievement of respondents in Chemistry based on the topics selected.

The second type of instrument that was used is on the students' attitude which was a modified four (4) point rating scale Students Attitudes scale towards Chemistry Inventory (SATCI) which was a standardized Chemistry Attitudes Survey adapted from Salta and Tzougraki (2004) which is made up of 30 items. This was employed before (pre-test) and after the treatment (post-test) in order to determine the students' attitudes in chemistry. For the purpose of collecting data for this study, the following procedure was followed based on the stages. In the 1st week (Preliminary stage), there was a Presentation of an introductory letter for permission to be obtained from the schools' authorities that was involved for the use of their students and teachers for the period of six (6) weeks. And also training of research assistance that was used to handle the experimental group and control group in the various schools which lasted for one week. In the 2nd week(Pre-treatment stage), administration of pre-test using CAT and SATCI to both experimental and control group in schools for the period of one week. In 3rd – 5th week, (Treatment stage) was used in teaching the experimental and control groups. In the 6th week, (Post test stage), revision, completion of selected topics and administration of the post test were carried out. Post test to both experimental and control group. In order to determine the extent to which the instrument can measure the achievement and attitudes of students in Chemistry, the Chemistry Achievement Test (CAT) and attitudes inventory scale (SATCI) was scrutinized by three experts, from faculty of Education Taraba State University Jalingo, Nigeria. The experts were asked to assess the instrument in terms of general content relevance validity, clarity and simplicity of language, relevance of items to the research topic, objectives, research questions and hypotheses and scope of coverage. To ensure face and content validity, each expert was provided with a copy of CAT and SATCI scale that contained topic of the research, purpose of the research, lesson plans, and table of specification, research questions and hypotheses. Based on the comments and suggestions of the experts, corrections and modifications were made on the instrument. Therefore, the content validity of CAT and SATCI were established by the above mentioned experts. The validators comments and observations included the following from validate 1 to validate 3 : effect corrections on question 8 and include options of 'D' in question 31, pilot test and run data analysis while on SATCI the researcher was asked to effect corrections on question 18 and 21. The second validate scored the instruments at % 62 and ask the researcher to effect corrections and proceed. The third validate asked the researcher to provide heading for the rating scale that is if is for achievement or attitude, the expert advice the researcher that the teacher has little or nothing to do especially during instruction. On attitude scale, the expert said it is satisfactorily. However, items should be stated one directional that is positively or negatively. Pilot test of the instrument was conducted to estimate the reliability index of the instrument with 40 SS2 Chemistry Students in school that cannot take part in the main study. The reason for selecting a pilot school different from the sampled schools was to avoid

experimental bias that is, these are distractions in behaviour which can arise when the participants in the study have the knowledge that they are subjects of the study. In other words, the behaviours of the subjects are influenced when they know that they are being used for a study. To overcome such bias in this study, the researchers used research assistants to coordinate the activity of experimental and control groups throughout the treatment period. The aim is to ascertain the reliability index of the research instruments. The internal consistency reliability of Chemistry Achievement Test (CAT) was determined using the Kuder-Richardson's formula-20 (K-R20) where a reliability index of 0.83 was obtained indicating that the instrument is reliable and suitable for this particular study. This formula was considered appropriate as it is applied to items that are dichotomously scored such as multiple choice items. Also Cronbach Alpha was used to test the reliability of the attitude scale. The reason is because it is used to determine the internal consistency of the item, that how closely related a set of item are as a group with reliability index of 0.82. The data collected was subjected to analysis at two different levels, Descriptive and Inferential levels. At the descriptive level, the descriptive statistics of mean and standard deviation was used to respond to research questions. While at the inferential level the Analysis of Covariance (ANCOVA) statistics was used to test the research hypotheses which takes care of initial group differences statistically; and the covariate is pre-test.. All hypotheses was tested at $p<0.05$ level of significance.

Presentation of Results

Answering Research question one

What are the mean academic achievement scores of students taught chemistry with Student Team Achievement Division (STAD Model) and those with Lecture Method?

Table1. Mean Achievement and Standard Deviation of prê-test and post-test of experimental (STAD) and control group (LM)

Group	N	Pre-test		Post-test		Mean
		Mean	Std Dev.	Mean	Std Dev.	Gain
STAD	68	24.15	6.52	58.71	6.70	34.56
LM	79	23.14	6.09	39.29	5.13	16.15
Mean Difference		1.01			19.42	18.41

Results of Table 1 show that the posttest mean achievement scores of students taught chemistry with Students Team Achievement Division (STAD) is 58.71 with standard deviation of 6.70, while that of those taught using Lecture Method is 39.29 with standard deviation of 5.13. The difference between the pretest and posttest achievement mean scores of STAD group is 34.56 and that of the Lecture Method group is 16.15. These differences show what were achieved by the two groups. There is also a difference of 19.42 between the posttest mean scores of the two groups; which is in favour of the STAD group; with mean gain of 18.41.The implication is that the students taught chemistry with Students Team Achievement Division (STAD) gained in achievement more than their Lecture Method counterparts.

Research question two: What are the mean academic achievement scores of male and female students taught chemistry with Student Team Achievement Division (STAD Model) and those with Lecture Method?

Table 2. Mean academic achievement scores of male and female students taught chemistry with Student Team Achievement Division (STAD Model) and those with Lecture Method

Group	Gender	N	Pretest	Posttest	Mean

			Mean	Std.Dev.	Mean	Std.Dev.	Gain
EXP.	male	30	24.20	7.34	59.40	7.65	35.20
	female	38	24.11	5.90	58.16	5.89	34.05
Mean Difference			**0.09**		**1.24**		**1.15**
CTRL	male	47	23.70	5.29	39.02	5.32	15.32
	female	32	22.31	7.11	39.69	4.90	17.38
Mean Difference			**1.39**		**0.67**		**2.06**

Results of Table 2 show that the posttest mean achievement scores of male students taught chemistry with STAD is 59.40 with standard deviation of 7.65, while that of the female students is 58.16 with standard deviation of 5.89. The difference between the pretest and posttest mean scores of the male students is 35.20 and that of the female students is 34.05. The difference between the posttest mean scores of the two gender is 1.24 and the mean gain is 1.15; in favour of the male students. The implication is that the male students taught chemistry with STAD gained in achievement more than their female counterparts.

Also on Table 2, it can be observed that the posttest mean achievement scores of male students taught chemistry with Lecture Method is 39.02 with standard deviation of 5.32, while that of the female students is 39.69 with standard deviation of 4.90. The difference between the pretest and posttest mean scores of the male students is 15.32 and that of the female students is 17.38. The difference between the posttest mean scores of the two gender is 0.67 and the mean gain is 2.06; in favour of the female students. The implication is that the female students taught chemistry with Lecture Method gained in achievement more than their male counterparts.

Research question three: What are the mean attitude scores of the students taught Chemistry with Student Team Achievement Division (STAD Model) and those students taught using lecture method?

Table 3. Mean Attitude scores of Pretest and Posttest of Experimental (STAD) and Control Groups

Group	N	Pre-attitude		Post-attitude		Mean
		Mean	Std.Dev.	Mean	Std.Dev.	Difference
CLS	68	79.07	19.18	83.59	20.61	4.52
LM	79	72.65	12.80	86.67	14.82	14.02
Mean Difference		6.42		3.08		9.5

Results of Table 3 show that the post-attitude mean scores of students taught chemistry with Students Team Achievement Division (STAD) is 83.59 with standard deviation of 20.61, while that of those taught using Lecture Method is 86.67 with standard deviation of 14.82. The difference between the pre-attitude and post-attitude mean scores of STAD group is 4.52 and that of the Lecture Method group is 14.02. The implication is that the students taught chemistry using Lecture Method acquired positive attitude more than their counterpart taught using STAD counterparts. There is also a difference of 3.08 between the post-attitude mean scores of the two groups; which is in favour of the Lecture Method group.

Hypothesis One: There is no significant difference between the mean achievement scores

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of students taught chemistry with STAD and students taught with Lecture Method.

Table 4. One-way Analysis of Covariance of the Mean Achievement Scores of the Experimental (STAD) and Control Groups **Tests of Between-Subjects Effects**

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	13794.907[a]	2	6897.454	196.984	.000	.732
Intercept	21749.066	1	21749.066	621.130	.000	.812
Pretest	20.213	1	20.213	.577	.449	.004
Method	13602.094	1	13602.094	388.461	.000	.730
Error	5042.209	144	35.015			
Total	361376.000	147				
Corrected Total	18837.116	146				

a. R Squared = .732 (Adjusted R Squared = .729)

Table 4 is one-way ANCOVA between groups analysis of covariance to compare the effect of STAD and Lecture Method on students' achievement in chemistry. The result F (1, 144) = 388.461, P = .000 < 0.05 shows that the two groups differ significantly. Thus, the null hypothesis is not retained. Therefore, there is a significant difference between the mean achievement scores of students taught chemistry with STAD and students taught with Lecture Method. The effect size (eta square = .730) is very high and it indicates that 73% of the difference in the mean score is based on the strategy used.

Hypothesis Two: There is no significant difference between the mean achievement scores of male and female students taught chemistry with Student Team Achievement Division (STAD) and those taught with Lecture Method.

Table 5. Two-way Analysis of Covariance of the Mean Achievement Scores of the Experimental (STAD)and Control Groups Based on Gender

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	13831.265[a]	4	3457.816	98.087	.000	.734
Intercept	21689.796	1	21689.796	615.270	.000	.812
Pretest	22.256	1	22.256	.631	.428	.004
Method	13246.906	1	13246.906	375.772	.000	.726
Gender	2.074	1	2.074	.059	.809	.000
Method*Gender	35.182	1	35.182	.998	.319	.007
Error	5005.851	142	35.252			
Total	361376.000	147				
Corrected Total	18837.116	146				

a. R Squared = .734 (Adjusted R Squared = .727)

Table 5 is one-way ANCOVA between groups analysis of covariance to assess the effect of Students Team Achievement Division (STAD) and Lecture Method on male and

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female students' achievement in chemistry. After adjusting the mean for the pre-test scores, the result F (1, 142) = 0.998, P = .319 >0.05 shows that there was no significant interaction effect of group and gender on posttest scores of students in chemistry achievement test. Also, the effect size (eta square = .007) is very low; hence the effect size is insignificant. Although the main effect for group: F (1,142) =375.772, p = 0.000 is significant, but for gender effect: F (1,142) =0.059, p = 0.809, it is not significant. This suggests that male and female students did not differ in the two groups (STAD& Lecture Method). Thus, the null hypothesis is not retained. Therefore, there is no significant difference between the mean achievement scores of male and female students taught chemistry with STAD and students taught with Lecture Method.

Hypothesis Three: There is no significant difference between the mean attitude scores of students taught chemistry using Students Team Achievement Division (STAD) and those students taught using Lecture Method.

Table 6. One-way Analysis of Covariance of the Mean Attitude Scores of the Experimental (STAD) and Control Groups Dependent Variable: Post-attitude

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1504.170[a]	2	752.085	2.438	.091	.033
Intercept	32089.161	1	32089.161	104.024	.000	.419
Pre-attitude	1156.900	1	1156.900	3.750	.055	.025
Method	623.435	1	623.435	2.021	.157	.014
Error	44421.013	144	308.479			
Total	1114129.000	147				
Corrected Total	45925.184	146				

a. R Squared = .033 (Adjusted R Squared = .019)

Table 6 is one-way ANCOVA between group analysis of covariance to compare the effect of Students Team Achievement Division (STAD) on students' attitude in chemistry. The result F (1, 144) = 2.021, P = .157> 0.05 shows that the two groups do not differ significantly. Thus, the null hypothesis is retained. Therefore, there is no significant difference between the mean attitude scores of students taught chemistry with STAD Model. The effect size (eta square = .014) is very low and it indicates that 1.4% of the difference in the mean score is based on the strategy used.

Therefore, the results of the study are summarized as follows:

i. There is a significant difference between the mean achievement scores of students taught chemistry with STAD and students taught with Lecture Method.
ii. There is no significant difference between the mean achievement scores of male and female students taught chemistry with STAD Model.
iii. There is no significant difference between the mean attitude scores of students taught chemistry with STAD Model.

Discussion of Findings

The result of the study in Table 1 and 4 shows that a significant difference exists among the mean achievement scores of students taught chemistry using Students Team Achievement Division (STAD Model) and lecture method. The students who were taught using STAD Model) had higher mean achievement scores in chemistry than those who were taught using lecture method. This means that STAD adopted in teaching chemistry is significant in enhancing students' academic achievement in chemistry. This therefore implies that the two instructional groups are not of equal strength. This study agrees with what was earlier found by (Akachukwu & Doye, 2018; Alabekee et al. 2015; Bello, 2013; Nnorom,2015; Ocampo& Bascos-Ocampo, 2015; Sani, 2015; Serjali & Abdul Halim,2020; Tran,2014; Yaduvanshi & Singh, 2018) that there is significant difference between students who were taught using STAD Model and those taught using lecture method.

The result of the study in Table 2 and 5 found that male students taught chemistry with STAD gained in achievement more than their female counterparts. On the other hand, female students taught chemistry with Lecture Method gained in achievement more than their male counterparts. In both cases however, the differences in the mean achievement scores were not significant. The finding of the study agrees with what was earlier found by Sani (2015) and Yaduvanshi & Singh (2018) that there is no significant difference in the performance between male and female students in the cooperative learning group (STAD Model) although in both cases, the female students achieved more than their male counterparts.

The results of the finding in Table 3 and 6 obtained shows that the post-attitude mean scores of students taught chemistry with Lecture method is higher than that of the STAD. The difference between the post attitude mean score of Lecture method is also higher than that of the STAD. The pretest and post test attitudes mean score differences for the two groups' shows that, that of the Lecture method group is higher. This suggests that students taught chemistry using Lecture Method have higher attitudes to Chemistry than their counterpart taught Chemistry using STAD. The result of the hypotheses tested shows that there is no significant difference between the mean attitude scores of students taught chemistry with STAD and students taught with Lecture Method. By implication, the difference is not statistically significant which contradicts findings by Ocampo and Bascos-Ocampo, (2015) who revealed that the attitude of students in the experimental group (STAD) significantly improved.

Conclusion

It is evident from the findings of this study to conclude that the use of Students Team Achievement Division (STAD Model) could provide a good way for students to learn chemistry. The study therefore concludes that there is a significant difference between the mean achievement score of students taught chemistry using STAD Model and Lecture method, difference between the mean achievement score of male and female students taught chemistry using STAD Model, difference between the mean achievement score of female and male students taught chemistry using lecture method. This STAD can be used to address the trend of poor academic achievement of secondary school students in chemistry.

Recommendations

Based on the conclusions drawn from the study, the following recommendations as it borders on chemistry education are made:

1. Pre-service and in-service Chemistry teachers should be trained on the use of STAD Model since it improves students' attitudes, achievement and is gender-friendly.
2. Chemistry teachers should be encouraged to use STAD Model to

improve the academic achievement of students in chemistry

3. STAD Model should be encouraged and integrated in chemistry lessons as it exposes students to dynamics and richness of the subject chemistry
4. Curriculum planners and science teachers should be incorporate innovative, problem and activity-based pedagogical strategies like STAD in all teacher education institutions

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