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# An Investigation into The Achievement of Junior Secondary School Students Taught Integrated Science Using the Cooperative Learning Strategy in Nigeria

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The Instructional strategy is an important variable that affect students' achievement in science in the classroom setting. The search for the effective strategies that would empower learners to exhibit improved science achievement is the purpose of this work. This study investigated the effect of cooperative learning strategy on the junior secondary school students' achievement in Integrated Science in Adamawa State. Pre-test, Post-test quasi experimental research design was employed for variable matching. The population was made of all JSS III Students in Adamawa State Secondary Schools in 2011 academic session. The sample consists of 256 JSSIII Students made up of 84 Students in $E_1$ Lecture Method group, 70 Students in $E_2$ Cooperative Learning Strategy group alone and 72 in $E_3$ Cooperative Learning Strategy and Lecture Method group. The treatment groups where randomly selected among selected participating schools intact classes were also randomly selected from the schools where there is more than one arm of JSSIII. Intact teachers known as research assistants after being trained by the researchers administered the treatment in order to remove teacher bias. The instruments used for Data Collection were a 50 items Integrated Science Achievement Test (ISAT). The reliability value of ISAT is 0.71. The instrument was administered before treatment (Pre-test) and after the treatment (Post-test). The data were analyzed using Analysis of Covariance (ANCOVA). Multiple Classification Analysis (MCA) was also used to detect the magnitude of Significant Variations. The results showed that: (i) There was a Significant main effect of treatment on achievement ($F_{(2,207)} = 740.95$, $P<.05$).

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Results show that all the treatment groups benefitted from the treatment. The Lecture group benefitted the least followed by the Cooperative Teaching Strategy group alone; the Lecture Method combine d with Cooperative Learning Strategy group benefitted the most. These findings have implications for the Classroom teacher, students, curriculum designers, text book writers and publishers. In line with these findings it was recommended that Cooperative Learning Strategy, together with Lecture could serve as a viable alternative to the Conventional Lecture Method particularly in the teaching of Integrated Science to Secondary School Students.

*Keywords*: cooperative learning strategy, self-esteem, classroom motivation and learning achievement

## INTRODUCTION

The role of science in the development of a nation is never in dispute. It is evident that the current development in science and technology has greatly affected the life of every human being so much that to be ignorant of the basic knowledge of this development is to live an empty, meaningless and probab1y unrealistic life. It will also be difficult for a nation with a scientifically illiterate citizenry to make any reasonable technically based political decision on issues of everyday life such as the environment, agriculture, health, transport, and communication or population growth. This is so because such a nation lacks the rudimentary tools to grasp the various arguments that are necessary for taking such decisions. Science therefore, has a privileged function of exerting a domineering if not a decisive influence on the development of a nation.

Orakotan (2004) noted that the vital role played by science in contemporary society is indispensable to the healthy existence of any nation. In recognition of the important role of science for national development, the Federal Government of Nigeria in the National Policy on Education (NPE, 2004) gave a special place to science, technology and mathematics education and the promotion of scientific literacy to her citizenry. In addition, the government put in place some reforms and measures aimed at harnessing the human and material resources in the country. Prominent among these is the National Policy on Science and Technology (FGN, 2011:4) that spelt out objectives and direction of science and technology education in Nigeria. Some of the objectives are:

- Producing world class scientists, engineers, and technologists who are well grounded in theory, practice of basic science and the needs of entrepreneurship.
- Providing adequate support
- for continuous training of academic staff in tertiary and research institutions.
- Strengthening the curricular in technological entrepreneurship and management of technology for science and engineering students.
- Mainstreaming students in arts and social sciences to appreciate the relevance of science technology and invention (STI) to profitability in business as well as natural development.
- Encouraging and providing opportunities for the products of informal training schemes in STI for further formal training.
- Strengthen capacity building institutions within the military, public and private sectors of the economy.
- Facilitate on-the-job standardized training for professionals in STI organizations.
- Promoting academic industry exchange programs to enhance knowledge sharing.

Despite all the aforementioned aimed at improving the production of scientists and the subsequent development and use of scientific products among the citizenry, Studies have shown that students who choose to study science, perform poorly in the senior secondary school certificate examination (SSCE) conducted by both the West African Examination Council (WAEC) and the National Examination Council (NECO). (Aghyeneku, 2003, Onyia, Osisioma, and Ogunsola Bandele, 2009, Oloyede & Omole, 2013).

Teaching science in Nigeria secondary schools is done in two parts: at the Junior level and at the Senior level. At the Junior Secondary School level, science is taught in a holistic form as Integrated Science. The Integrated science curriculum is expected to provide the relevant introduction cum foundation of learning science at the senior secondary school level. Poor performance in integrated science at the junior secondary school level is a thing of worry because of the role it is supposed to play in the subsequent learning of science at a higher level (Nwagbo, 2006). Unfortunately there are evidences which show students under achievement in Integrated Science at the Junior Secondary School level. (Nwoji, 2000, Demid, 2011).

Idowu (2011) observed that integrated science provide students sound basis for further science study, hence a child that is not well grounded in Integrated science at this level would not show interest in offering core science subjects (biology, chemistry and physics) at the Senior Secondary School level. Idowu (2011) also observed that due to poor teaching methods employed in the teaching of the subject by teachers, students find it difficult to understand the concept taught, and this has led to the development of negative attitude towards the subject by the students which in turn led to many of them not showing interest in offering core science subject at the senior secondary school level and science oriented courses at the Nation's tertiary Institutions.

As stated above many intervention strategies have been designed and mounted to check the ugly trend of science under-achievement. Also, intervention studies aimed at identifying various instructional strategies that could mediate the handicaps of the conventional teaching strategies have been carried out. Some of the current implemented strategies suggested from researches include: the discussion method, demonstration method, project method (Kolawole, 2007); concept mapping (Smith, 2007, Oloyede& Adeoye, 2009). Others are: the flow map method (Adeyemi 2002); Cooperative learning strategy (Wyk, 2010) integrated video media effectiveness, problem based learning strategy (Iroegbu, 2002); conflict map (Tsai, 2000); framing and team assisted individualization (Cooper,2010,). Model-based strategy (Okoronka and Ogunsola -Bandele 2004,Oloyede & ogunsola,2011) analogy based strategy (Okoronka, 2008) and inquiry based method (Onyia, Osisioma and Ogunsola-Bandele 2009). Use of Advanced Organisers (Oloyede, 2009). Enhanced Feedback strategy (Oloyede, 1998).

Though these intervention strategies have been generally adduced as solutions, they may not achieve the ultimate goal of improved performance and enrolment in science. This is because they have failed to take into account the reality of classroom situation in our schools. The public schools' classroom to which majority of Nigerian children belong to is characterized by overcrowding, inadequate instructional materials and basic facilities. These naturally force the teachers to resort to the conventional lecture method despite its inadequacies. What method therefore can the teacher use to teach science in our peculiar classroom environment to be able to address the various challenges observed? These researchers are of the opinion that an instructional strategy which perhaps is capable of improving performance on one hand while addressing the large class size and inadequate instructional materials issue on the other is the cooperative learning strategy. Under this strategy, students can share books and other materials while working in cooperative groups as well as participate actively in learning. In

agreement with this, Dumas (2003) asserted that "after nearly fifty years of research and scores of studies, there is strong agreement among researchers that cooperative learning strategy can and usually do have positive effects on students achievement." Also, the cooperative learning strategy like no other learning method allows for the total involvement of learners in the process of learning: (Adeyemi, 2002; Ogunkola, 2002, Clarkson and Sampson, 2008 and Ajaegbuna 2009).

As a learning strategy, cooperative learning while addressing the large class size and inadequate instructional materials problem also takes care of how learners interact among themselves. The model of cooperative learning that is proposed in this study is the Student Team Achievement Division (STAD) which was developed by Slavin (1996). The choice of STAD was based on the findings of Johnson, Maruyama, Johnson, and Nelson (1981); Stanne (2000) who in a meta-analysis of the cooperative learning models, had found among other things that; STAD has the largest effect size when the effectiveness of the different cooperative learning models were compared. The model involves grouping students together heterogeneously by ability, gender, race, and ethnicity. Students then learn materials in teams and take quizzes as individuals. This model is considered appropriate for a variety of subjects including science if the focus is on material with single right answer (Slavin, 2011). In addition Johnson and Ahlegren (1976) reported that students' cooperativeness and competitiveness is positively related to students' motivation to learn. In support, Ghaith (2009), Trans and Lewis (2012) both argued that cooperative learning strategy promotes positive attitude towards both didactic and inquiry methods of teaching and learning. According to them students taught using cooperative learning strategy are likely to learn more than those taught using competitive method. While there are many empirical evidence supporting the use of cooperative Learning Strategy in teaching, (Slavin 2011, Borsch, Jurga-Lohman and Giesen 2003), the extent to which it could be beneficial in teaching Integrated Science in Nigerian Secondary Schools could not be known, if it is not empirically tested.

This Study therefore addressed the problem of the effect of Cooperative Learning Strategy on Junior Secondary School Students Achievement in Nigeria, using sample from Adamawa State.

## Objective of the study

The objective of the study was to determine the effect of Cooperative Learning Strategy on the achievement of Junior Secondary School Integrated Science students in Nigeria.

## Hypothesis

The following null hypothesis was tested at 0.05 level of significant.

There is no significant main effect of Cooperative Learning Strategy on the Achievement of students in Integrated Science.

## METHODOLOGY

This study adopted a pre-test, post-test, control group, quasi-experimental research design. The study was carried out in Adamawa State. Simple random sampling was used to select three local government areas from the three senatorial zones of the state to give the study an even coverage of the state. Simple random sampling technique was used to select six schools – two each from the sampled local government areas. Simple random sampling was used to select which school should be given what treatment. In schools where there was more than one Junior

Secondary School class 3, simple random sampling was used to select the class used for the study. Intact class was used for the study and the Integrated Science teacher who is the trained research assistant administered the treatment and administers the instruments to avoid teacher bias. Students from the two selected schools in each Local Government Area belonged to the same experimental conditions. However, the selected schools were located in such a way that subjects could not easily get in touch with each other as a way of reducing contamination. A total sample size of 256 Junior Secondary School 3 students found in the classes so randomly selected, were used for the study.

A researcher made 50 - item multiple choice Integrated Science Achievement Test (ISAT) was used as the instrument for collecting data in this study. Topics for the study were drawn from the Nigeria Integrated Science Project Textbooks 1, 2, and 3 written by the Science Teachers Association of Nigeria (STAN). The duration of time and the topics covered are reflected in an item specification analysis for the study (Table 1).

**Table 1:** Table of Item Specification for Integrated Science Achievement Test (ISAT)

| S/N | Topic/Content | Recall | Application | Reasoning/ thinking | Total Number of Items |
|---|---|---|---|---|---|
| 1. | Ecology | 25, 39 | 29,33 | 26,30 | 6 |
| 2. | Air and Burning | 1,3,31, 16, 13 | 6 | 48,15 | 8 |
| 3. | Energy | 2, 22, 36, 41, 50 | 17,32,19 | 40 | 9 |
| 4. | Chemical substances and reaction | 8, 21, 28, 44, 43 | 5,49 | 10,18,23,27 | 11 |
| 5. | Digestion | 4,9,12,45 | 34 | 24 | 6 |
| 6. | Excretion | 35,37,7,42 | 47 | | 5 |
| 7. | Machines | 46 | 14, 20, 38 | 11 | 5 |
| | Total | 26 | 13 | 11 | 50 |

***NB**: Only three out of the six levels of cognitive domain were used for the study.*

The ISAT instrument was face validated by consulting three experts in Science Education Department of Adamawa State University, Mubi. The three experts were in Physics and Chemistry Education. On the basis of their recommendations and suggestions, the items were modified in order to achieve content and face validity. The original set of 57 items was then reduced to 50. This was then administered to 100 JSS III students from two schools that were not part of the main study. Students' scores from the test were analyzed to determine the test reliability and suitability. The Cronbach alpha coefficient was used in calculating the reliability, which gave a value of 0.71..

Three instructional strategies were used in the study; cooperative learning strategy, cooperative learning strategy and lecture method combined and lecture method alone. The experimental conditions are the cooperative learning strategy, and cooperative learning strategy combined with lecture method. The control groups were taught using lecture method alone. The treatment for the three groups lasted for eight weeks. The research assistants conducted the experiment under the supervision of the researchers. The research assistants who handled the experimental groups were trained in the conduct of cooperative learning lesson by the researchers before the commencement of the experiment. They used the lesson plans given to them by the researchers to teach the experimental group.

In the cooperative learning and cooperative learning plus lecture groups, the students were divided into groups of five students. The first experimental group $E_1$,

consist of 14cooperative learning groups. The second experimental group consists of 14cooperative learning groups. The sitting arrangement was structured so as to allow for unhindered movement of the subjects in each group to discuss with one another in the group during treatment implementation. The subjects were instructed to work together as a team, seek help from one another, and help one another to understand the learning materials and topics taught them. In addition, they were told that individuals would not be rewarded or reprimanded for either the failure or success of the group, rather each group would be held responsible and accountable for either the success or failure of each group. They were introduced to social skills such as caring for one another, sharing ideas, doing things collectively, helping one another, how cooperation leads to success, how to perceive each other and the need to contribute to the overall learning success of each other within their various groups.

In the control group, the students were not given any instructions regarding the mode of interaction. The conventional lecture method was used. The teacher who handled the control group used the sample lesson plan for control group. All the teachers taught the same topics contained in the Nigeria integrated science text books authored by the Science Teachers Association of Nigeria..

## Method of data collection

The researchers requested and got official permission for the use of schools used for the study from their various principals. The Integrated Science teachers were then trained before the commencement of the study on how to dispense the treatment on subject. The researcher met with the teachers once in a week for two hours for two weeks outside the normal school hours in their various schools. The pre-tests were administered on the subjects during the first one week. Teachers were told to encourage subjects to practice in their classroom environment with regards to the new strategy of teaching used. After an additional six weeks of treatment, the post tests were then administered.

## Method of data analysis

The various data collected from the pre and post tests were analysed using the analysis of covariance (ANCOVA) with the pre - test score serving as a covariate to the post test score.

## RESULTS AND DISCUSSION

**Hypothesis $H_{01}$:** There is no significant main effect of Cooperative Learning Strategy on the Achievement of students in Integrated Science.

This hypothesis was tested using ANCOVA. Table 2 gives the ANCOVA results:

**Table 2.** Summary of ANCOVA Results of Achievement in Integrated Science by Instructional Approaches**.**

| Source | SS | df | MS | F | Sig | eta |
|---|---|---|---|---|---|---|
| Treatment Group | 55787.661 | 2 | 28743.830 | 740.948 | .000* | .877 |
| Error | 8030.220 | 207 | 38.793 | | | |

**Significant p< 0.05*

Table 2 shows the ANCOVA results of achievement in Integrated Science by instructional approaches. A three way between groups Analysis of Covariance was carried out to determine the effectiveness of three instructional approaches – cooperative learning strategy combined with lecture method, cooperative learning strategy alone and the lecture method. The independent variable was the three

instructional approaches, i.e. experimental conditions at 3 levels. The dependent variable was the students' achievement scores in Integrated Science obtained after exposing the participants to experimental treatment and the covariate was the students' pre-test scores obtained prior to exposing the participants to experimental treatment. Preliminary checks were conducted to ensure that there was no violation of assumptions of homogeneity of regression slopes, homoscedasticity, linearity and outliers. After adjusting for the covariate, the results showed that there was a significant main effect of treatment on the mean achievement scores of students in Integrated Science ($F_{(2, 207)}$ = 740.95, $p$ < 0.05), effect size was large, partial eta squared = 0.88]. This indicates that 88% of the variability in the dependent variable is accounted for by the experimental treatment when this value is multiplied by hundred and expressed as percentage.

To clarify and find out which is the most effective of the treatments, a Multiple Classification Analysis was carried out and the result is shown in the table below.

Table 3 gives the MCA results:

**Table 3.** Multiple Classification Analysis (MCA) on Post-test Scores by Treatment Groups. Grand Mean = 53.58

| Variable Category BETA | N | Unadjusted Deviation | ETA | Adjusted for factor and covariates |
|---|---|---|---|---|
| Lecture Method | 84 | -30.230 | | -29.835 |
| Cooperative strategy | 70 | 12.253 | .962 | 12.701 |
| Cooperative strategy Combined with Lecture | 74 | 23.355 | .946 | 22.459 |

The Multiple Classification Analysis (MCA) on post-test scores by treatment group shown in Table 3reveals that Cooperative Learning Strategy combined with Lecture Method (CLSLM) group had the highest adjusted post-test mean scores of 76.039; followed by the Cooperative Learning Strategy (CLS) group which had the adjusted post-test mean score of 66.281; and lastly the Lecture Method (LM) group which had the adjusted post-test mean score of 23.745. This can be expressed mathematically as CLSLM > CLS > LM. This implies that the most effective method of instruction for Integrated Science therefore is Cooperative Learning Strategy combined with Lecture Method of the three approaches.

## DISCUSSIONS

The analysis of the data on students' achievement in Integrated Science by instructional approaches is presented on Table 2. The result showed that the main effect of treatment on the mean achievement scores of students in Integrated Science is significant. This means that the critical F value for the degree of freedom 2 at 0.05 alpha levels is less than the calculated F value from the experiment. Therefore, $H_{01}$ was rejected. This shows that all the treatment groups benefitted from the treatment but to find out which treatment group benefitted most, the Multiple Classification Analysis was undertaken to ascertain which group achieved significantly highest than the other groups. Table 3 shows that Cooperative Learning Strategy combined with Lecture Method group achieved significantly highest than the Cooperative Strategy alone group which also achieved significantly higher than the Lecture Method alone group. This can be expressed in mathematical terms as follows: CSCL > CS >LM.

The result of this study shows that the Cooperative Learning Strategy together with Lecture Method is superior to the Cooperative Learning Strategy alone and the Lecture Method alone. The difference cannot be attributed to chance; rather it can be due to the treatment given. This results agrees with Stahls (2003) in which he

used cooperative learning strategy in teaching learners and found out that those students taught integrated science using cooperative learning strategy and lecture perform better than those taught by other methods.

Johnson and Johnson (2005) also reported that when students truly work deep together in the cooperative way, they achieved much higher, and liked the subject, the teacher, and the school better. According to Johnson and Johnson when cooperative learning strategy is used, the question should not be who will do well but how many can be prepared to do well. Also Adeyemi (2002) and Ogunkola (2002) reported the same findings that cooperative learning strategy has proven to be one of the strategies which increase students' academic achievement.

Similar findings have been reported in other studies Clarkson and Sampson (2008) demonstrated that students exposed to small group learning strategy, achieved significantly higher than those in a whole individualistic class strategy. The reason is that in small heterogeneous groups, discussion and interaction stimulate and engender equal participation by all the learners in the group.

The findings of this study are in agreement with those of Oyekan (1993), Eilks (2002. These writers agreed that one of the factors militating against effective academic achievement of students in various subject areas in our schools across the nation is the application of unworkable method of teaching.

Von (2002) also agreed that most teachers have failed to create learning situation in which students' interaction with each other and with the learning materials for improved learning is incorporated into the learning method. In competitive learning, learner competes inappropriately in the class. Each student seeks the best for himself/herself regardless of whether or not others achieve their learning goals. They are also rewarded and graded on the basis of individual class work performance since the goal structure in the class is competitive rather than cooperative. This makes students to perceive that they can achieve their goals if and only if the other students with whom they are learning fail to achieve their goal. As a result of this, traits that are contrary to acceptable societal values selfishness, low positive social interaction, and low level of trust, acceptance, support and rivalry which are inimical to sharing of ideas, supporting and assisting one another and mutual concern for each other are generated and propagated among the students. This is contrary to what is obtained in cooperative learning classrooms where learning is considered as a social activity.

Teaching science using the lecture method is not the best (Okebukola, 2002). However, cooperative learning method allows students to have insights into how other students obtain and use information. This leads to expansion of understanding of their thinking process because by sharing ideas, the students externalize their ideas and reasoning skills Stahl (2003). In line with this, noted that cooperative learning strategy stimulates critical thinking and helps students to clarify ideas through discussion and sharing of ideas. Students improved achievement in Integrated Science as a result of the use of Cooperative Learning Strategy which on active participation, guided practice, immediate feedback, and reinforcement which provided the avenue for learning that might have led to the improved achievement observed in the groups. The consequence of these could be increased motivation, and encouragement to learn and enhanced self-efficiency required for achievement. Furthermore this achievement could be as a result of the fact that instruction was conducted in small heterogeneous cooperative learning groups which paved way for individual attention and equal participation. This has contributed to the improved achievement in Integrated Science. This in line with the views of Vygotsky(1978) who believed that all knowledge come to being as a result of people interacting in the society. This improved result could also be as a result of arguments that emanates from each group member in addition Piaget (1970) believed that social arbitrary knowledge such as Language of Science needs to be learned through

interactions with others. These interactions could lead to cognitive conflicts, exposing inadequate reasoning and creating disequilibrium. The result would be the emergence of higher quality understandings.

From the above result it could be said that children learn higher mental function such as thinking, reflection, reasoning and problem solving in cooperation and interaction with others within the Cooperative Learning Strategy groups.

## CONCLUSION

The evidence from the findings reveals that Cooperative Learning Strategy is more effective than the conventional lecture method. When Cooperative Learning Strategy is combined with lecture method, it shows that it is more effective than when Cooperative Learning Strategy alone is used as when lecture method is used alone.

## RECOMMENDATIONS

On the basis of the findings of this study, the following recommendations are made:

1. The success in the use of the Cooperative Learning Strategy in teaching Integrated Science is indicative of the need for organizing seminars and a workshop that equips teachers to enable them acquire more knowledge and skills of using the strategy in teaching.
2. Students should always be encouraged to work together in groups so as to enable them imbibe the culture of working together cooperatively in order to promote their gaining science skills and knowledge.
3. The administrators of junior secondary schools should encourage teachers to use Cooperative Learning Strategy in their teaching.
4. Principals of Secondary Schools should endeavour to procure manuals, journals and magazines on cooperative learning-based instruction for the school library. This is to reinforce teachers who may wish to use the strategy.
5. Cooperative Learning Strategy should be used alongside other teaching methods and strategies in order to provide a way of meaningfully availing variety in the teaching of science. This is because cooperative learning is innovative and has the potential to motivate more learners towards learning and specializing in science.

## REFERENCES

Adeyemi, S.B.(2002).Relative effects of Cooperative Learning and Individualized Learning Strategies on Students declarative and Procedural Knowledge in Map Work in Osun State*, Unpublished PhD Thesis University of Ibadan, Ibadan.*

Aghyeneka, E. U. (2003). The Nature of Science Education in Nigeria Today*, Kusagu Journal 1(1), 43 – 48.*

Ajaegbuna, H.I.(2009).The challenges of teaching to Geographers and geography Teachers in Nigeria. *A paper presented at the High School geography Conference at University of Ibadan.*

Borsch, F. Jurgen - Lohmann, J., & Giesen H. (2003). Achievement through Cooperative Learning. Jigsaw in German elementary Schools. Retrieved 14th May 2011 from *http://www.unifrankfort.ed/fbo5/ifpp/joesen*

Clarkson, D. B. & Sampson, V. (2008) Assessing Dialogic argumentation in On-line Environment to relate structure, ground, and Quality. *Journal of research in Science teaching* 45 (3), 6.

Cooper, S. S. (2010) Effect of Cooperative, competitive and individualistic learning on students' achievement in science clan. *Journal of Research in Science Teaching: 19(5), 351-356.*

Demide, C.O. (2011) Effect of Previous Knowledge on Students Cognition, Comprehension and achievement in Some Content Areas in Chemistry. Unpublished Ph.D thesis,Abubakar Tafawa Balewa University, Bauchi.

Dumas, A. (2003), *Cooperative learning:* A response to diversity. Retrieved March, 16, 2012 from http://www.cole.ca.gw/iasa/coop

Eilks,T.(2002).Learning at Stations in Secondary Level Chemistry Lesson *Science Education International 3(1), 11 – 18*.

Federal Government of Nigeria (2004) National Policy on Education. NERDC Press Lagos.

Federal Government of Nigeria (2011). National Policy on Science and Technology. NERDC Press Lagos-Lagos.

Ghaith G. (2009). Learners' perceptions of their STAD *Cooperative experience system* 29, (10), 289-301.

Idowu, C. B. (2011). Students' performance in the environmental aspect of integrated science. A case study of Oyo State College of Education, Oyo. *Journal of Science Technology and Mathematics* 1(1), 50-57

Iroegbu, T. O. (2002). Problem-based learning numerical ability and gender as determinants of achievement, problem solving, and line graphing skills in senior secondary Physics in Ibadan. *Unpublished PhD Thesis, University of Ibadan, Ibadan.*

Johnson, D. W. & Ahlergren, A. (1976). Relationship between student attitudes about Cooperative and Competition and attitude toward Schooling. *Journal of Educational Psychology* 68(1), 92 – 102.

Johnson, D. W. & Johnson, R.T. (1989). Cooperation and competition: Theory and Research. Edina, MN: International Book Company.

Kolawole, E. B. (2007). Effects of Competitive and Cooperative learning strategies on Academic performance of Nigeria students in mathematics. *Educational Research Review 3(1), 33-37.*

Nwagbo, C. R. (2006). Effects of Two Teaching Methods on the achievement and attitude to Biology of Students of Different Levels of Scientific literacy. *International Journal of Educational Research* 45 (2), 216 – 229.

Nwoji, Q. J. R. (2000). Improving the teaching and Learning of Introductory Technology through the use of Media. In Akale, A.M. G.(Ed), 41st *Annual Conference Proceedings of STAN on enriching Science Technology and Mathematics education*, 402-405. Ibadan Heinemann.

Ogunkola, B. J. (2002). Instructor – Expressiveness, Student's locus of control and Cognitive entry behaviour as determinants of Students achievement in and attitude towards Biology. *Unpublished Ph.D. Thesis, University of Ibadan. Ibadan.* 65-69.

Ogunsola Bandele, M. F. & Osisioma, I. (2007). Preparing for the 21st Century Classroom-moving. Towards the Use of Cyber space as a Technology - Based Information Source. Proceeding of NARST (2009) Annual Conference Graden Groove Carlifornia.

Okebukola, P. A. O. (2002). Introduction. In Adeyegbe, S. 0, Akpan, B.B, Adenuga, I. J, Pele, S.F, Umar, B and Okebukola P. A. O. Catch up Chemistry for SSCE and UME. Heinemann Educational Books Ibadan Nigeria

Okoronka, A. U. (2004). Model based instruction, Cognitive style, and quantitative ability as determinant of students learning outcomes in secondary school physics in Lagos state. *Unpublished Ph.D Thesis. University of Ibadan. Ibadan*.

Okoronka, A. U. &, Ogunsola – Bandele, M. F.. (2008). Making the teaching and learning of Wave concepts fun using Analogical model. *Science Teacher Association ofNigeria. Proceeding of the 49th Annual Conference 2008.*

Oloyede, O. I. (2008). The Effect of Enhanced Feedback strategy on Integrated Science Achievement. The Jos Journal of Education. 3, 17 - 18.

Oloyede, O. I. (2009). A Meta – Analysis of the Effect of Advanced Organisers on Acknowledgement and Retention of SSS Chemistry. International Journal of Educational Sciences. 2. 1 -5

Oloyede, O. I. 7 Adeoye, F.(2009). Comparative Effect of the Guided Discovery and Concept Mapping Strategies on SSS Chemistry Achievement in Nigeria. Eurassian Journal of Physics & Chemistry Education. 1 (2) 86 – 92 http://www. Eurassianjournals.com.

Oloyede, O. I. & Ogunsola `Femi (2011). The Relative Effects of Model – Based Instructional Strategies on Nigerian Attitude Towards Chemistry. JOLORN 13, (2) 23 – 27.

Oloyede, O. I. & Omole, C. O.(2013). Effect of Previous Knowledge On Students Cognition Some Content Areas in Chemistry. Eurasians Journal of Physics & Chemistry. 5 (1) 71 79.

Onyia, C. R. Osisioma, I. U Ogunbandele. M. (2009). Capturing Urban middle School students voice on the use of science inquiry in their classroom. *Proceedings of NARST 2009 Annual conference* Garden Groove California.

Orankotan, A. F. (2004). Meta-cognitive Instructional Strategies of framing and rehearsals on students' learning outcome in secondary school Genetics. *Unpublished Ph.D. Thesis, University of Ibadan. Ibadan*

Oyekan, S. O. (1993). Diagnosis of Students Weakness.: A Conceptual Framework for Remediation of Underachievement in Science. *Journal of Science Teachers Association of Nigeria* 28(1), 82 – 90.

Piaget, J. (1970). Piaget's Theory. In PH Mussen (Ed.) Carmichael's Manual of child's Psychology (3rd Ed.) 1. New York Wiley.

Slavin, R. E. (1996). *Research on Cooperative learning and achievement: what we know, what we need to know.* Retrieved September, 26, 2011 from *http://www successful.com/resource/Research/cooplearn.html* 1 – 20.

Slavin, R. E. (2011). Instruction Based on Cooperative Learning. In R. E. Mayer & P. A. Alexander (Eds) handbook of Research on learning and instruction. New York: Taylors Francis.

Smith, P. (2007) A review of Science in Secondary Schools in England. *Teaching Science 22(3), 123-124.*

Stahl, R. (2003). From "Academic strangers" to successful members of a cooperative learning group: An inside the learners Perspective. In cooperative learning in the social studies classroom: An invitation to social study-Washington. D.C. National Council for the social studies.

Stanne, M. E. (2000). Effects of Small group learning on Undergraduate in Science, Mathematics, Engineering,and Technology: A Meta-Analysis. National Institute for Science Education: Madison, Wi, *http://www.wier.wisc.edu/nise/cli/ cllresourc/Rzhtm*. (Accessed May 26, 2011).

Trans, V. D. & Lewis, R. (2012) the effect of cooperative learning on students at Giang University in Vietnam. *Internal Education Studies* 5(1), 86-99.

Tsai, C. C. (2000). Enhancing science instruction: The use of conflict maps. International *Journal of Science Education* 22 (3), 285-302.

Von, S. C. (2002). Effects of Inquiry based Teacher Practices on Sciences Excellence and Equity. *Journal of Educational Research* 69(1), 24-30.

Vygotsky, L. S. (1978). Mind in Society. In Cole, M. John-Steiner, V. Scribner, S aSouberman, E (eds) Cambridge, M.A: Harvard University press.

Wyk, M. (2010) The effect of Students Team Achievement Division (STAD) on achievement, retention, and attitudes of Economic education Students, University of Free State, South Africa 2010 EABR ERLC Conference proceedings, Dublin Ireland