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EFFECTS OF MULTIPLE INTELLIGENCE TEACHING STRATEGY ON STUDENTS' ACADEMIC ACHIEVEMENT AND ATTITUDES TOWARDS CHEMISTRY IN JALINGO EDUCATION ZONE OF TARABA STATE, NIGERIA

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Abstract

The study investigated the effects of Multiple Intelligence Teaching Strategy on Students' academic achievement and attitudes towards Chemistry in Jalingo Education Zone of Taraba State, Nigeria. Quasi-experimental design, involving the non-equivalent control group design and was used for the study. The study used an intact class made up of 183 Chemistry students of Senior School Two (99 males and 84 females) drawn from two public science oriented senior secondary schools. Multiple Intelligence Teaching Strategy Chemistry Achievement Test (MITSCAT) and Students Attitudes towards Chemistry Inventory (SATCI) were the instruments for data collection. Data collected were analysed using Mean and Standard Deviation to answer the research questions and Analysis of Covariance to test the hypotheses at 0.05 level of significance. The findings revealed that there is a significant difference between the mean-achievement scores of the students taught Chemistry using Multiple Intelligence Teaching Strategy (MITS) and those students taught Chemistry using Conventional Lecture Teaching Method. The findings also showed that there is no significant difference in attitude scores between the two groups; male and female students mean-achievement scores; and male and female students attitude scores taught Chemistry using MITS and conventional lecture teaching method. It is therefore concluded that to enhance higher achievement and attitude of students in Chemistry, MITS should be adopted. It is recommended amongst others that Chemistry teachers be exposed to MITS since it is learners-centred, gender-friendly, and enhances students' attitudes and achievement in Chemistry.

Keywords: Multiple Intelligence Teaching Strategy, Conventional Lecture Teaching Method, Attitudes towards Chemistry

Introduction

In Nigeria, chemistry is considered as an important subject and is taught in the last three years of secondary education usually called the senior secondary school (SSS). It is taught as a single subject and the scope covered and understood within this period is questionable. In spite of the number of years' chemistry has been taught in our secondary schools, it is noteworthy that little meaningful learning of chemistry concepts has taken place and this can be proved by students' inability to apply already learnt concepts. Available evidence from West African Examination Council (WAEC) indicates that student's achievement in chemistry, especially at the senior secondary school level worsen as years go by and many students seen to have negative attitude towards the subject due to poor teaching-learning process in science classrooms. The Chief Examiner's Report (WAEC, 2018) revealed that the performance of the candidates was

below average and was worse than WASSCE for School Candidates, 2017 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 for WASSCE for School Candidates, 2018. The Chief Examiner also reported that students did not show basic understanding of simple concepts in Chemistry and also exhibited poor communication skill.

Teaching strategies are all the things the teachers use to aid the learners in their learning processes and are the means used to bring about effective teaching and learning. Obara and Okoh (2015) viewed teaching strategies as "all the things the teacher utilizes to interactively enhance, motivate and facilitate teaching and learning in an attempt to ensuring the academic achievement of a set objectives." The effectiveness of teaching strategies depends upon the manner and degree to which they meet the needs of the teacher and students. Teaching brings about understanding and involves a teacher, a learner, a subject matter and teaching materials. Therefore, to bring about learning, the teacher engages in certain activities such as talking, demonstration, and gives instruction and others, which are the various strategies that bring about learning such as brain based, concept mapping, and Multiple Intelligence Teaching Strategy among others, (Adediran, 2014). Teachers need to use different instructional skills to ensure students' active participation in the classroom for creativity, innovative and critical thinking.

It is on this premise that this study investigates Multiple Intelligence Teaching Strategy (MITS) which is in sharp contrast to the traditional approach of understanding and expressing one's intelligence as an effective strategy for instructional process. Multiple Intelligence Teaching Strategy is a new trajectory against the long-lived conventional methods of teaching and judging student's intelligence based on ability to solve problems, use of logic and critical thinking. It is a way of lumping one's intelligence together under one label of raw intelligence, (Duru & Okeke 2010). Kagan (2008) posited that students should be taught based on their ability and ways of learning.

The Multiple Intelligence Teaching Strategy used in this study is hinged on the Multiple Intelligence theory, propounded by Gardner (1983) which had a particular impact in the field of education where it inspired teachers and educators to explore new ways of teaching aimed at eight different kinds of intelligence. They are: Verbal-Linguistic intelligence, Visual-spatial intelligence, Mathematical intelligence, kinaesthetic intelligence, Musical intelligence, Interpersonal intelligence, Intrapersonal intelligence and Naturalistic intelligence. Though for the sake of the study, the teacher is expected to use only four (4) intelligences; verbal-linguistic, visual-spatial, interpersonal and intrapersonal intelligence during the lesson.

The relevance of Multiple intelligence theory for Chemistry as a subject is that it emphasizes that an alternative teaching method such as Multiple Intelligence Teaching Strategy (MITS) which can be used to encourage student's intelligence or cognitive development. MITS recognizes that each student possesses these intelligences, but they are not always developed well or effectively. Teachers could therefore activate the less-pronounced intelligences in students through the effective use of this strategy by carefully diversifying the strategy to encompass child-centred teaching, open-ended projects,

cross-curricular activities, independent study, learning centre activities, multi model work, group projects, discovery learning among others which could in due course bring about poor academic achievement in secondary school Chemistry.

Due to the observed poor academic achievement in Chemistry in external examinations (such as WAEC) by students in Jalingo Education Zone over the years (2013-2017) has been very discouraging with average of 36.21% that had a credit, 39.40% with pass and 24.39% that Failed (Taraba State Ministry of Education Resource Centre, Jalingo, 2018). Previous studies such as Akbas (2004) and Asci (2003) that the teaching method used to disseminate knowledge does have an effect on the academic achievement of students. It then means that other teaching method such as Multiple Intelligence teaching strategy which have been recommended by experts such as (Udobia 2002; Asçı, 2003; Akbas 2004; Anaduaka, 2008; Douglas & Onika 2008; Harriman, 2010; Okoli & Okoli, 2014; Mkpanang, 2016; Gurcay & Ferah, 2017; & Veli, 2017) can improve achievement and attitudes of students on other subject areas, it becomes necessary that the teaching method be explored in the teaching of chemistry. The studies reviewed also showed a gap in the present study area and Chemistry as a subject. The main purpose of this study therefore is to investigate the effects of Multiple Intelligence Teaching Strategy on student's academic achievement and attitudes towards Chemistry in Jalingo Education Zone of Taraba State, Nigeria. The statement of the problem therefore is: "Will the usage of Multiple Intelligence teaching Strategy help in improvement of students' academic achievement and attitudes towards Chemistry'?

The study was guided by the following research questions:

i. What is the difference in the mean-achievement scores of the students taught Chemistry using Multiple Intelligence Teaching Strategy and those of the students taught Chemistry using Conventional lecture teaching method?
ii. What is the difference in the mean-achievement scores of the male and female students taught Chemistry using Multiple Intelligence Teaching Strategy compared to those male and female students taught Chemistry using Conventional Lecture teaching method?
iii. What is the mean attitudes scores of the students taught Chemistry using Multiple Intelligence Teaching Strategy and those students taught Chemistry using conventional lecture method?
iv. What is the mean attitudes scores of male and female students taught Chemistry using Multiple Intelligence Teaching Strategy and those students taught Chemistry using conventional lecture method?

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

HO_1: There is no significant difference between the mean-achievement scores of the students taught Chemistry using Multiple Intelligence Teaching Strategy and those students taught Chemistry using conventional lecture teaching method.

HO_2: There is no significant difference between the mean-achievement scores of the male and female students taught Chemistry using Multiple Intelligence Teaching Strategy compared to those students taught Chemistry using conventional lecture teaching method.

HO_3: There is no significant difference in attitudes scores of the students taught Chemistry using Multiple Intelligence Teaching Strategy as compared to those students taught Chemistry using Conventional Lecture Teaching Method.

HO_4: There is no significant difference in the attitudes scores of the male and female students that are taught Chemistry using Multiple Intelligence Teaching Strategy as compared to those male and female taught Chemistry using conventional lecture teaching method.

Methodology

The design used in the study is the Quasi-experimental design (pre-test, post-test, non-equivalent control group design).; and specifically employing the non-equivalent control group design. The sample for the study was made up of 183 (99 males & 84 females, Experimental group=100, Control group=83) SS 2 Chemistry students in public secondary schools in 2017/2018 academic session in Jalingo Education Zone of Taraba state, drawn from two secondary schools using purposive sampling.

The instruments used for data collection were Multiple Intelligence Teaching Strategy Chemistry Achievement Test (MITSCAT) made up of 30 items; and a modified four (4) Likert scale Students Attitude scale towards Chemistry Inventory (SATCI) which was a standardized Chemistry Attitudes Survey adapted from Myra Khattah MSU-2006 which was made up 30 items. This MITSCAT was made up of two tests, that is, the pre-test (administered before the experiment) and the post-test (administered after the experiment).

In order to determine the coefficient of stability of the Chemistry academic achievement test (MITSCAT) and student's attitudes towards Chemistry inventory (SATCI), the reliability of the instruments was determined by trial testing the instruments using an equivalent sample intact class of 49 SS 2 Chemistry (28 males and 21 females) Students. The reliability coefficient of the MITSCAT was found to be 0.77 using Kuder-Richardson formula (K-R formula 20). And reliability coefficient of SATCI was 0.93 using Cronbach Coefficient Alpha technique. The values or result obtained from the trial testing indicated that the instruments were reliable and suitable for the study.

The administration of the instruments was done in two phases: the first phase was a pre-test, which was administered to the students a week before the treatment. After the administration of the pre-test, the students were taught the selected topics for four weeks (40 minutes for each lesson) in the same intact classes. The teachers that participated or served as research assistants in the study were the regular teachers from the selected schools for both the experimental and the control groups respectively. The second phase was a post-test that was done after the experiment to determine which teaching strategy was more effective. In the control group, students were taught using the Conventional

Lecture Teaching Method through lectures, discussions and demonstrations by the teachers and the students were inactive in class lessons. While the experimental group were exposed to Multiple Intelligence Teaching Strategy where the students were grouped and encouraged to brainstorm and share ideas, solve problems, think critically and logically. The essence of the treatment was to observe whether there was a change in the students' academic achievement of students when post-tested for both experimental and control groups.

The data collected form the MITSCAT were subjected to analysis at two different levels. First, it was at the level of Descriptive statistics and second was at the level of inferential statistics. Mean and standard deviation were used at the level of descriptive statistics in order to respond to the research questions. While at the inferential level, Analysis of Covariance (ANCOVA) statistics was used to test the null hypotheses and the covariate pre-test. The null hypotheses that were formulated were tested at a significant level of $p < 0.05$. The inferential statistic permit decision making on whether or not to accept the hypotheses after being tested.

Experimental Group (Multiple Intelligence Teaching Strategy) procedures

For the experimental group, the teachers use the lesson plan (instructional guide) prepared for Multiple Intelligence Teaching Strategy. This provided an avenue for the teachers to teach the students the skills and thinking habits necessary to interact with others and control their own behaviour (students) where the teacher only act as a facilitator. This is done through verbal-linguistic, visual-spatial, logical-mathematical, kinaesthetic-bodily, musical-rhythmic, interpersonal, intrapersonal and naturalistic intelligence. Though for the sake of the study, the teacher is expected to use only four (4) intelligence; verbal-linguistic, visual-spatial, interpersonal and intrapersonal intelligence during the lesson. In doing this, through class discussion and use of different colours on the periodic table drawn on a cardboard paper, all the four intelligences are encouraged and observed. Teachers and students can have formulated the steps of a particular skill and develop internal scripts that can help students to respond more thoughtfully. All of these were used at each step during the presentation of the lesson so that learners can display the four (4) intelligences as intended by the study.

In order to develop interpersonal intelligence, students were guided to communicate effectively with one another to be able to develop relationship by designing lessons that include group work and by planning cooperative learning activities. To develop intrapersonal, the students were also guided to understand their own emotions, motivations, self-reflection and also aware of their strengths and weaknesses. The students were also guided to use spoken or written words (verbal/linguistic) through class discussions to read, write or draw and label the Periodic table. The students were also guided to form and manipulate a mental model (Visual/spatial intelligence); which also involved students' visual thinking and imaginative. The students applying Visual/spatial intelligence learnt Period table mostly with visual presentation such as pictures, diagrams, charts and demonstrations using models. At each step during presentation, the

teacher concluded the step-in order to correct the students where they got it wrong and to enhance better understanding of the content discussed.

Results

Answering Research Question One: Answer to research question two is presented in Table 1.

Table 1: Mean-achievement scores and Standard Deviations of Students Taught Chemistry Using Multiple Intelligence Teaching Strategy (MITS) and Conventional Lecture Teaching Method (CLTM)

Group	N	Pre-test		Post-test		Mean
		mean	std. dev	mean	std. dev	gain
MITS	93	29.03	6.90	42.41	8.39	13.38
CLTM	82	22.17	5.97	30.71	8.46	8.54
Mean difference		6.86		11.70		

Results of Table 1 show that the post-test achievement means scores of students taught using MITS is 42.41 with standard deviation of 8.39, while that of those taught using conventional lecture teaching method is 30.71 with standard deviation of 8.46. The difference between the pre-test and post-test achievement mean scores of MITS group is 13.38 and that of the conventional lecture teaching method group is 8.54. The pre-test and post-test achievement mean score differences for the two groups shows that that of the Multiple Intelligence Teaching Strategy group is higher. There is also a difference of 11.70 between the post-test mean scores of the two groups in favour of the MITS group. This suggests that students taught using Multiple Intelligence Teaching Strategy achieved higher than their counterparts taught using CLTM, but was tested with $H0_1$ on Table 5.

Answering Research Question Two: Answer to research question two is presented in Table 2.

Table 2: Mean-achievement scores and Standard Deviations of Students Taught Chemistry Using Multiple Intelligence Teaching Strategy (MITS) and Conventional Lecture Teaching Method (CLTM) Based on Gender

Group	gender	N	Pre-test		Post-test		Mean
			mean	std. dev	mean	std. dev	gain
MITS	male	32	28.75	6.94	42.38	8.04	13.63
	female	61	29.18	6.93	42.43	8.63	13.25
Mean difference				0.43	0.05	0.38	
CLTM	male	40	22.45	5.84	31.60	8.08	9.15
	female	42	29.10	6.15	29.86	8.82	0.76
Mean difference				6.65		1.74	8.39

From Table 2, it can be seen that the post-test mean-achievement scores of the male students taught using MITS is 42.38 with standard deviation of 8.04, while that of the female is 42.43 with standard deviation of 8.63. The difference between the pre-test

and post-test mean scores of the male students taught using MITS is 13.63 and that of the female students is 13.25. The difference between post-test mean scores of the two sexes is 0.05, which was not really significant. The implication is that the male students taught chemistry using MITS gained in achievement more than their female counterparts, though the difference was negligible.

It can also be seen that the post-test mean-achievement scores of the male students taught using conventional lecture teaching method is 31.60 with standard deviation of 8.08, while that of the female is 29.86 with standard deviation of 8.82. The difference between the pre-test and post-test mean scores of the male students taught using conventional lecture teaching method is 9.15 and that of the female students is 0.76. The difference between post-test mean scores of the two sexes is 1.74, in favour of the male students. The pre-test and post-test mean differences show that the male students taught chemistry using CLTM gained in achievement more than their female counterparts, but was tested with $H0_2$ on Table 6.

Answering Research Question Three: Answer to research question three is presented in Table 3.

Table 3: Mean Attitude Scores and Standard Deviations of Students Taught Chemistry Using Multiple Intelligence Teaching Strategy and Conventional Lecture Teaching Method

Group	N	Pre-test		Post-test		Mean
		mean	std. dev	mean	std. dev	gain
MITS	93	89.12	15.87	90.69	12.28	1.57
CLTM	82	85.78	11.57	86.24	13.62	0.46
Mean difference		3.34		4.45		1.11

Results of Table 3 show that the post-test Attitude mean scores of students taught chemistry using Multiple Intelligence Teaching Strategy is 90.69 with standard deviation of 12.28, while that of those taught using conventional lecture teaching method is 86.24 with standard deviation of 13.62. The difference between the pre-test and post-test Attitude mean scores of MITS group is 1.57 and that of the CLTM group is 0.46. The pre-test and post-test Attitude mean score differences for the two groups shows that that of the MITS group is higher. There is also a difference of 4.45 between the post-test mean scores of the two groups in favour of the MITS group. This suggests that students taught chemistry using MITS have higher Attitude to chemistry than their counterparts taught chemistry using conventional lecture teaching method, but was tested with $H0_3$ on Table 7.

Answering Research Question Four: Answer to research question four is presented in Table 4.

Table 4: Mean Attitude Scores and Standard Deviations of Students Taught Chemistry Using Multiple Intelligence Teaching Strategy and Conventional Lecture Teaching Method Based on Gender

Group	gender	N	Pre-test		Post-test		Mean
			mean	std. dev	mean	std. dev	gain
MITS	male	32	87.88	19.02	92.13	12.71	4.28
	female	61	89.77	14.07	88.25	11.94	-1.52
Mean difference				1.89	3.88		
CLTM	male	40	86.38	10.32	87.08	13.59	0.70
	female	42	85.21	12.74	87.62	13.81	2.41
Mean difference			1.17		0.54		

From Table 4, it can be seen that the post-test means attitude scores of the male students taught chemistry using MITS is 92.13 with standard deviation of 12.71, while those of the female students taught chemistry is 88.25 with standard deviation of 11.94. The difference between the pre-test and post-test mean attitude scores of the male students taught chemistry using MITS is 4.28 and that of the female students is -.52. This suggests that while male improved on their Attitude towards chemistry, the female students' attitude towards chemistry declined. The difference between post-test mean attitude scores between male and female students is 3.88, in favour of the male students. The implication is that the male students taught chemistry using MITS were more favorably disposed to chemistry than their female counterparts.

It can also be seen that the post-test means attitude scores of the male students taught chemistry using conventional lecture teaching method is 87.08 with standard deviation of 13.59, while that of the female students is 87.62 with standard deviation of 13.81. The difference between the pre-test and post-test mean attitude scores of the male students taught using conventional lecture teaching method is 0.70, while that of the female students is 2.41. The difference between post-test mean scores of the two sexes is 0.54, in favour of the female students. The pre-test and post-test mean differences show that the female students taught chemistry using conventional lecture teaching method showed improved attitude towards chemistry than their male counterparts, but was tested with $H0_4$ on Table 8.

Testing Ho_1: Test result of Ho_1 is presented in Table 5.

Table 5:Results of One-way Analysis of Covariance on Methods of Teaching on Students' Achievement in Chemistry.

Sources of Variation	Sum of Squares	df	Mean Square	F	Sig squared	Partial Eta
Corrected Model	12138.761[a]	2	6069.381	171.157	0.000	0.666
Intercept	1754.198	1	1754.198	49.469	0.000	0.233
Pre-test	6172.176	1	6172.176	174.056	0.720	0.503
Method	983.445	1	983.445	27.733	0.000*	0.139
Error			6099.273	172	35.461	
Total			256852.000	175		
Corrected Total	18238.034			174		

Table 5 is a one-way between groups analysis of covariance (ANCOVA) to compare the effect of Multiple Intelligence Teaching Strategy and conventional lecture teaching method on students' achievement in chemistry. After adjusting for the pre-test scores, there is a significant difference between the two groups on post-test scores of chemistry achievement test F (1,172) = 27.73, p = 0.00, partial eta squared = 0.14. The effect size shows that only 13.9% (eta squared = 0.139) is based on the method used. There was a moderate relationship between the pre-test and post-test scores on the chemistry achievement test, as indicated by a partial eta squared value of 0.50. Thus, the hypothesis of no significant difference between the mean-achievement scores of the students taught chemistry using Multiple Intelligence Teaching Strategy and that of the students taught chemistry using the conventional lecture teaching method is, hereby, not retained.

Testing Ho_2: Test result of Ho_2 is presented in Table 6.

Table 6:Results of Two-way Analysis of Covariance (ANCOVA) on Gender and Methods of Teaching on Students' Achievement in Chemistry.

Sources of Variation	Sum of Squares	df	Mean Square	F	Sig	Partial Eta squared
Corrected Model	12172.806[a]	4	3043.201	85.297	0.000	0.667
Intercept	1770.077	1	1770.077	49.613	0.000	0.226
Pre-test	6143.933	1	6143.933	172.206	0.660	0.503
Gender	26.076	1	26.076	0.731	0.394	0.004
Method	967.300	1	967.300	27.112	0.000	0.138
Gender*method	8.324	1	8.324	0.233	0.630	0.001
Error	6065.228	170	35.678			
Total	256852.000	175				
Corrected Total	18238.034	174				

Table 6 is a 2 by 2 between-groups analysis of covariance to assess the effect of MITS and CLTM on male and female students' achievement in chemistry. After adjusting the mean for the pre-test scores, there is no significant interaction effect of

gender and methods on post-test scores of students in chemistry achievement test F (1, 170) = 8.32, p = 0.63, with almost no effect size (partial eta squared = 0.001). Although the main effect is significant, group: F (1, 170) = 27.11, p = 0.00, gender effect is not significant, F (1, 170) = 0.73, p = 0.39. These results suggest that males and females did not differ in the two groups (MITS & CLTM). Thus, the hypothesis of no significant difference between the mean-achievement scores of the male and female students taught chemistry using MITS compared to the male and female students taught chemistry using conventional lecture teaching method is, hereby retained.

Testing Ho_3: Test result of Ho_3 is presented in Table 7.

Table 7: Results of One-Way Analysis of Covariance on Methods of Teaching Students' Attitudinal Change towards Chemistry.

Sources of Variation	Sum of Squares	df	Mean Square	F	Sig	Partial Eta squared
Corrected Model	229.759[a]	2	114.879	0.684	0.506	0.008
Intercept	35291.140	1	35291.140	210.126	0.000	0.550
Pre-test	13.639	1	13.639	0.081	0.776	0.000
Method	226.061	1	226.0	611.346	0.248	0.008
Error	28887.750	172	167.952			
Total	1400912.000	175				
Corrected Total	29117.509	174				

Table 7 is a one-way between groups analysis of covariance to compare the Attitude of students taught chemistry using MITS and CLTM. After adjusting for the pre-test scores, there is no significant difference between the two groups on post-test attitude towards chemistry F (1,172) = 1.35, p = 0.25, partial eta squared = 0.008. The effect size shows that only 0.8% (eta squared = 0.008) of students' attitude towards chemistry is based on the method used. There is no relationship between the pre-test and post-test scores on attitude towards chemistry, as indicated by a partial eta squared value of 0.000. Thus, the hypothesis of no significant difference in the attitudinal change towards chemistry of students taught chemistry using MITS and those taught chemistry using the conventional lecture teaching method is, hereby retained.

Testing Ho_4: Test result of Ho_4 is presented in Table 8.

Table 8: Results of Two-Way Analysis of Covariance on Gender and Methods of Teaching on Students' Attitudinal Change towards Chemistry.

Sources of Variation	Sum of Squares	df	Mean Square	F	Sig	Partial Eta squared
Corrected Model	545.803[a]	4	136.451	0.812	0.519	0.019
Intercept	35152.102	1	35152.102	209.153	0.000	0.552
Pre-test	7.786	1	7.786	0.046	0.830	0.000
Gender	114.528	1	114.528	0.681	0.410	0.004
Method	341.182	1	341.182	2.030	0.156	0.012
Gender*method	198.046	1	198.046	1.178	0.279	0.007
Error	28571.705		170	168.069		
Total	1400912.000		175			
Corrected Total	29117.509		174			

Table 8 is a 2 by 2 between-groups analysis of covariance to assess the attitudinal change towards chemistry of male and female students taught chemistry using MITS compared to the male and female students taught chemistry using conventional lecture teaching method. After adjusting for the pre-test attitude scores, there is no significant interaction effect of gender and methods on the attitudinal change towards chemistry, $F(1, 170) = 1.178$, $p = 0.28$, with almost no effect size (partial eta squared = 0.007). Neither of the main effects were statistically significant, methods: $F(1, 170) = 2.03$, $p = 0.16$, gender effect is not significant, $F(1, 170) = 0.68$, $p = 0.41$. These results suggest that males and females did not differ in the two groups (MITS and CLTM). Thus, the hypothesis of no significant difference between the mean-achievement scores of the male and female students taught chemistry using MITS compared to the male and female students taught chemistry using CLTM is, hereby retained.

The findings from the study are summarized thus:

i. There is a significant difference between the mean-achievement scores of the students taught Chemistry using MITS and those students taught Chemistry using CLTM.
ii. There is no significant difference between the mean-achievement scores of the male and female students taught Chemistry using MITS compared to those students taught Chemistry using conventional lecture teaching method.
iii. There is no significant difference in attitudes scores of the students taught Chemistry using MITS as compared to those students taught Chemistry using CLTM.
iv. There is no significant difference in the attitudes scores of the male and female students that are taught Chemistry using MITS as compared to those male and female taught Chemistry using conventional lecture teaching method.

Discussion of Findings

From the result obtained in Tables 1 and 5, it can be seen that students taught chemistry using MITS achieved higher than their counterparts taught using CLTM. This is shown in their academic achievement scores obtained in the covariance analysis. The post-test results obtained showed that there is a statistical difference between the two groups. This is also supported by the rejection of the null hypothesis that there is no significant difference between the mean-achievement scores of the students taught Chemistry using MITS and that of the students taught Chemistry using the CLTM. This finding agrees with that of Udobia (2002), Asçı (2003), Akbas (2004), Anaduaka, (2008), Douglas and Onika (2008), Harriman (2010), Ovez (2012) Okoli and Okoli, (2014), Mkpanang, (2016), Gurcay and Ferah, (2017) and Veli, (2017) who investigated the effects of MITS on the academic achievement of Science students. They asserted that students exposed to MITS show considerable increase in academic achievement when compared to those taught using CLTM, hence the need for teachers to incorporate MITS strategies that will lead to increased academic achievement.

As observed in the result in Tables 2 and 6, the male students taught Chemistry using MITS gain more in achievement than their female counterparts, though difference was insignificant. When their post test results were compared, the mean score of male students taught Chemistry using MITS outperformed their female counterparts. From the result obtained, the post-test mean-achievement scores of the male students taught using MITS was higher than that of the female students. The difference between the pre-test and post-test mean scores of the male students taught using MITS was however not statistically significant. Therefore, there is no significant difference between the mean-achievement scores of male and female students taught chemistry using MITS compared to male and female students taught chemistry using CLTM. The findings also support Okoli and Okoli, (2014) who discovered that gender have no significant influence on students' academic performance. But, contradicts Ssempala (2005) ditto Maduabum, (2006), who showed that male students outperformed their female counterparts in chemistry.

Results obtained from the study as shown in Tables 3 and 7 revealed that the post-test attitudes mean scores of students taught using MITS is higher than that of the CLTM. The difference between the pre-test and post-test attitudes mean scores of MITS group is also higher than that of the CLTM group. The pre-test and post-test attitudes mean score differences for the two groups shows that that of the MITS group is higher. This suggests that students taught chemistry using MITS have higher attitudes to Chemistry than their counterparts taught chemistry using CLTM. Results obtained from the tested hypothesis in Table 7 however shows that there is no significant difference in the attitudes of students taught chemistry using MITS and those students taught Chemistry using the CLTM. By implication, the different is not statistically significant. The findings corroborate that of Reardon (2000), Armstrong maintains (2004), who posited that multiple intelligences approach to social skills provides an avenue for teachers to teach the skills and thinking habits necessary for students to interact with

others and control their own behaviour thereby develop positive attitude towards learning. The findings agree with the statistical analysis by Akbas (2004) which indicated no significant result about students' attitudes toward science and also with Gurcay and Ferah, (2017) whose findings showed that multiple intelligences-based instruction had no significant effect on students' attitudes towards force and motion topics. But, the findings of this study disagree with that of Gokhan and Omer (2010) whose result showed a significant difference between the attitude scores of the experimental group and the control group.

The study observed from Tables 4 and 8 that the post-test means attitude scores of the male students taught using MITS is higher than that of the female, but the difference was not statistically significant. It can also be seen that the post-test attitudes mean scores of the male students taught using CLTM is statistically insignificant with that of the female students. This finding is in consonance with that of Loori (2005) who asserted that students (male and female) who are taught using MITS exhibited positive attitude towards learning compared to their counterparts that were taught using CLTM. The findings of this study also agree with the works of Mkpanang, (2016) whose result indicated that Multiple Intelligence was significantly more effective in promoting students' interest in physics over the conventional approach. From the preceding, it is clear that Multiple Intelligence has the ability to influence a change in attitudes in learning Chemistry among secondary school students. The implication therefore is to ensure that Multiple Intelligence be integrated in the curriculum, this will go a long way in demystifying those concepts that scare students away from Chemistry, hence enhance their attitudes towards learning the subject.

Since MITS provided the opportunity for learners to display different ways of intelligence, the findings from could be used to provide students the opportunity to share their intelligence as they interact with one another during group activities. With MITS, it has been established that students can demonstrate their various hidden intelligences, improved their achievement and attitudes towards Chemistry and is gender-unbiased.

Conclusion

From the foregoing, it is evident to note that MITS enhances students' academic achievement more than the CLTM. Similarly, it is noted that the attitudes of students taught Chemistry using MITS surpasses those of the students taught Chemistry using CLTM.

It is therefore concluded that to enhance higher achievement and attitude of students in Chemistry, MITS should be adopted. This will go a long way in reducing the sustained poor academic achievement of Chemistry students in both internal and external examinations.

Recommendations

Based on the results of the data analysis, the following recommendations are made:

i. Chemistry teachers should be exposed to MITS since it is learners-centred and helps them get involved in the whole process. This will go a long way in enhancing students' attitudes and achievement in Chemistry.
ii. Chemistry students should be introduced to MITS as against consistent use of Conventional Lecture Method. The students should be engaged in learning activities while the teacher does the function of a guidance and facilitator, thereby making learning become more effective and permanent.
iii. Chemistry teachers should endeavour to give female and male students equal opportunities in the classroom. Teachers of Chemistry are advised to adopt MITS, which is free from gender bias. In using MITS both sexes are capable of competing and collaborating in classroom activities.
iv. The usage of MITS in Chemistry lessons will encourage both male and female students to develop positive attitude towards Chemistry. This will enhance their academic achievement in Chemistry in Taraba State and Nigeria as a whole.

References

Adediran, G. (2014). Attitudes towards science: A review of the literature and its implications. *International Journal of Science Education*, 25(9):1049-1079.

Adunola, H. (2011). Attitudes towards Chemistry. *Research in Science and Technology Education*, 20(1): 67-81.

Asçı, Z. (2003). *The effects of multiple intelligences-based instruction on ninth graders ecology achievement, attitudes toward ecology and multiple intelligences,* Unpublished Master thesis, Middle east technical university.

Akbas, A. (2004). *The effects of multiple intelligences-based instruction on six graders' science achievement and attitudes towards science,* Unpublished Master Thesis (M.Ed.), Middle East Technical University.

Amazigo, C. (2000). *Relationship between Emotional Intelligence and academic achievement in non-traditional college students.* Consortium for research on emotional intelligence in organisation U.S.A.

Anaduaka, U. S. (2008). *Effect of multiple intelligences teaching approach on students' achievement and interest in geometry*. Unpublished PhD dissertation, University of Nigeria, Nsukka. Animalu 2000.

Douglas, M. & Onike, K. (2008). Multiple intelligences and experiential learning styles: a mixed method study of registered nurses' attitudes toward computers and web-based learning. Doctoral dissertation, available from: *ProQuest dissertations and theses database. (UMI No. 3444168).*

Gardner, H. (1983). *Frames of mind: The theory of multiple intelligences*. New York: Basic books.

Gokhan, M. & Omer, J. K. (2010). *Improving student achievement in language arts through implementation of multiple intelligences strategies*. Retrieved from: http://orders.edrs.com/members/sp.cfm.

Gurcay D. & Ferah, H.O. (2017). The effects of multiple intelligences-based instruction on students' Physics achievement and attitudes. *Journal of Baltic Science Education*, 16 (5), 666-677.

Harriman, V. (2010). The effect of multiple intelligence teaching strategies on achievement in reading and mathematics (doctoral dissertation). *Available from ProQuest dissertations and theses database. (UMI No. 3413038).*

Loori, A. A. (2005). Multiple intelligences: a comparative study between the preferences of males and females, *Social behaviour and personality*, 33(1):77-88.

Mkpanang, J.T. (2016). Multiple intelligences development approach (MIDA) and students' interest and achievement in physics. *International Journal of Education, Learning and Development,* 4(9) 33-45.

Okoli, J.N. & Okoli, S.O. (2014). Effect of Multiple Intelligence-Based Instructional Approach on secondary school students' achievement in the learning of difficult Biology concepts. *International Journal of Scientific & Engineering Research*, 5 (4), 118-127.

Ovez, F. T. D. (2012). The effects of the 4MAT education model on the student achievements and learning style. Necatibey- Faculty of Education, *Electronic Journal of Science and Mathematics Education,* 3(2), 178-194.

Ssempala, F. (2005). Gender Differences in Performance of Chemistry Practical Skills among Senior Six Students in Kampala District. PhD Thesis, Boca Raton, Florida, USA Dissertation.com, Academic book publishers.

Udobia, N. (2002). *Effect of multiple intelligence teaching strategies on students' achievements in integrated science.* STAN proceeding, 51st annual conference, 190-198.

Veli, B. (2017). The effect of multiple teaching strategies on academic achievement: a meta-analytic and thematic study. *Educational sciences: theory & practice* 17(6) 2057-2092.

West African Examination Council (WAEC), (2018). *Chief examiners reports, Nigeria.*