

**A COMPARATIVE STUDY OF COOPERATIVE AND CONVENTIONAL
LEARNING STRATEGIES ON ACADEMIC ACHIEVEMENT OF
STUDENTS IN BIOLOGY**

By

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Abstract

The study compared the effect of Cooperative and Conventional learning strategies on academic achievement of senior secondary students in the Federal Capital Territory, Abuja, Nigeria. The study adopted the pre-test- post-test quasi-experimental design. The population comprised 27, 160 senior secondary school students (SS 11) in four public co-educational schools from which a sample size of 379 was drawn through a random sampling technique. Instrumentation was a Biology Achievement Test (BAT). Findings revealed a significant difference between the mean pre and post-test scores of students taught Biology through cooperative learning strategy; a significant difference between the mean pre and post-test scores of students taught using conventional learning strategy; a significant difference in achievement mean score in a post-test in Biology between students taught using cooperative and those taught using conventional learning strategies. It was therefore recommended amongst others, that workshops and seminars be organized on the operating procedure of cooperative learning strategy for teachers in Abuja.

Keywords: Cooperative learning strategy, Conventional learning strategy, academic achievement

1.0 Introduction

Dating back to the missionary and colonial eras (Hashimi, 2018), Education Ordinances did not reflect the conditions and aspirations of the Nigerian people for future development (Hamilton-Ekeke, Dorgu, and Ebiere, 2015) as curricula were deficient in content and methods (Brown, 2015). Today's transformation is rapid. Science and technology have become development indicators, and education is said to build the human capital needed for economic growth. In keeping with the dynamics of social change and the demands on education, the National Policy of Education has been reviewed in its 4th edition to introduce Information and Communication Technology (ICT) into the school curriculum, reposition Science, Technical and Vocational education in the scheme of national education for optimum performance (Agbetuyi and Oluwatayo(2012).

At the 'heart' of science, is Biology. It provides answers to large scale problems and answers fundamental questions about life as well as paves the way to scientific investigation and many professions. It's curriculum, like other science subjects, is activity-oriented and student- centered. Field studies, guided discovery, laboratory techniques are some of the teaching methods recommended for science teaching. However, studies indicate that Science teachers are poorly trained in content and pedagogy (Samba,Achor,Josiah and Ogbeba,2010),as most teachers adopt *conventional method* or teacher-centered approach (Babajide, 2015), where instructors initiate discussions in the classroom and focus is on knowing content in books. The students receive the information passively and reiterate the information memorized in examinations (Chopper, 2010). This strategy makes grasping some scientific concepts, skills, and principles difficult for students (Lindsay, 2011). It does not involve students in active learning; does not promote insightful learning and long-term retention of some abstract concepts in Biology (Ahmed and Abimbola, 2011; Umar, 2011). This strategy contradicts the cooperative learning class. With *Cooperative Learning Strategy*, students work cooperatively in small heterogeneous groups. The strategy is characterized by learners' positive dependence on each other towards the attainment of group goals (Uwameiye, 2016). It is grounded in the belief that learning is most effective when students are actively involved and work cooperatively to complete academic tasks (Lewis, 2019). Positive interdependence, Face-to-face Interaction, Individual accountability, Interpersonal social skills development, group processing are the basic elements of cooperative learning strategy (Johnson and Johnson, 2012). Higher academic achievement and retention; critical and social skills development, appreciation of individual differences of learners; increased participation; increased motivation to working together are some of the benefits of the strategy. Additionally, it increases self-awareness, self-esteem, and confidence; reduces anxiety, and helps the development of better attitudes toward teachers, and school (Ismail and Allaq,2019).

1.1. Theoretical framework

Five theories lend support to this study. First, conventional learning strategy is supported by *Behavioral learning theory* which postulates that learning is affected by changes in the environment (Weeger, 2012); that one's behavior is the result of environmental factors (Filipatali,2013);that humans are born as blank slates (tabula rasa), learn everything from the environment and that social norms shape our personality. It also holds that learning is achieved through two types of conditioning- *classical* conditioning (through association), and *operant* conditioning through reinforcement which could be positive or negative (Britwum, 2014). In the learning process. therefore, a behaviorist teacher enforces a lot of practices, encourage rote learning through drills; assess the mental or emotional state of the student and respond to them;

makes clear, the lesson objectives and frame them around behaviors, as a change in behavior is evidence that learning has taken place (Britwum, 2014).

Cooperative learning strategy on the other hand is supported by four (4) theoretical perspectives. These are the *Cognitive Development Theory* of Vygotsky and Piaget that emphasizes an interactive, cooperative and learner-centered approach to learning (Tran,2013); *Social Learning Theory* of Albert Bandura, which holds that people learn more by observing and imitating desired behavior (Tran,2013); *Constructivist Learning Theory* of Brunner which holds that learners are in control of own learning construction in an active, social and creative way; *Social Interdependence Theory* (Johnson & Johnson, 2005) which holds that learners help each other learn because they care about group members; derive self-identity benefits from group membership (Tran, 2013). It is associated with the degree to which actions of one person substitutes for the actions of another person, the openness to being influenced and to influence others, and the investment of psychological energy in objects outside of oneself (Johnson and Johnson,2009). In essence, how goals are structured determines how individuals interact, and interaction patterns, create outcomes.

This present study involved the Jigsaw 11 model of cooperative learning strategy and the 'modified lecture method' (characterized by the teacher being the sole resource person, and intermittently introduces some elements of Demonstration and Questioning in the course of the lecture).

1.2 Statement of the problem

Biology is a component of the senior secondary school curriculum. Academic achievement of students in Biology in both internal and external examinations has been on the daily decline (Boyi, 2013). Achievement in Biology WAEC examinations for the periods: 2009, 2010, 2011, 2012, 2013, indicate percentage decline of 51.9%, 53.7%, 55.9%, 58.1% and 59.7% respectively (Chief Examiners' Report, 2013). This consistent decline has become worrisome. What could be responsible for this? Could it be as a result of the poor method of teaching; urban-rural school location; or that boys are more inclined to sciences than girls?

2.0 Methodology

The study adopted a pre and post-test quasi-experimental design, as it aimed at estimating the causal impact of an intervention on the target population without random assignment (White and Sabarwal, 2014).

2.1 Purpose of the Study

Studies that compared the effect of both learning strategies abound. These include those by Trans (2014); Timayi, Bolaji, and Kajuru (2015); Uwameiye (2016); Jimoh, Idris, and Olatunji (2016). These indicate a higher academic achievement of cooperative learning strategy relative to conventional learning strategy. While studies by Perveen, Mohamood, and Arif (2011) indicate that cooperative learning strategy is not more effective than conventional learning strategy. However, studies are yet to be conducted on senior secondary school students' performance in Biology in the Federal Capital Territory

(FCT), Abuja

The specific objective of the study was to investigate comparatively, the effect of cooperative and conventional learning strategies on senior secondary school students' academic achievement in Biology in the Federal Capital Territory (FCT), Abuja, Nigeria.

2.2 Research Questions

Based on the purpose of the study, the following research questions were raised:

- (i) What would be the pre and post-test achievement of senior secondary school students taught Biology using the cooperative learning strategy in the Federal Capital Territory, Abuja?
- (ii) What would be the pre and post-test achievement of senior secondary school students taught Biology using conventional learning strategy in the Federal Capital Territory, Abuja?
- (iii) What would be the effect of cooperative and conventional learning strategies on students' academic achievement in a post-test in Biology in the Federal Capital Territory, Abuja?

2.3 Research Hypotheses

The following null hypotheses were formulated and were tested at 0.05 level of significance. H_{01} : There is no significant difference between the pre and post-test achievement mean scores of students taught Biology using conventional learning strategy.

H_{02} : There is no significant difference between the pre and post-test achievement mean scores of students taught Biology using cooperative learning strategy.

H_{03} : There is no significant difference between the achievement mean scores of students taught Biology using conventional and cooperative learning strategies in a Biology post-test.

2.4 Population of the Study

The population consists of 27,160 SS11 Biology students of the 2017/2018 academic session in 51 co-educational public secondary schools in the six (6) Area Councils of the Federal Capital Territory (FCT). A sample of 379 (181 boys, and 198 girls) was obtained using a simple random sampling technique. Four co-educational schools were selected—two each from urban and rural school locations. From these two locations, two schools were selected and intact classes selected and assigned to experimental and control groups, bringing the number of intact classes to four (4).

2.5 Instrumentation

Biology Achievement Test (BAT), consisting of fifty (50) multiple-choice question types with 4 options was the instrument. It measured the performance of students in both the experimental (cooperative) and control (conventional) learning groups before and after treatment. The content validity of BAT was assured by the use of a table of specification (based on the different levels of objectives of the cognitive domain). Further validation was by two specialists in science education. Using the test-retest technique, and by applying the Pearson- Product Moment correlation coefficient technique, reliability of 0.74 was obtained.

2.6 Data Collection Procedure

Before the commencement of treatment, Teachers who handled the experimental groups were trained on the basic principles of the Jigsaw 11 model of cooperative learning strategy. Students in the experimental groups were made to undertake an orientation program on the concepts of group goals, division of labor, group rewards as well as social skills to foster meaningful interaction. Steps taken to manipulate the independent variables with the experimental and control groups on commencement of treatment are as follows: (a) Experimental Group: Adopting Jigsaw 11 model of cooperative learning strategy, students were assigned to heterogeneous study teams (Homegroups) of three to six members each, and academic materials were broken down into smaller topics or sections and presented to the students. Each member of the Homegroup was responsible for learning the assigned portion. Students from different Home teams but with the same assigned learning portion met with each other in Expert Groups to discuss and help one another learn the common material. After learning their portion of the material in the Expert groups, students return to Home groups to teach home team members what was learned; students were then tested. At the end of each sub-topic, an assignment was given, and at the beginning of the next lesson, the work books in which students did the assignment were collected or exchanged, marked. Any item answered wrongly by students was noted, and corrections were effected at each Homegroup.

(b) Control group: - the first lesson was introductory. Subsequent lessons were taught following teachers' regular manual (conventional learning strategy). A day after the completion of lessons, the BAT post-test was administered to both classes without advanced notice.

2.7 Method of Data Analysis

Data on pre and post-test scores were analyzed using the Statistical Package for Statistics (SPSS) version 20. For the descriptive statistics, Mean and Standard Deviation were used to answer research questions, and for research hypotheses, a paired sample t-test was run to determine whether student's academic achievement was significantly different on the pre and post-tests in the determination of the impact of an intervention.

3.0 Results

3.1 Descriptive Statistics

Table1: Descriptive statistics of pre and post-test achievement of students taught Biology using conventional learning strategy.

Conventional Learning				
strategy	Mean	N	Std. Deviation	Mean Achievement
Pre-test	33.07	188	7.685	31.21
post-test	64.28	188	10.490	

The result in Table 1 showed that the mean pre-test score was 33.1, and the mean post-test score, 64.3 (with an improvement of 31.2 between post and pre-test scores of the students). This result implies that the conventional learning strategy affects the learning of Biology in senior secondary schools in Abuja, FCT.

Table2: Descriptive statistics of pre and post-test achievement of students taught Biology using the cooperative learning strategy

Tests	N	Mean	Std. Deviation	Mean Achievement
Pre-test	191	38.35	10.089	38.49
Post-test	191	76.84	9.952	

The result in Table 2 indicated a mean pre-test score of 38.4 and a mean post-test score of 76.8. The improvement between post and pre-test scores of the students was 38.4, implying that the cooperative learning strategy affects the learning of Biology in senior secondary schools in Abuja, FCT.

Table 3: Descriptive statistics of the achievement of students taught Biology using Conventional and Cooperative learning strategies.

Teaching methods	N	Mean	Std. Deviation	Std. Error Mean
Cooperative learning Strategy	191	76.84	9.952	.720
Conventional learning Strategy	188	64.28	10.490	.765

In comparing the two learning strategies, there was a higher mean score for students that were taught Biology using cooperative learning strategy, ($mean = 76.8$, $SD = 9.95$), than students taught using conventional learning strategy ($mean=64.3$, $SD=10.49$). The mean achievement of students that learned Biology through the cooperative strategy was higher than the achievement of students that learned Biology through conventional strategy.

3.2 Inferential Statistics

Table4: Paired samples t-test result of achievement in Biology between pre and post-test scores of students taught using conventional learning strategy.

Pair	N	d.f.	Mean	Std. error	t – value	P-Value	Decision
Pre-test	188	187	33.07	7.685	-43.372	0.000*	H ₀ is rejected
Post-test	188		64.30	10.49			

Results on a paired samples t-test indicate a statistically significant difference, as the post-test score of students was significantly higher ($mean = 64.3$, $standard deviation = 10.49$) than the mean pre-test score of students before they were taught ($mean = 33.07$, $standard deviation = 7.685$). The mean difference between the pre and post-test scores of students' achievement in Biology after being taught using the conventional teaching method was 31.2. This difference was significant because $t_{(187)} = -43.372$ was greater than the $t_{critical}$ of -

1.96 and $(P = 0.000 < 0.05)$ at the level of confidence, $\alpha = 0.05$ and 187 degree of freedom (d.f.). The null hypothesis is rejected and the alternative hypothesis was accepted. This implies that there is a significant difference between the mean pre and post-test achievement of students taught Biology through conventional learning strategy. The result also implies that the conventional teaching method has a statistically significant effect on the achievement of students taught Biology in senior secondary in FCT.

Table5: Paired samples t-test result of achievement in Biology between the pre and post-test score of students taught using the cooperative learning strategy

Pair	N	d.f.	Mean	Std. error	t – value	P-Value	Decision
Pre-test	191	190	38.35	10.089	-33.799	0.000*	H ₀ is rejected
Post-test	191		76.84	9.952			

A paired samples t-test run between the pre and post-test mean achievement of students taught Biology with cooperative learning strategy found a statistically significant result. The post-test score was significantly higher (*mean=76.84, standard deviation = 9.952*) than the mean pre- test score (*mean = 38.35, standard deviation = 10.089*); mean difference between the pre and post-test students' achievement was 38.49. This difference was significant because $t_{(187)} = -33.799$ was greater than the t_{critical} of -1.96 and $(P = 0.000 < 0.05)$ at the level of confidence, $\alpha = 0.05$ and 190 degree of freedom (d.f.) as set by researcher. The null hypothesis is rejected and the alternative hypothesis was accepted. This implies that there is a significant difference between the mean pre and post-test scores of the students taught Biology through cooperative learning strategy. Cooperative learning strategy has a statistically significant effect on the achievement of students taught Biology in senior secondary schools in FCT.

Table 6: Independent samples t-test mean achievement in Biology between students taught using cooperative and conventional learning strategies.

Learning Strategies	N	d.f.	Mean	Std. error	t – value	P-Value	Decision
Cooperative	191	377	76.8	9.951	11.969	0.000*	H ₀ is rejected
Conventional	188		64.3	10.95			

Results from an independent two samples t-test run to determine if there were a difference between students' achievement in Biology after being taught using cooperative and conventional learning strategies was statistically significant. The mean achievement of students taught using the cooperative learning strategy was higher (*mean = 76.8, SD =*

9.951) than the mean achievement of students taught using conventional learning strategy, ($mean = 64.3, SD = 10.95$). The mean difference in students' achievement in Biology between cooperative and conventional learning strategies was 12.5. This difference was significant because $t_{(377)} = 11.969$ was greater than the t-critical of 1.96 and ($P = 0.000 < 0.05$) level of significance at the 377 degrees of freedom. The null hypothesis is rejected and the alternative hypothesis was accepted. This implies that there is a significant difference between the mean score achievement in Biology between senior secondary school students taught using cooperative learning strategy and those taught using conventional learning strategy in Federal Capital Territory, Abuja.

4.0 Discussion of Major Findings

In the course of the study, three results were obtained with regards to the consequences of cooperative and conventional learning strategies from descriptive and inferential statistics. First, there was a significant difference between the mean pre and post-test scores of students taught Biology through cooperative learning strategy. This result is consistent with findings by Timiayi, Bolaji and Kajuru (2015), Bukonola and Idowu (2012) on academic achievement; and consistent with findings by Khashi'ie et al (2017), Malik and Alam (2019), that students' academic achievement in post-test was better when compared to the pre-test.

What then could be the reason for this result? Could it be a "preemptive" effect of the pre-test resulting in better achievement in a post-test or how learning materials were structured? On structuring of instruction, social Interdependent theory postulates that how goals are structured determines how individuals interact, and interaction patterns create outcomes. The cooperative learning environment could have enabled 'promotive' interaction, whereby, individuals assisted each other's effort through mutual help, influence, communication, trust, and exchange of resources, leading to greater mastery.

Secondly, there was a significant difference between the mean pre and post-test scores of students taught Biology through conventional learning strategy. Findings here are consistent with results by Ja'afar-Furo, Abdullahi, and Badgal (2014) on higher academic achievement of conventional learning strategy when compared with a combined method of Demonstration and Lecture methods; as well as those of results of Khashi'ie et al (2017), Malik, and Alam (2019). The gain from pre-test to post-test may be attributed to the way the teacher presented new and incremental goals, monitored progress, provided feedback, and reinforced desired behavior through rewards. In essence, the learning materials were structured to help students progress from simple to complex skills development (Filipatalu, 2013) which is in line with the Behaviorist theory of learning.

Muthukumar, Suzanne, and Anandarajan (2013), stated that the pre-test helps learners stay focused, answer post-test questions which they could not answer in the pre-test. It draws students' attention into the habit of reflecting on knowledge, laying aside their previous misconception about a topic; fosters interest in students in finding out why they missed questions, leading them to consider the possibility that their premises were incorrect. Furthermore, Kelly (2019) states that pre-testing students have a releasing effect, in that by the time the post-test comes, students feel more comfortable with the material that is familiar to them, adding that pretest provides additional exposure.

Overall, both cooperative and conventional learning strategies resulted in mean gains though higher for cooperative learning strategy; supporting findings by Lak, Soleimane, and Parveneh (2017) that learner-centered and teacher-centered methods result in improved academic achievement.

Thirdly, there is a significant difference between the mean score achievement in Biology post- test between students taught using cooperative learning strategy, and those taught using conventional learning strategy. This result is consistent with findings by Abdullah (2010); Uwameiye (2016); Jimoh, Idris, and Olatunji (2016), hence Khan, Nazneen, Ahmed, and Khalid (2016) stated that the Learner-centered approach is more effective than the Teacher- centered approach on enhancing academic achievement

If education aims at increasing the quality and academic achievement of learners, and the teacher's role that of selecting appropriate learning method, it becomes pertinent to take a second look at cooperative learning strategy, which according to Sonam and Kulshrestha (2014), is of great utility and wisdom; a suitable method at all level of education and one successful event in psychology and educational science. The lower achievement with the conventional learning strategy adopted in the control group may have resulted in the teacher providing a low-quality learning experience.

4.0 Conclusion

The high degree of preparedness the teachers brought to instructional planning may have resulted in the experimental groups doing better. Learners were directly engaged as against having learning materials delivered to them. They gained practice in self and peer teaching, developed expertise that enabled contributions to group efforts; became conversant with the use of appropriate terminologies, engaged in discovery, problem-solving, and learning. The teachers' roles were those of providing a favorable environment for learning and that of a guide. It is evident from the findings that the jigsaw 11 cooperative learning strategy has a comparative advantage over the conventional lecture method in enhancing students' academic achievement. Thus, the study concludes that the jigsaw cooperative strategy is more effective in teaching than the conventional lecture method. Seniors secondary school Biology teachers should employ a jigsaw cooperative learning strategy in instruction. Nonetheless, studies should be conducted to further affirm the appropriateness of jigsaw and other cooperative learning strategies for teaching Biology.

It is therefore recommended that workshops, seminars be organized by the Federal Ministry of Education on cooperative learning strategy and its operating procedure for teachers in the Federal Capital Territory (FCT), and made mandatory for all Biology teachers to enhance their skills in furthering the use of cooperative methods in Biology and other subjects; Schools' Management and Teachers to expose Biology students to jigsaw II cooperative learning strategy to engender motivation to learning through social interaction that enables the attainment of higher academic achievement and greater retention of concepts; Cooperative learning intervention should be given for a longer time period to observe its effectiveness; Curriculum outlay should reflect the operational procedures of cooperative learning strategy in a way that ensure that teachers position themselves as guides or facilitators of knowledge, while learners engage themselves in collaborative research and discussions towards construction their own knowledge for greater retention and transfer of knowledge.

REFERENCES

- Agbetuyi, P. & Oluwatayo, J., A. (2012). Information and communications technology (ICT) in the Nigerian Educational system. *Mediterranean Journal of Social Sciences*, 3 (3), 41- 45.
- Ahmed, M., A. & Abimbola, I., O. (2011). Influence of teaching experience and school location on biology teachers' rating of the difficult levels of nutrition concepts in Ilorin, Nigeria. *JOSTMED*, 7 (2), 52-61. Retrieved from <https://files.eric.ed.gov/fulltext/EJ1035855.pdf>. Accessed November 3, 2017.
- Babajide, V., F. (2015). Science Education in Nigeria: The Journey So Far. *International Journal of Innovative Research in Education, Technology, and Social Strategies* 1(1).1- 17.
- Boyi, A., A. (2013). Education and Sustainable National Development in Nigeria: Challenges and way forward. *Mediterranean Journal of Sciences* 4(8), 147-152
- Britwum, S., A. (2014). *Discuss The Educational Implications of The Behaviorist Theory In The Mathematics Classroom*. Retrieved from: https://www.Academia.Edu/8953152/The_Educational_Implications_Of_The_Behaviorist_Theory_of_Learning. Accessed, November 4, 2019.
- Brown, G., M. (2015). Science and Technology Education in Nigeria: A Historical Perspective. *SCSR Journal of Educational Research (SCSR-JER)*. 1 (1), 33 –41. Retrieved from: www.scholarconsult.com. Accessed May 14, 2019.
- Bukunola, B., J. & Idowu, O., D. (2012). Effectiveness of cooperative learning strategies on Nigerian Junior Secondary Students' academic achievement in Basic Science. *British Journal of Education, Society & Behavioral Science* 2(3), 307-325.
- Chopper, Z. (2010). *Traditional Teaching Methods: How are they used in the Education System?* Retrieved from: <http://zvavanhuchopper.blogspot.com.ng/2010/10/traditional-teaching-methods-how-are.html>, Accessed February 21, 2018.
- Filipatali, T (2013). *Learning Theories. Their Influence on Teaching Methods*, Retrieved from <https://www.grin.com/document/293498>, Accessed November 5, 2019.
- Hamilton-Ekeke, J-T., Dorgu, J., T & Ebiere, T. (2015). Curriculum and Indigenous Education for Technological Advancement. *British Journal of Education*, 3 (11), 32-39.
- Hashimi, A., M. (2018). Challenges of Educational Development in Nigeria: Issues of Chemical Sciences. *Chemistry and Materials Research*. 10 (3), 1-7.

- Ismail, S., A., A. & Allaq, K., A. (2019). *The Nature of Cooperative Learning and Differentiated Instruction Practices in English Classes* {online}. Retrieved from: <https://doi.org/10.1177/2158244019856450>.
- Ja'afar-Furo, M., R., Abdullahi, Y., & Badgal, B., E. (2014). Effects of Demonstration and Lecture methods of teaching Apiculture on Performance of Agric. Students in Adamawa State University, Nigeria. *Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development* .14 (2),173-177.
- Jimoh, A., G., Idris, L., I. & Olatunji, B., A. (2016). Effect of jigsaw cooperative learning strategy and gender on students' academic achievement in Cost Accounting in Colleges of Education in Ogun State, Nigeria. *International Journal of Academic Research in Education and Review*, 4(5),150-157.
- Johnson, D., W., & Johnson, R., T. (2009). Social Interdependence Theory. Retrieved from: <https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=13&ved=2ahUKEwiz>. Assessed February 25, 2019.
- Johnson, D., W., & Johnson, R., T. (2012). *Social Interdependence Theory* In D. J. In Christie (Ed), *Encyclopedia of Peace Psychology*. Hoboken, NJ: Wiley – Blackwell.
- Johnson, D. W., & Johnson, R. T. (2015). *Theoretical approaches to cooperative learning*. In R. Gillies (Ed.), *Collaborative Learning: Developments in Research and Practice* (17-46). New York: Nova.
- Khan, A ., Nazneen., M, Ahmed, S., S. & Khalid., A (2016). A Comparative Analysis of Effectiveness of Learner-centered Approach and Teacher-centered Approach in Writing Skills of undergraduate students. *Linguistics & Literature Review*. 3 (2), 1-17.
- Kelly, M. (2019). *Pretests: Everything you need to know*. Retrieved from: <https://www.thoughtco.com/importance-and-uses-of-pretests-7674>. Assessed November 20, 2019.
- Khashi'ie, N., S., Said, R., M., Zainal, N., A & Miswan, N., H. (2017). *A Comparison Study of Students' Performance in Pre and Post Result of A Mathematics Competency Test*. DOI:10.1051/ mateconf/20178704001. Retrieved from: <https://www.mateconferences.org> > pdf > mateconf_encon2017_0400. Accessed November 20, 2019
- Lak, M., Soleimani, H., & Parvaneh, F. (2017). The Effect of Teacher-Centeredness Method vs. Learner-Centeredness Method on Reading Comprehension among Iranian EFL Learners. *Journal of Advances in English Language Teaching*, 5 (1), 1-10.

- Leaving Certificate Examination (2013). *Chief Examiner's Report, Biology*. Retrieved from: https://www.examinations.ie/archive/examiners_reports/Chief_Examiners_Report_Biology_2013.pdf. Accessed April 20, 2017.
- Lewis, B. (2019, November 13). *What Is Cooperative Learning?* Retrieved from: <https://www.thoughtco.com/what-is-cooperative-learning-2081641>.
- Lindsay, P. (2011). Abstract Teaching for a Concrete World: A Lesson from Plato. *American Political Science Association*, 44 (3), 605-610.
- Malik, T., G & Alam, R. (2019). Comparative Analysis Between Pre-test/Post-test Model and Post-test-only Model in Achieving the Learning Outcomes. *Pakistan Journal of Ophthalmology* 35 (1), 1-6.
- Muthukumar, S., Suzanne, M., D., & Anandarajan, B. (2013). Introduction of Pre-Test and Post- Test enhances attentiveness to Physiology lectures – Students' perceptions in an Indi International. *Journal of Biomedical And Advance Research* 4 (05), 341-344.
- Parveen, O., Mahmood, S., T., Mahmood, A., I. & Arif, M. (2011). Effect of Cooperative learning on academic achievement of 8th Grade students in the subject of Social Studies. *International Journal of Academic Research* 3 (1), 950.
- Samba, R., Achor, E., Josiah A. & Ogbeba, J. (2010). Teachers' awareness and utilization of innovative teaching strategies in secondary school science in Benue state, Nigeria. *Educational Research*, 1 (2), 032-038.
- Sonam, M. & Kulshrestha, A., K. (2014). Implementation of Cooperative Learning in Science: A Developmental-cum-Experimental Study. *Education Research International*, 2014, 7. Retrieved from: <https://new.hindawi.com/journals/edri/2014/431542/#introduction>
- Timayi, J., M., Bolaji, C. & Kajuru, Y., K. (2015). Effects of Jigsaw IV cooperative, learning strategy (J4CLS) on academic performance of secondary school students in geometry. *International Journal of Mathematics Trends and Technology*. 28 (1), 12-18.
- Tran. V., D. (2013). Theoretical Perspectives Underlying the Application of Cooperative Learning in Classrooms. *International Journal of Higher Education*, 2 (4), 101-115.
- Tran, V., D. (2014). The effects of cooperative learning on academic achievement and knowledge retention. *International Journal of Higher Education*, 3 (2), 1-10

- Umar, A. A. (2011). Effects of biology practical activities on students' process skill acquisition in Minna, Niger State, Nigeria. *JOSTMED*, 7(2), 118–126.
- Uwameiye. B., E. (2016). Cooperative learning strategy and students' academic achievement in Home Economics. *International Journal of Academic Research in Progressive Education and Development*, 5 (2),120-127.
- Weeger, M. J. (2012). A comparison of the two theories of learning - Behavioral and Constructivism as applied to face - to - face and online learning. *E - Leader*, 3-10.
- White, H. & Sabarwal, S. (2014). *Quasi-experimental design and Methods, Methodological Briefs: Impact Evaluation 8*, UNICEF Office of Research, Florence.