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Comparative Effectiveness of three Active Learning Strategies in Transforming Learners' Outcomes in Basic Science for Social Change in OSUN State

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Abstract: The study investigated the effectiveness of conceptmapping, collaborative and inquiry learning strategies on the learning outcomes of students in Basic Science in Junior Secondary Schools inOsun State, Nigeria as assessed by their performances and attitude. This is with the ultimate goal of effecting transformational social change through improved performance and attitude to science learning. The study employed the pretest, post-test quasi experimental research design involving 120 junior secondary II students in three intact classes selected from three schools in the three senatorial districts of Osun State through simple random sampling technique. Two instruments, Basic Science Achievement Test and Students' Attitude Questionnaire were used to collect data for the study. Data collected were analysed using mean, standard deviation and Analysis of Covariance. The results of the study showed that there were significant effects of the instructional strategies on students' academic performance ($F=7.359$, $p<0.05$) with collaborative instructional strategy having the highest significant effect on students' academic performance ($\bar{x}=10.8667$) followed by concept mapping ($\bar{x}=10.2333$) and inquiry instructional strategy($\bar{x}=9.7333$).The results also revealed that there were significant effects of the instructional strategies on the attitude of the students towards Basic Science ($F=7.141$, $p<0.05$). The students exposed to inquiry strategy ($\bar{x}=46.2000$) exhibited highestpositive attitude followed by concept mapping strategy ($\bar{x}= 45.4000$).The results of the study finallyshowed thatthere were significant effect in the retention ability of students taught with CMLS, CLS and ILS in Basic Science at ($F = 19.694$; $p<0.05$). Students exposed to collaborative instructional strategy ($\bar{x}= 13.9000$) had the highest retention ability followed by inquiry learning strategy ($\bar{x}= 13.2333$). The study concluded that conceptmapping, collaborative and inquirylearning strategies which are active learning strategies are effective and innovative in improving students' academic performance and attitude in schools. The observed positive changes in performance and attitude has implications for learners' transformational social change as they could most likely as teenagers divert attention to learning science rather than unscrupulous behaviour in the society.

Keywords: Conceptmapping, Collaborative learning strategy, Inquiry learning strategy, Learning outcomes, Basic Science, Performance, Attitude, Social Change

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I. INTRODUCTION

Miscreant behaviour amongst teenagers has been linked with school dropout and absenteeism from school. There is the need to get students to be actively involved and interested in their classroom activities and encourage better performance as part of the panacea for achieving desired social change. Science has become an integral part of the society in the modern world. Science and technology is no doubt one of the most important components in the fight against poverty. It is obvious that science subjects are necessary for development of science and technology, which is an important component, if we have to achieve our national goals and targets in alleviating poverty (Aladejana,2006).Science is a catalyst and a driving force of change for national and international development as well as social transformation. The role of science in this modern world is changing, it is totally different from that of a generation ago. Countries which have made optimaluse of science and tailored its processes to suit their environment and cultural values are today in the forefront of scientific and technological development (Aladejana, 2015). For any nation to uplifts her economy, science subjects are needed to be thorougly done in schoolssince science is a continuous search for explanation of phenomena in nature (Omorugbe & Ewansiha, 2013).Since the impact of science to national development cannot be overemphasized, hence the Federal government of Nigeria introduced the teaching of science as a subject to her

schools and science concepts arepresentedat the primary and junior secondary levels of education as a Basic Science.

Despite the role of science to nation building, students' performance in and attitude towards science subjects at both junior and senior secondary levels of education in Nigerian schools have been consistently poor both in internal and public examinations at all levelsof education in Nigeria (Ajayi, 2009; Adeyemi, 2011; Ojedokun&Aladejana 2013).The Nigerian Educational Research and Development Council (NERDC, 2010) reported that the performance of students in public examinations over the years has been poor in junior school sciences (Mathematics, Basic Science and Basic Technology). This was also affirmed by the findings of Omorogbeand Ewansiha (2013). Many factors have been identified to be responsible for this malady. These include learning difficulty,poor methodology, teacher's factor, anxiety and fear for the subject among others, (Sowumi & Aladejana, 2013;Olajide & Aladejana, 2016).

There is obvious poor performance in examinations and thereare fewer students who are studying science at the senior secondary schools (Aladejana, 2003). Omorogbe and Ewansiha (2013) also reported that the poor achievements are attributed to poor quality of teaching. It has been demonstrated that the quality of instruction is fundamental to student learning outcomes (Aladejana, 2015). Efforts to remediate the persistent poor performance and attitude have proved abortive most especially at the junior secondary school level of education where the teaching of science should start early in child's life.There is therefore the need to improve the teaching and learning of science in schools if the Nation is to compete successfully in technology-intensive global markets as the world is rapidly moving to the age where without investing in science and technology there will be no development and less emphasis has been made in improving the teaching of science in our junior secondary schools.It isexpected that students'learning of science through Basic Science using realistic instructional techniques should enhance the inculcation of the generic skills of inquiry, reasoning,conceptualizing, problem solving and communicating. Byapplying these skills, students are not only expected to construct their knowledge but also to establish confidence and positive attitudes towards science.Attitude towards science implies a general positive or negative feeling about science; whether a person likes or dislikes science. Attitude towards science is closely related to achievement in science (Belinda,2010). A significant relationship was found with a mean correlation ranging from 0.16 to 0.70 between students' attitude toward science and their achievement. One of the concerns of teacher education is to bring about a positive change in attitude. Teacher training is concerned with desirable change in student-teachers' attitude toward himself/herself and his/her pupils. Attitude has an effect upon students' selection of different subjects and also on their interest and achievement in the scientific knowledge (Aladejana, 2003). Generally, attitudes are considered as the degree of positive or negative feelings towards an object, course or event. Positive or favourable attitude facilitates the learning of subjects while a negative attitude results in poor learning because achievement determines behaviour. In spite of all efforts by science educators, science still remains a dreadful subject by learners in the schools.Thus, it becomes imperative that other innovative teaching approaches should be employed to make the teaching and learning of Basic Science more interesting at this level of education and perhaps the performance and attitude could be better if teaching approaches such as concept mapping, collaborative and inquiry learning instructional strategies are used.

Statement of Problem

Studies have shown that students' performance in and attitude towards Science subjects in Nigerian secondary schools have been consistently poor especially in Senior School Certificate Examinations (SSCE) as reported by some scholars (Aladejana, 2008; Adeyemi, 2011; Omorogbe & Ewansiha, 2013&Aladejana, 2015). This may not be unconnected with the teaching and learning process that still engages the use of conventional expository teaching method in teaching Basic Science at the Junior Secondary School (JSS) level. This method has been criticized in literature as being teacher-centred, outdated and unfriendly to learners. A number of innovative methods have been devised to teach Science at the JSS, among which are concept mapping, collaborative and inquiry methods, which are self- regulated learning strategies for students. However, the extent to which these strategies could enhance the learning outcomes of students (knowledge, attitude and retention) have not been adequately researched and reported in the literature, hence this study.

Purpose of the Study

The study aimed at investigating the relative effectiveness of concept-mapping, collaborative and inquiry learningstrategies on the learning outcomes of junior secondary school students in Basic Science. Specifically, the objectives of the study are to;

(i) investigate the effectivenesss of concept-mapping, collaborative and inquiry learning strategies on students' knowledge of Basic Science concepts in Junior Secondary Schools (JSS) in Osun State;
(ii) examine the effectivenesss of the three strategies on the attitude of JSS students towards learning of Basic Science in the State; and

(iii) investigate the effectiveness of the three strategies on students' retention ability of learned concepts of JSS students in Basic Science in the study area.

Hypotheses

1) There is no significant effect of concept mapping, collaborative and inquiry learning strategies on the performance of students in Basic Science.
2) There is no significant effect of the three strategies on the attitude of students towards the learning of Basic Science.
3) There is no significant effect of the three strategies on the retention ability of students in Basic Science.

II. METHODOLOGY

The study employed the equivalent pretest, post-test control group quasi experimental research design. The population for the study comprised all junior secondary school students in Osun State. The study sample consisted of 120 junior secondary II (JS II) students in three intact classes. Three Local Government Areas (LGAs) selected by simple random sampling technique were used for the study. From each of the three LGAs, one school was selected through simple random sampling technique. The three schools were randomly assigned to three experimental groups. The two instruments used for data collection were: Basic Science Achievement Test (BSAT) and Students'Attitude Questionnaire towards the Learning of Basic Science (SAQLBS). Data collected were analysed using mean, standard deviation and Analysis of Covariance (ANCOVA).

III. RESULTS

Hypothesis One: There is no significant effectof concept mapping, collaborative and inquiry learning strategies on the performance of students in Basic Science.

In order to test this hypothesis, data collected on the performances of students taught with Concept Mapping Learning Strategy (CMLS), Collaborative Learning Strategy (CLS) and Inquiry Learning Strategy (ILS) in Basic Science were subjected to Descriptive Statistics, Analysis of Covariance (ANCOVA) and Post Hoc Test and the results are presented in the Tables below.

TABLE 1: Descriptive statistics of the effect on the performance of students taught with CMLS, CLS and ILS in Basic Science.

Descriptive Statistics

DependentVariable: Post-test of students'performance

Strategies	Mean	Std. Deviation	N
CMLS	10.2333	3.31853	40
CLS	10.8667	4.18316	40
ILS	9.7333	3.40318	40
Total	**9.4083**	**3.91398**	**120**

Results in Table 1above showed the descriptive statistics of the effect in the performances of students taught with the three strategies. It can be observed from the table that the mean scores of the students' academic performance in Basic Science having been exposed to CMLS, CLS and ILS are $\bar{x}$=10.2333, $\bar{x}$=10.8667 and$\bar{x}$=9.7333 respectively. The results implied that students exposed to Collaborative Learning Strategy (CLS) with the highest mean score of ($\bar{x}$=10.8667) performed better than those that were taught with CMLS and ILS Table 1 above does not show the significant effect in the performances of students taught with the three strategies but these effects are presentedin Table 2 below using Analysis of Covariance (ANCOVA).

TABLE 2: Analysis of Covariance (ANCOVA) of the effect on the performance of students taught with CMLS, CLS and ILS in Basic Science.

Tests of Between-Subjects Effects

Dependent Variable: Post-test of students' performances

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	291.492[a]	3	97.164	7.359	.001	.160
Intercept	10622.008	1	10622.008	804.540	.001	.874
Strategies	291.492	3	97.164	7.359	.001	.160
Error	1531.500	116	13.203			
Total	12445.000	120				
Corrected Total	**1822.992**	**119**				

a. R Squared = .160 (Adjusted R Squared = .138)

Results in the Table above revealed that there is significant effect in the performances of students taught with CMLS, CLS and ILS in Basic Science at ($F = 7.359$; $p<0.05$). Therefore, the null hypothesis that

states that there is no significant effect in the performance of students taught with the three strategies in Basic Science is thus rejected. A partial eta squared value of 0.160 showed that 16.0% of the variance in the posttest scores of the students is accounted for by the treatments as the effect size.

Hypothesis Two: There is no significant effect of the three strategies on the attitude of students towards the learning of Basic Science.

In order to test this hypothesis, data collected on the attitude of students exposed to Concept Mapping Learning Strategy (CMLS), Collaborative Learning Strategy (CLS) and Inquiry Learning Strategy (ILS) in Basic Science were subjected to Descriptive Statistics and Analysis of Covariance (ANCOVA) andthe results are presented in the Tables below.

TABLE 3: Descriptive statistics of the attitude of students taught with the three strategies towards Basic Science.

Descriptive Statistics

Dependent Variable: Post-attitude

Strategies	Mean	Std. Deviation	N
CMLS	45.4000	7.40736	40
CLS	40.4000	5.64221	40
ILS	46.2000	6.12175	40
Total	**44.0000**	**6.86466**	**120**

Results in Table 3 above shows the descriptive statistics of the effect in the attitude of students taught with the three strategies towards the learning of Basic Science. It can be deduced from the table that the mean scores of the students exposed to the three strategies are CMLS ($\bar{x}_=$ 45.4000), CLS ($\bar{x}_=$ 40.4000) and ILS ($\bar{x}_=$ 46.2000) in Basic Science. However, students that were exposed to Inquiry Learning Strategy (ILS) exhibited better attitudinal mean score of ($\bar{x}_=$ 46.2000) over those exposed to CMLS and CLS towards the learning of Basic Science. The significant effect in the attitude of students taught with the three strategies is presented in Table 4using Analysis of Covariance (ANCOVA).

TABLE 4: Analysis of Covariance (ANCOVA) of the effect on the attitude of students taught with CMLS, CLS and ILS in Basic Science.

Tests of Between-Subjects Effects

Dependent Variable: Post-attitude

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	602.195[a]	3	200.732	4.806	.004	.144
Intercept	1967.003	1	1967.003	47.097	.000	.354
Pre-attitude	9.395	1	9.395	.225	.141	.003
Strategies	596.486	2	298.243	7.141	.001	.142
Error	3591.805	86	41.765			
Total	178434.000	90				
Corrected Total	**4194.000**	**89**				

a. R Squared = .144 (Adjusted R Squared = .114)

Results in Table 4 revealed that there is significant effect in the attitude of students exposed to CMLS, CLS and ILS in Basic Science at ($F = 7.141$; $p<0.05$). Hence, the null hypothesis was rejected. A partial eta squared value of 0.142 indicated that 14.2% of the variance in the attitudinal scores of the students is accounted for by the treatments as the effect size. To know the multiple comparisons of students' attitude towards Basic Science, students taught with the three strategies were compared differently and the results are presented in Table5 below.

TABLE 5: Scheffe Post Hoc analysis of the effect on the attitude of students towards Science when taught with CMLS, CLS and ILS

Scheffe Post Hoc Test of Multiple Comparisons

Dependent Variable: Post-attitude

(I) Strategies	(J) Strategies	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
CMLS	CLS	4.973*	1.670	.004	1.654	8.292
	ILS	-.875	1.676	.603	-4.208	2.457
CLS	CMLS	-4.973*	1.670	.004	-8.292	-1.654
	ILS	-5.848*	1.672	.001	-9.172	-2.525

ILS	CMLS	.875	1.676	.603	-2.457	4.208
	CLS	5.848*	1.672	.001	2.525	9.172

Based on estimated marginal means
*. The mean difference is significant at the .05 level.
b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Table 5 indicates Scheffe Post Hoc analysis of multiple comparisons of students' attitude towards Basic Science. It can be seen from the table that attitude of the students exposed to CMLS are significantly different from those exposed to CLS at (Mean Difference = 4.973; $p<0.05$). In addition, there was significant difference in attitude of students that were taught with CLS and ILS at (Mean Difference = 5.848; $p<0.05$).Although studentsthat were exposed to CMLS and ILS at (Mean Difference= 0.875; $p>0.05$) also exhibited some differences in attitude towards Basic Science yet the differences were not significant.

Hypothesis Three: There is no significant effect of the three strategies on the retention ability of students in Basic Science.

In order to test this hypothesis, data collected on the retention ability of students taught with Concept Mapping Learning Strategy (CMLS), Collaborative Learning Strategy (CLS) and Inquiry Learning Strategy (ILS) in Basic Science were subjected to Descriptive Statistics, Analysis of Covariance (ANCOVA) and Post Hoc Test and the results are presented in Tables below.

TABLE 6: Descriptive statistics of the effect on the retention ability of students taught with CMLS, CLSand ILS in Basic Science.

Descriptive Statistics

Dependent Variable: Retention ability

Strategies	Mean	Std. Deviation	N
CMLS	13.1000	3.78153	40
CLS	13.9000	4.94347	40
ILS	13.2333	4.28858	40
Total	**11.4917**	**5.33420**	**120**

Results in Table 6 revealed the descriptive statistics of the effect in the retention ability of students taught with the three strategies. It can be noticed from the table that the mean scores of the students exposed to the three strategies are CMLS ($\bar{x}$=13.1000), CLS ($\bar{x}$=13.9000) and ILS ($\bar{x}$=10.2333) respectively. However, students that were exposed to Collaborative Learning Strategy (CLS) had better retention ability over those that were exposed to other strategies considering its highest mean score of students ($\bar{x}$=13.9000). However, the significant effect was revealed using Analysis of Covariance (ANCOVA) as presented in table 7 below.

TABLE 7: Analysis of Covariance (ANCOVA) of the effect on the retention ability of students taught with CMLS, CLS and ILS in Basic Science.

Tests of Between-Subjects Effects

Dependent Variable: Retention ability

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	2617.454[a]	4	654.364	97.916	.001	.773
Intercept	126.309	1	126.309	18.900	.001	.141
Post-test of SP	1280.096	1	1280.096	191.547	.001	.625
Strategies	394.844	3	131.615	19.694	.001	.339
Error	768.538	115	6.683			
Total	19233.000	120				
Corrected Total	**3385.992**	**119**				

a. R Squared = .773 (Adjusted R Squared = .765)

Results in Table 7 above shows that there is significant effect in the retention ability of students taught with CMLS, CLS and ILS in Basic Science at ($F = 19.694$; $p<0.05$). Therefore, the null hypothesis that states that there is no significant effect in the retention ability of students taught with the three strategies and teacher expository method in Basic Science is thus rejected. A partial eta squared value of 0.339 indicated that 33.9% of the variance in the retention scores of the students is accounted for by the treatments as the effect size.

IV. CONCLUSION

The study concluded that concept mapping, collaborative and inquiry learning strategies are effective and innovative teaching methods in improving students' academic performance and attitudes in schools which has implications for learners' transformational social change in the society.

V. RECOMMENDATIONS

Based on the conclusion of findings of this study, it is hereby recommended that :

1. Curriculum planners should include innovative methods of teaching Basic Science concepts such as concept-mapping, collaborative and inquiry strategies in the junior secondary school curriculum.
2. Government should ensure that education policy statements are translated into reality.
3. Workshops, seminars and conferences should be organised for science teachers on the new innovative methods of teaching science subjects in schools on regular basis.

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