

# Effect of Cooperative Learning Strategy on Students' Academic Achievement in Mathematics in Senior Secondary Schools in Mubi Educational Zone, Adamawa State, Nigeria

Dr. Marcel P. Agah<sup>1</sup> and Ezekiel, Saratu Midankiya<sup>2</sup>

<sup>1</sup>Department of Science Education, Adamawa State University, Mubi, Nigeria

<sup>2</sup>Mubi North Local Education Authority, Mubi Adamawa State, Nigeria

**Abstract:** The study investigated the effect of the cooperative learning approach on students' academic achievement in Mathematics in senior Secondary Schools in Mubi Educational Zone, Adamawa State. The study adopted quasi – experimental design. The estimated Population for the study was 11,987 male and female students. Four schools were selected using simple random sampling without replacement techniques. The intact classes used constituted the Experimental group taught Mathematics by cooperative learning strategy (130), while the other two intact classes formed the control group taught Mathematics by Lecture method (132). The instrument for the study was Mathematics Achievement Test (MAT) adopted and constructed by the researcher. The reliability index of 0.80 was obtained using Cronbach's alpha statistics. Data was analyzed using independent sample t-test statistics to test the hypotheses raised. The findings of this study revealed that there was significant difference in the mean scores of students taught Mathematics using Cooperative learning strategy and lecture method(  $t = 10.04, df = 260, p < 0.05$ ). There was no significant difference in the retention rate of students taught Mathematics using Cooperative learning strategy and lecture method(  $t = 1.51, df = 260, N = 262, p > 0.05$  ). There was no significant gender difference in the students taught Mathematics using Cooperative learning strategy in the study area(  $t = - 65, df = 128, N = 130, p > 0.05$  ). Based on the findings of this study, it was recommended among others that Mathematics teachers should incorporate cooperative learning strategy with other instructional approaches in lesson delivery in order to improve students' ability in the learning and understanding of Mathematics in senior secondary schools.

**Key words:** Paradigm shift, Cooperative Learning, Constructivism, Academic Achievement, Reflective Thinking, Cognitive Skills, Mathematics and problem-solving.

## I. INTRODUCTION

In educational researches, the use of instructional strategies of teaching and learning forms a major topic of discourse. Educators have advocated for a paradigm shift from traditional talk and chalk approach of teaching /learning to an all engagement of students in teaching and learning process (learner – centered. The particular interest is the observation that poor instructional approaches are used in the classroom. Learners are often subjected to the conventional method of

instruction, which is referred to as authoritarian pedagogical approach. Therefore, there is the need to look for effective and innovative instructional strategies that will promote effective teaching and learning outcomes of students in Mathematics.

Cooperative learning strategy is one of such innovative instructional techniques that could be used by teachers to promote effective teaching learning outcomes of students in Mathematics. It is also an innovative strategy of problem solving where students sit in group and contribute ideas spontaneously and proffer solutions to those problems. Cooperative learning strategy elicits higher level of reflective thinking and creative problems solving including synthesis, application and evaluation. Students' interaction is important for developing cognitive skills involved in generating ideas towards the solution to the problem. Cooperative approach is a tool used by team to bring out the ideas of each individual and present them in an orderly fashion to the rest of the team. The key ingredient is to provide an environment free of criticism for creative and unrestricted exploration of options or solutions. In cooperative teaching and learning, Students are asked to: think carefully about the questions and answers, pair partner, share answers with a partner, and prepare to share both answers with the entire class.

The quality of education that teachers provide to students is dependent upon what teachers do in their classroom (Iksan & Zakaria, 2007). They find it easier to merely tell the students what they need to be told and expect them to sit still, do their work, memorize and repeat. This teacher-led method to education is what Freire (2009) calls the banking concept in education. Here, the knowledge is passed down by the 'all knowing' teacher to empty vessels who will regurgitate the knowledge.

The teaching method used in the class is one of the factors that make students become passive and have less interaction with each other in doing tasks. It is believed that most people favour some particular method of interacting with, and processing information thereby exhibiting distinctive behaviors suitable to allow them to learn. For quite some time

now, educators in all fields most especially mathematics are becoming increasingly aware of the critical importance of understanding how individuals learn, because this impacted the teaching strategies on academic performance and learning outcomes (Bandura, 2006).

Learning styles refer to how individuals process, focus, make information meaningful, and gain new information in order to translate it into building new skills. Learning style is a stable preference that is used by individuals to effectively organize, then process and develop their understanding of any learning challenge, task or situation. The general consensus here is that there exists a multitude of learning styles.

Similarly, just as the learners learn in different ways, so also teachers teach in different ways. In fact, effective teaching requires flexibility, creativity and responsibility in order to provide an instructional environment able to respond to the learner's individual needs and the attainment educational outcomes (Fayombo, 2014). Moreover, most students learn best when the style of presentation is aligned with their preferred learning style.

Consequently, the term "Learner-centered instruction" is used frequently to describe efforts to "move away from instructional methods that relied on mass transmission of knowledge" (Paris & Combs, 2006) toward a more constructivist, inquiry-based approach. Student-centered learning is more focused on developing these skills rather than transmitting knowledge, and utilized correctly in mathematics courses could encourage independent thinking (Polya on, 1971, as cited in Boaler, 2008). According to American Psychological Association (1997), Student-centered learning, also known as learner-centered education, broadly encompasses methods of teaching that shift the focus of instruction from the teacher to the student. In original usage, student-centered learning aims to develop learner autonomy and independence by putting responsibility for the learning path in the hands of students.

The level to which student-centered pedagogical approaches have a positive impact on meaningful student learning naturally depends on other factors, which include the number of students and the student-staff ratio within any given secondary (Tsui, 2002). Furthermore, the notion of a multi-step approach to delivering tasks related to student work also needs to be examined, on the premise that a critical analysis of the steps leading to learning is necessary in any discussion on student learning.

Constructivism is a theory of learning and an approach to education that lays emphasis on the ways people create meaning of the word through series of individual construct which gives room to the active involvement of students in learning. Vygotsky, 1978 claimed that all reality is a narrative construction in the imagination of individual which leads to self-directed, creative and innovative. The learners should discover their own truths about the world. He believed that instructors and learners are equally involved in the learning

process. Piaget theory of cognitive development proposed that humans could not be "given" information which they immediately understand and use. Instead, humans must "construct" their own knowledge through the processes of assimilation and accommodation (Omototse 2014). In line with this, Matthews (2000) contends that "constructivism is undoubtedly a major influence in contemporary science and mathematics education". In essence, constructivism is described as a learning theory that claims that: "knowledge is not passively received, but is actively built up by the cognizing subject"; and "that the function of cognition is adaptive and serves the organization of the experimental world" (Matthews, 2000). Carr, Jonassen, Litzinger and Marra (1998) also mentioned that constructivism emphasizes learner activity. Thus, from a constructivist perspective, knowledge is not passively received from the world, from others, or from authoritative sources. Rather, all knowledge is created as individuals (and groups) adapt to and make sense of their experiential worlds (MacLellan & Soden, 2007).

Cooperative learning refers to a method of instruction whereby students work together in groups to achieve common goals. In contrast to the Lecture method, where students work individually or competitively, with cooperative learning students help one another and benefit from sharing ideas. It is the instructional strategy used in small groups so that students work together to maximize classroom learning and accomplish shared learning goals. It is a strategy by which small teams, each with students of different levels of ability are engaged in learning activities to improve their understanding of a subject, and how learners construct knowledge as a process of making sense and giving meaning. (Aronson 2002, Ifamuyiwa & Akinjola 2008), has noted that cooperative learning approach encourages listening, engagement and empathy by giving each member of the group an essential part to play in academic activity. This cooperation by design facilitates interaction among all the students in the class, leading them to come to value each other as contributors to their common task. This implies that, cooperative learning is a process of interaction among peers in order to reach a common learning goal.

Agah (2015), conducted a study on the influence of bilingual instruction on Mathematics performance of Margi speaking junior Secondary School Students in North-Eastern Nigeria and found that Significant differences exists in the Academic Achievement of Male and Female Students. John and Benjamin (2015) conducted a study on gender differences in Mathematics achievement and retention scores: a case of Problem-Based Learning (PBL) method. The study revealed that male and female students taught algebra using PBL did not significantly differ in achievement and retention scores, thereby revealing that male and female students are capable of competing and collaborating in Mathematics. Beside this, inconsistent findings have been discovered on gender differences and academic achievement (Olowe, 2010). Effective problem solving is an opportunity to move forward,

rather than mitigate a setback. If you approach it in that light, your solution changes, your process changes and so does your team dynamic. As a leader or manager, consider identifying the strengths and weaknesses of your team as they relate to this issue. Start tackling problems as a powerful team and create a competitive advantage for your organization (Lubienski, 2000).

Hence, the aim of this research is to assess whether the application of cooperative learning strategy or approach in the teaching/ learning of Mathematics can produce differential academic achievement among senior secondary school students.

#### *Statement of the Problem*

Mathematics is seen by the society as the foundation of scientific technological knowledge that is vital in socio-economic growth and development of a nation. Despite the importance of Mathematics in the life of human beings, the performance of the students in Mathematics does not impress the societies; this may be due to the method of teaching used by the teachers. The role of a teacher is to find a means of improving the academic achievement of the students in his / her area of specialization that will lead to the fast growth and development of the nation. Also, professional teachers must have a sound knowledge of the pedagogical approach which empowers them to deliver the subject successfully. To achieve this, the study intends to cover effects of cooperative learning approach on students' academic achievement in mathematics in Senior Secondary Schools in Mubi Educational Zone, Adamawa State, Nigeria.

#### *Purpose of the Study*

The main purpose of this study is to determine the effect of the cooperative learning approach on students' academic achievement in Mathematics in senior Secondary Schools in Mubi Educational Zone, Adamawa State. The specific objectives are to determine;

#### *Research Hypotheses*

The following null hypotheses were tested at 0.05 level of statistical significance.

$H_{01}$ : There is no significant difference in achievement scores between students taught Mathematics using the cooperative learning strategy and those taught using traditional teaching method in senior secondary schools in Mubi educational zone, Adamawa state, Nigeria.

$H_{02}$ : There is no significant difference in the retention rate between students taught Mathematics using the cooperative learning strategy and those taught using the traditional teaching method in senior secondary schools in Mubi educational zone, Adamawa state, Nigeria.

$H_{03}$ : There is no significant difference in achievement between male and female students taught Mathematics by

using the cooperative learning strategy in senior secondary schools in Mubi Educational Zone, Adamawa state, Nigeria.

## II. RESEARCH DESIGN

The research design adopted for this study is Quasi-experimental research design, which includes; pre-test, post-test and non-equivalent control group design using intact classes. The design consists the treatment group and a control group. Pre-tests was used to determine the equality and the entry behavior of the two groups, two selected Schools from the Mubi Educational Zone was used for experimental and control groups, which give the total number of four schools. The design is represented as follow;

$$\begin{array}{ccc} O_1 & X_1 & O_2 \\ O_3 & X_2 & O_4 \end{array}$$

Where

$O_1$  and  $O_3$  are the pre-test scores for the two groups (Experimental and Control)

$O_2$  and  $O_4$  are the post-test scores for the two groups.

$X_1$  = Experimental treatment using the cooperative learning approach

$X_2$  = Treatment to the Control group, which was subjected to the traditional (Lecture) Method.

#### *Population*

The target population for this study was 11,987 consisting of all SSII students from the Fifty-nine (59) Government Senior Secondary Schools in Mubi Educational Zone ( Mubi North ,Mubi south, Maiha, Michika and Madagali Local Government Area) Adamawa State, Nigeria.

#### *Sampling Technique*

Simple random sampling technique was used through balloting without replacement for selecting two out of the five Local Government Areas in Mubi Educational zone so that each Local Government Area will have equal chance of being part of the sample to avoid bias. Four schools were selected from the Sampled Local Government Areas in the urban area using Purposeful and Simple random sampling technique of which two schools was used for experimental group and two for the control group. Intact classes stream was used for instructions and assessments in all the selected Schools.

#### *Instrumentation*

The data for the study was collected from the students through Mathematics Achievement Test (MAT) picked from past 2013 – 2017 NECO and WAEC questions, while other questions were constructed by the researcher. The construction of the MAT instrument was based on the topic that was taught by the researcher or research assistance to the experimental and control groups. The selection of the topic/contents for this study was from the curriculum of the SSII syllabus in Mathematics, which was based on three

content areas namely; (i) Logarithm Equation (ii) Quadratic Equation (iii) Progressive Equations. The research instrument consists of sections, namely; section A is the Demographic data, section B is the objectives part and section C is the essay part. The objectives part contains thirty questions to answer all and the essay part contains six questions to answer any four. The marks allocated to objectives 30% and to the essay questions were 70% respectively.

*Validation and Reliability*

The instrument was validated by experts in Mathematics Education and pure mathematics with a reliability coefficient of 0.80. The Mathematics Achievement Test (MAT) was administered by the researcher and the research-assistants to the respondents in each of the sampled schools and was collected back immediately.

*Method of Data Analyses*

Independent t-Test statistics was used for the analysis of data. The null hypotheses are tested at 0.05 level of significance.

**III. RESULTS**

*Ho<sub>1</sub>*: There is no significant difference in the achievement scores between students taught Mathematics using the Cooperative Learning Strategy (CLS) and those taught using traditional Lecture Method (LM) in senior secondary schools in Mubi educational zone, Adamawa State-Nigeria.

Table 1: Summary of t-Test Analysis of Students' Post Test Scores in Mathematics Based on groups

Source	N	Mean	Mean Difference	SD	Df	t	Sig. (2-tailed)
Exptal Group	130	31.05	13.56	13.59	260	10.04	.000
Control Group	132	17.48		7.44			

Significant;  $p < 0.05$ .

The analysis in Table 1 shows that there is significant difference in the mean scores of students taught mathematics based on the learning methods ( $t = 10.04$ ,  $df = 260$ ,  $p < 0.05$ ). This result clearly indicates that the alternative hypothesis is supported, which means that there is significant difference in the achievement scores between students taught Mathematics using the Cooperative Learning Strategy (CLS) and those taught using traditional Lecture Method (LM) in senior secondary schools in Mubi educational zone, Adamawa State-Nigeria since they differ significantly in their achievements scores.

*Ho<sub>2</sub>*: There is no significant difference in the retention rates scores between students taught Mathematics using the Cooperative Learning Strategy (CLS) and those taught using traditional Lecture Method (LM) in senior secondary schools in Mubi educational zone, Adamawa State-Nigeria.

Table 2: Summary of t-Test Analysis of Students' Retention Test Scores in Mathematics Based on groups

Source	N	Mean	Mean Difference	SD	Df	T	Sig. (2-tailed)
Exptal. Group	130	47.87	13.56	3.96	260	1.51	.133
Control Group	132	47.23		2.76			

Not Significant;  $p > 0.05$ .

Table 2 reveals that there is no significant difference in the retention rates scores between students taught Mathematics using the Cooperative Learning Strategy (CLS) and those taught using traditional Lecture Method (LM) in senior secondary schools in Mubi educational zone, Adamawa State-Nigeria. ( $t = 1.51$ ,  $df = 260$ ,  $p > 0.05$ ). This implies that both the Cooperative Learning Strategy (CLS) and traditional Lecture Method (LM) to an equivalent extent have almost same retention rates scores due to repetition of same question after the pre- test.

*Ho<sub>3</sub>*: There is no significant difference in the achievement test scores between male and female students taught Mathematics using the Cooperative Learning Strategy (CLS) in senior secondary schools in Mubi educational zone, Adamawa State-Nigeria.

Table 3: Summary of t-Test Analysis of Students' Achievement Test Scores in Mathematics Based on Gender.

Source	N	Mean	Mean Difference	SD	df	T	Sig. (2-tailed)
Male	69	30.32	2.39	14.03	128	-.65	.518
Female	61	31.87		13.14			

Not Significant;  $p > 0.05$ .

Table 3 exhibits that there is no significant difference in the achievement test scores between male and female students taught Mathematics using the Cooperative Learning Strategy (CLS) in senior secondary schools in Mubi educational zone, Adamawa State-Nigeria ( $t = -.65$ ,  $df = 128$ ,  $p > 0.05$ ). This implies that both gender (male and female) an equivalent extent have almost same achievement scores in mathematics that failed to produce significant statistical difference. The result obtained implies that gender is not a determinant of high achievement scores in mathematics but other factors like ability of the teacher to impart knowledge, learning environment and the students' ability and intelligence quotient on the other hand..

**IV. DISCUSSION OF FINDINGS**

Result of data analysis shows that students taught Mathematics using the Cooperative Learning Strategy (CLS) performed significantly better than those taught using traditional Lecture Method (LM). This result is in agreement

with the result of prior studies established by Adeyemi (2008), Effendi and Zanaton (2007) who reported that an experimental group of students who were instructed through cooperative learning approach showed significantly higher scores in a mathematics achievement test and problem solving skills than a controlled group that was instructed through the traditional lecture method. Also, a study by Zakaria, Lu Chung, & Daud (2010), found that cooperative learning improves students' achievement in mathematics. Further, cooperative learning is an effective approach that mathematics teachers need to incorporate into their teaching. Leonard (2001), showed that cooperative learning was effective for low and middle-achieving students.

It has been observed in this study that the Cooperative Learning Strategy had no significant effect on students' retention of mathematics. The findings support similar works of John and Benjamin (2015): who found that the difference in the mean post retention test scores was not significant on innovative methods that aid retention but do not agree with the findings by, Nworgu (1996), who found significant effect on students' retention. The fact that the Learning Activity Package helped students to retain more, may be because it is activity-packed and students were allowed to interact with the learning materials promoting meaningful learning and not rote learning (Hake, 1998). When the materials learnt are meaningful, they tend to be stored in the long term memory.

It has also been established in this study that there is no significant difference in the achievement test scores between male and female students taught Mathematics using the Cooperative Learning Strategy (CLS). This finding is in parity with that of John and Benjamin (2015), who revealed that male and female students taught algebra using PBL did not significantly differ in achievement and retention scores, thereby revealing that male and female students are capable of competing and collaborating in mathematics. Kirkpatrick and Cuban (1998), also concluded that when male and female students at all level of education had the same amount and type of experiences on computer, female achievement scores and attitudes are similar in computer classes and classes using computer. Also, Spencer (2004), found no significant influence of gender on the achievement of college students in mathematics when they were exposed to mathematics courseware in online and traditional learning environment. In addition, this finding showed that performance is a function of orientation, not gender. This could be attributed to the fact that the activities in the Learning Activity Package are carried out by the students themselves, at their own pace during and after the school period, so this has given both the male and female students chances of performing equally. On the other hand, the mean achievements score of female students being slightly better than their male counterparts can be associated with social attachment that what a man can do, a woman can do even better though naturally, males are more science incline than female.

On the contrary, the finding of this study disagrees with that of Agah (2015), who conducted a study on the influence of bilingual instruction on Mathematics performance of Margi speaking junior Secondary School Students in North-Eastern Nigeria and found that Significant differences exists in the Academic Achievement of Male and Female Students. In-line with this, Fabunmi (2004), also discovered that gender composition has a significant relationship with students' academic performance and that of gender composition has a significant influence on secondary school students' academic performance. Therefore, it has been observed that, the issue of Students' academic achievement in Mathematics and other subjects based on gender is inconsistent or flexible, depending on the outcome of the study and this agrees with (Olowe, 2010 ) who states that, inconsistent findings have been discovered on gender differences and academic achievement.

## V. CONCLUSION

This study established that the Cooperative Learning Strategy was more effective than the traditional lecture method of students' achievement in Mathematics despite the similarity in the retention rate in Mathematics. The mean achievement score of the male students was found to be slightly less than their female counterpart using CLS even though there was significant difference in the achievement of Mathematics between the treatment and control groups. On the same note, the mean retention score between students taught Mathematics using the Cooperative Learning Strategy (CLS) and those taught using traditional Lecture Method (LM) was not significantly different. In the same vein, the result obtained in this study implies that gender is not a determinant of high achievement scores in mathematics but other factors like ability of the teacher to impart knowledge, learning environment and the students' ability and intelligence quotient on the other hand.

## VI. RECOMMENDATIONS

In view of the results obtained at the course of this study, the following recommendations are made:-

- Government and relevant professional bodies like Science Teachers Association of Nigeria (STAN) should organize mandatory seminars and workshops to educate and sensitize the serving Mathematics teachers on the profound need for employing the Cooperative Learning Strategy to make teachers to be accustomed and familiar with especially when teaching and learning Mathematics.
- Government agencies and professional associations whose primary responsibility is to design and revise the curriculum for secondary schools should as a matter of urgency incorporate, emphasize and enforce the use of Cooperative Learning Strategy in the teaching of senior secondary schools Mathematics.

- Government agencies and professional bodies like NERDC and STAN should sponsor researches related to Cooperative Learning Strategy in enhancing achievements in other classes of senior secondary schools Mathematics. This can further be sustained when Government, through the local agencies, State and Federal ministries of education should encourage the Mathematics textbook writers by giving them special fund to publish Mathematics textbooks on the Cooperative Learning Strategy.
- Finally, it has been observed that there were no Mathematics teachers in most of the schools in the study area, it was economic, Geography and Government teachers that were used to teach Mathematics then later on they hand it over to the N-Powers who usually considered to be part-time teachers. Therefore, government should employ Mathematics teachers for better academic achievement of the subject in the state and nationwide.

#### REFERENCES

- [1] Adeyemi, B .A. (2008). Effects of cooperative learning and problem solving strategies on junior secondary school students' achievement in social studies. *Elect.Journal ResearchEducation Project*, 16(3),69 –708.
- [2] Agah, M. P. (2015). Influence of bilingual instruction on Mathematics performance of Margi speaking junior secondary school students in Borno and Adamawa State, Nigeria. An Unpublished Ph.D Thesis Submitted to the Department of Science Education, Faculty of Education, Adamawa State University, and Mubi.
- [3] Aronson, E. (2002). Building empathy, compassion and achievement in the Jigsaw classroom in improving academic achievement; Impact of Psychological Factors. New York: Academic Press.
- [4] Bandura, A. (2006). Guide for constructing self-efficacy scales. In F. Pajares, & T. Urdan (Eds.), *Self-efficacy Beliefs on Adolescents* (7). Greenwich, CT: IAP Information Age Publishing.
- [5] Boaler, J. (2008). What's Mathematics Got to Do with It? How Parents and Teachers Can Help students in the learning of mathematics?
- [6] Carr, A. A., Jonassen, D. H., Litzinger, M. E. & Marra, R. M. (1998). Good ideas to foment educational revolution: the role of systemic change in advancing situated learning, constructivism, and feminist pedagogy. *Educational Technology*, 5-15.
- [7] Fabunmi , M. (2004). The role of gender on secondary school student' academic performance in Edo state, Nigeria .*West African journal of Education*,24(1): 90 – 93.
- [8] Fayombo, P. O. (2014). Reshaping teaching and learning: The transformation of faculty pedagogical content knowledge'. In: *Higher Education*, 51(4):619-647.
- [9] Freire, P. (2009). *Pedagogy of the oppressed*. (Chapter 2, 27-56) New York:
- [10] Hake, R. R. (1998). Interactive-engagement versus traditional methods: a six-thousand learner survey of mechanics test data for introductory physics courses. *American Journal of Physics*, 66(1):64-74.
- [11] Iksan, Z. & Zakaria, E. (2007). Promoting cooperative learning in science and mathematics education. *Journal of Mathematics, Science and Technology Education*. 3(1), 35-39.
- [12] John, T. A. & Benjamin, I. I. (2015).Gender differences in mathematics achievement retention scores. Case of problem-Based learning method .*International journal of research in Education and science*,1 (2): 45 – 50.
- [13] Kirkpatrick, H. & Cuban, and L. (1998) .Should we are worried? What the research says about gender differences in access, use, attitudes and achievement with computers .*Educational Technology*, 38(4): 56 – 60.
- [14] Leonard, J. (2001). How group composition influenced the achievement of sixth grade Mathematics students. *Mathematical Thinking and Learning*, 3(2&3), 175-200.
- [15] Lubienski, S.T. (2000). Problem solving as a means toward mathematics for all: An exploratory look through a class lens. *Journal for Research in Mathematics Education*, 31(4): 454-482.
- [16] Maclellan, E. and Soden, R. (2007). 'The significance of knowledge in learning: a psychologically informed analysis of higher education students' perceptions'. *International Journal for the Scholarship of Teaching & Learning*, 1(1):1-18.
- [17] Mathews, M. R. (2000). Constructivism in science and mathematics education. In D.C. Phillips (ed.), *National Society for the Study of Education*, 99th Yearbook:161-192. Chicago: Chicago University Press.
- [18] Olowe, T.T.( 2010). Effect of computer animation and instructional model on the performance of students in senior secondary school biology in Minna metropolis unpublished ph.D. Thesis, University of Ilorin.
- [19] Nworgu, B. G. (1996, August 12 – 17). Teaching for ConceptualUnderstanding Physics: A Conceptual – Change InstructionalModel. A Lead Paper Presented at the 37th Annual Conference of STAN held at Uyo.
- [20] Omototse, B. A. (2014) , *Educational Psychology :Essential foundation for teaching*.
- [21] Paris, L. & Combs, K. (2006). The evolution of a collaborative concept mapping activity for undergraduate microbiology students.*Journal of Further and Higher Education*, 29(1): 1-14.
- [22] Spencer, D. J. (2004).Engagement with mathematics course ware in traditional and online learning environments: Relationship to motivation, achievement gender and gender orientation .Unpublished dissertation, Graduation school of Emory University. Emory.
- [23] Tsui, L. (2002). 'Fostering Critical Thinking through effective pedagogy: Evidence from Four Institutional Case Studies'. *The Journal of Higher Education*, 73(6):740- 763.
- [24] Vygotsky, L. S. (1978). *Mind in society*. (Trans. M. Cole). Cambridge, MA: Harvard University Press.
- [25] Zakaria, E., Lu Chung, C., &Daud, M. (2010). The effects of cooperative learningon students' mathematics achievement and attitudes toward mathematics.*Journal of Social Sciences*, 6(2): 272-275.