International Journal of
Innovative Research in Technology, Basic and Applied Sciences
p-ISSN: 2465-7301 | e-ISSN: 2467-8171

IJIRTBAS
Vol. 7, No. 1
February, 2024

Effect of Jigsaw IV Cooperative Learning Strategy on Students' Performance in 2-D Geometry Among Secondary School Students in Jema'a Local Government, Kaduna State, Nigeria

[1]Iliyasu A., [3]Jamilu A. A., & [2]Haruna M.
[1&2]Department of Mathematics Federal, College of Education Zaria
[3]Department of Maths and Statistics, Nuhu Bamalli Polytechnic, Zaria

Article DOI: 10.48028/iiprds/ijirtbas.v7.i1.06

Abstract

This study examined the effects of Jigsaw IV Cooperative Learning Strategy (J4CLS) on Students' Performance in Geometry among Secondary School Students in Jema'a Local Government. A pretest, posttest Quasi-experimental research design was used for the study. The population of this study comprises of nine (9) public Senior Secondary Schools (SS II) Students in Jema'a Local Government. Two (2) schools were randomly selected as sample for the study. The experimental group was exposed to J4CLS while the control group was taught using lecture method of teaching. The two schools selected, were pretested to find their academic status before the treatment. An Instrument was developed named Geometry Performance Test (GPT) with reliability coefficient of 0.77 using SPSS. The concept of geometry discussed in this study was plane geometry (2-D Geometry). Descriptive statistics was used to describe the data while Inferential Statistics was used to analyze the data at alpha (α) =0.05 level of significance. The result revealed that there is significant difference in the mean scores of secondary students taught 2-D Geometry concepts with J4CLS and their counterparts taught with conventional method. Students exposed to J4CLS achieved higher than those exposed to lecture method of teaching. However, it was found that the strategy is gender friendly, based on the findings, recommendations were made such as: J4CLS should be merged into the streams of teaching of mathematics specifically 2-D geometry and other science related subjects at Senior Secondary Schools in Jema'a Local Government, Kaduna State, Nigeria.

Keywords: *Jigsaw IV Cooperative Leaning Strategy, Performance, 2-D Geometry.*

Corresponding Author: Iliyasu A.

Background to the Study

Mathematics is one of the core subjects taught in schools. It is generally accepted as a foundation of science, technology as well as other disciplines such as accounting, business administration, transportation, geography, hematology, and engineering among others. (Okeke, 2011). Mathematics as a subject has occupied a sensitive place in school curriculum and plays a vital role in the development of any nation (Odilli, 2006) in (Dapson, 2000). In contemporary Education, Mathematics Education is the practice of teaching and learning Mathematics along with the associated scholarly research (Tudunkaya & Jamilu, 2019).

Geometry is a branch of mathematics that deals with the study of plane shapes (2-D geometry) and solid shapes (3-D geometry). Geometry as one of the two fields of pre-modern mathematics, the other being the study of numbers. Geometry from the Ancient Greek; geo "earth", -metro "measurement" arose as the field of knowledge dealing with 2-D and 3-D relationships. Classic geometry was focused on compass and straightedge construction. Geometry was revolutionized by Euclid who introduced mathematical rigor and the axiomatic rigor still in use today. In modern times, geometric concepts have been generalized to a high level of thought and complexity and have been subjected to the methods of calculus and abstract algebra, so that many modern branches of the field are barely recognizable as the descendants of early geometry (Tudunkaya & Jamilu, 2019). Inekwe (2005) opined that, geometry receives a general disfavor among secondary school students. Numerous studies have shown that geometry is of great important than most areas of Mathematics and also, helps students to understand and love Mathematics (Julie, 2015). Geometry is any shape seen as a set of specific set points, while a plane means a collection of all lines (Pereira et al., 2021). Geometry is highly important so much so that, engineers apply its knowledge in construction of houses, cars, chairs and almost all equipment we use in our day-to-day activities.

The earliest recorded beginnings of geometry can be traced to early populates, who discovered obtuse triangles in the ancient Indus Valley, and ancient Babylonia from around 3000 BC. Early geometry was a collection of empirically discovered principles concerning lengths, angles, areas, and volumes, which were developed to meet some practical need in Surveying, Construction, Astronomy, and Various crafts. Among these were some surprisingly sophisticated principles, and a modern mathematician might be hard put to derive some of them without the use of calculus. For example, both the Egyptians and the Babylonians were aware of versions of the Pythagorean Theorem about 1500 years before Pythagoras and the Indian Sulba Sutras around 800 B.C. contained the first statements of the theorem; the Egyptians had a correct formula for the volume of a frustum of a square pyramid. Adetula (2002) sees it as a tool which helps in logical reasoning with meaningful inference. Adekola (2010), views geometry as the branch of mathematics that deals with the study of shapes both planes and solids. Geometry questions during mathematics examinations were not well attended thus, students do skip geometry questions in the examination (Sambo, 2015). Sambo (2015), stated that, these abilities to make logical reasoning and deductions helps individuals in coining solutions both individual and societal challenges which helps in nation's building. Geometry is one of the key topics in mathematics which, its knowledge is being applied in many vocations across the globe (Sam

& Salman, 2016). It is also, one of the major topics in the senior secondary school mathematics curriculum. The knowledge of geometry is crucial in many fields of human life like Engineering. Geometry helps in logical thinking.

Jig-saw (IV) Cooperative Learning Strategy is based on the theory of Constructivism, Peer learning theory of Piaget (1969) and social learning theory of Vygotsky (1978). The constructivism is a school of thought that believes in learners actively constructing their own knowledge and understanding using previous knowledge and interacting with instructional materials under the guidance of the teacher. Constructivism is a theory based on observation and scientific study about how people learn (Fosnot, 1996). It says that people construct their own understanding and knowledge of the world through experiencing things and reflecting on those experiences. When we encounter something new, we have to reconcile with our previous ideas and maybe changing what we believe, or maybe discarding the new information as irrelevant. In any case, learners are active creators of their own knowledge. Constructivist such as Piaget (1977) and Bruner (1996) believe that individuals actively construct their own knowledge by comparing new ideas or concepts with their current knowledge. In Jigsaw (IV) cooperative learning strategy also, students are actively involved in constructing their own understanding and knowledge of the concepts based on the previous experience acquired and reflecting on those experiences through active participation in the lesson.

The peer learning theory of Piaget, (1969) believed that learning improved with the help of peers. Piaget found that, children need to discuss their findings as well as having stimulating environment in which they learn in peers. Learners need to be active, have hands-on opportunities, and not to become the least passive as the case may often be. He thought peer interaction could help students to recognize contradictions and interpretation of a problem. The dialogue creates cognitive gains and allows students have a relationship built on cooperation. Piaget opined that teachers should create an enabling environment of mutual respect such as that of Jig-saw (IV) Cooperative Learning Strategy where learners works in peer and shared the knowledge acquired so as to ensure meaningful learning and mastery of the lesson. The entire group depended on the other member of the group for success. Therefore, this theory supports the use of J4CLS in Science Education.

Vygotsky (1978), in his Social Cognitive Theory, reflected the structure of Jig-saw Cooperative Learning in learners. Vygotsky believed that infant was born with some level of social-cognitive ability. This ability would have enhanced as long as the children grew-up with understanding and supportive adults who encouraged their verbalization and permitted collaborative conversations. He theorized that, as learners grow, they experience more social interaction with adults and peers. These interactions allow them to develop functions such as language skills, voluntary attention, scientific skills and memory. Vygotsky believed that the zone of proximal development of a child is the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under guidance or in collaboration with more capable peers. The zone of Proximal Development is usually determined from below what a child can

learn on his/her own, and above by what a child can learn with the help of others, such as peers or teacher as seen in Jig-saw (IV) Cooperative Learning Strategy. This study adopted the theory of constructivism, because students in J4CLS are active creator of their own understanding and knowledge of the concepts given through experiencing things and reflecting on those experiences. Also, in J4CLS introduction is the first step that provides an anchoring idea to understand the tasks given to them at hand.

The Jig-saw is a Cooperative Learning Strategy that is grounded in the belief that learning is most effective when students are actively involved in sharing ideas and work cooperatively to complete their academic task (Gumel, 2015). Jigsaw is a cooperative learning strategy in which everyone becomes an expert and shares learning so that eventually all group members understand the content treated. The Jigsaw model is chosen for the study because of its unique characteristic of providing optimum opportunities for the students to independently study the task given to individual member of the group. This model also makes students to become cream of the crop of their own learning.

The jigsaw technique was created with the goals of enhancing positive educational outcomes and to help students realize they are essential components of a whole and encourages cooperation in a learning environment (Aronson, 2008). In science education, the Jigsaw method is reported to be used in classes more often than other collaborative learning methods, especially in Mathematics, physical sciences and the Earth sciences (Ibrahim, 2019). This is because the Jigsaw method is considered to enhance cooperative learning by making each student stress on a particular topic (Johnson, & Johnson, 2009). This study verified the effect of Jigsaw IV Cooperative Learning Strategy on Students' Retention in Zaria Metropolis Kaduna State, Nigeria.

Academic performance is the extent to which a student, teacher or institution has achieved their short or long-term educational goals (Tudunkaya & Jamilu, 2019). Completion of educational degrees such as higher diploma and bachelor's degrees represent academic achievement (Friedman & Mandela 2011). Academic performance is commonly measured through examinations and continuous assessments, but there is no general agreement on how it is best evaluated or which aspects are most important procedural knowledge such as skills or declarative knowledge such as facts. Furthermore, there are inconclusive results over which individual factors successfully predict academic performance, elements such as test anxiety, environment, motivation, and emotions consideration when developing models of school achievement (Hannon & Ann 2014). The researcher therefore examines the effect of Jigsaw IV cooperative learning strategy on students' performance among SSII students in Jema'a Local Government Area, Kaduna State.

Objectives of the Study

The objective of this study is to determine:

1. The Effect of Jigsaw IV Cooperative Learning Strategy on Students' Performance among SSII students in Jema'a local government.
2. The Effect of Jigsaw IV Cooperative Learning Strategy on Gender.

Research Questions

The study addressed these research questions:

1. Is there any significant difference in the mean performance scores of students in SSII taught 2-D geometry concept using J4CLS and those taught with the conventional method?
2. Is there any significant difference in the mean performance scores of male and female students taught 2-D geometry concept using J4CLS?

Null Hypotheses

Null hypotheses were formulated and tested at $P \leq 0.05$ level of significance as follows:

$H0_{1:}$ There is no significant difference in the mean performance scores of SSII students taught 2-D Geometry concepts using J4CLS and those taught same concepts using the conventional method.

$H0_{2}$: There is no significant difference in the mean performance scores of male and female students taught 2-D Geometry concepts using J4CLS.

Research Design

The design for this study is pretest, posttest quasi-experimental research design. This is according to Kerlinger and Leer (2005) involves two groups, one group was assigned as experimental, and the other group was tagged control. This is suitable because of the advantages listed by (Lakpini, 2006 in Ibrahim, 2019) which is as follows.

i. The superiority of one instructional strategy over the other can easily be tested.
ii. It gives indications of concept attainment ability of understanding gained by students after they have been exposed to a particular teaching treatment.
iii. The pretest scores give indication as to whether the groups are equal in the concepts they hold before interaction was given.

The population of this study comprises of fifteen (15) public Senior Secondary Schools (SS II) Students in Jema'a local government. Two (2) schools were randomly selected as sample for the study. The samples selected were pre-tested to ensure that they are not significantly different. The experimental group was exposed to Geometry concepts for five weeks using J4CLS while the control group was exposed to Geometry concepts also for five weeks using lecture method. A posttest was administered to observe if there was any significant difference in students' academic performance among the groups.

The instrument for this study is Geometry Performance Test (GPT) was developed for the purpose of generating and analyzing data. The GPT comprises ten (10) items of essay test questions, this is because: Essay test allow students to express their ideas with relatively few restraints. Essay involves recall and write thereby no options to select from, therefore guessing is eliminated. The students must supply answer rather than selecting the good response, thus, it involves descriptive knowledge of students. The posttest in this study is to check the academic performance of the students in SSII on Geometry Concept in Jema'a local government. The reliability coefficient was found to be 0.79 using SPSS. Pre-test was administered to both sampled population groups and the records was kept, then the control

group was treated using lecture method of teaching while the experimental group was treated with the Jigsaw IV Cooperative Learning Strategy for five weeks. Then, post-test was administered to both the control and the experimental groups. The data collected were analyzed by the application of both descriptive and inferential Statistics. For descriptive Statistics mean and standard deviation was used to describe the research questions while for inferential Statistics t-test was used to answer the null hypotheses at at = 0.05 (5%) level of significance.

Result

Research question 1: Is there any significant difference in the mean performance scores of students in SSII taught 2-D geometry concept using J4CLS and those taught with the conventional method?

Table 1: Descriptive Statistics on Performance

Group	N	Mean	Std. Deviation	Mean diff.
Experimental	85	30.31	7.83	
				15.41
Control	72	14.90	6.57	
Total	157			

The results in Table 1 above showed that the students in the experimental group had a mean score of 30.31 performed higher than their counterparts in the control group with a mean score of 14.90 with the mean difference of 15.41.

Research question 2: Is there any significant difference in the mean performance scores of male and female students taught 2-D geometry concept using J4CLS?

Table 2: Descriptive Statistics of Performance on Gender

Group	N	Mean	Std. Deviation	Mean diff.
Male	38	68.73	3.313	
				0.52
Female	47	68.20	3.290	
Total	85			

The results in table 2 above revealed that the mean of male students was slightly higher than that of the female students of 68.73 and 68.20 respectively with the mean difference of 0.52.

Hypotheses Testing

$H0_{1:}$ There is no significant difference in the mean performance scores of SSII students taught. 2-D Geometry concepts using J4CLS and those taught same concepts using the Conventional Method.

Table 3: Inferential Statistics for Performance

Group	N	Mean	SD	t_{cal}	t_{crit}	Df	Remark
Experimental	85	30.31	7.83				
				10.95	1.98	155	S
Control	72	14.90	6.57				

Key: S=Significant

Table 2 showed that the mean scores of both the experimental and control groups with the mean of 30.31 and 14.90 respectively. The mean difference between them is 15.41. However, from above we have $\mathbf{t_{critical\,(10.95)} > t_{calculated\,(1.98)}}$ **at** α=0.05 level of significance. Hence, $\mathbf{H0_1}$ is rejected and therefore concluded that there was significant difference in the mean scores of students taught geometry using J4CLS and those taught with the conventional method.

Ho_2: There is no significant difference in the mean performance scores of male and female students taught 2-D Geometry concepts using J4CLS.

Table 4: Inferential Statistics for Gender

Group	N	Mean	SD	t_{cal}	t_{crit}	Df	Remark
Male	38	68.73	3.32				
				0.24	1.65	83	N S
Female	47	68.20	3.29				

NS= Not significant

Table 4 revealed that the calculated t-value (t = 0.24) was not significant at α=0.05. Similarly, the
$t_{critical} > t_{calculated}$. Hence. Ho_2 was therefore retained, and it was concluded that there was no significant difference in the mean scores of male and female students taught geometry concepts using J4CLS.

Results

Results of testing null hypotheses showed that significant difference exist in the mean performance scores of SS II Students taught with J4CLS and those taught with lecture method. The result of the mean scores of the student in the experimental group maintained a higher performance rates than their counterparts in the control group. The nature of J4CLS is learning by doing and elaborating. In J4CLS, the students worked together in groups, where each student became an 'expert' for a specific topic, and subsequently taught this topic to his or her home group. This finding agrees with Tanel and Erol (2008) in which the effectiveness of the Jigsaw learning method and conventional teaching method were compared on achievement and retention in a Physics course in a University in Turkey. An experimental group received the Jigsaw technique and a control group received traditional lecture teaching.

The finding also agreed with Nolan, Hanley, Divietri and Harvey, (2018) who revealed that Students also, understand the topic taught better than those not assigned to that topic. These results highlight the benefits of students teaching, as part of a jigsaw activity, on their own

learning. The study has two objectives which are to investigate the effect of Jigsaw IV Cooperative Learning Strategy on Students' Performance among SSII students in Jema'a local government and also to investigate the Effect of Jigsaw IV Cooperative Learning Strategy on Gender.

Conclusion

Based on the findings in this study, it could be concluded that J4CLS enhances performance of 2-D Geometry concepts of secondary school students. This is because all SS II students exposed J4CLS, performed 2-D Geometry concepts better than those exposed to traditional method of teaching. In addition, J4CLS make students become active author of their knowledge, analyze such knowledge and apply it to a real-life situation as in J4CLS.

Recommendations

On the basis of the findings and conclusion arising from this study, the following recommendations were made.

1. The use of Jigsaw IV Cooperative Learning Strategy, J4CLS seems to be appropriate in improving the performance of students in senior secondary schools 2-D Geometry. It should, therefore, be incorporated into the main stream of pedagogy in the teaching of Mathematics specifically 2-D Geometry and other science subjects at senior secondary schools in Jema'a local government, Kaduna State, Nigeria.
2. The use of Conventional Method of Teaching, it has been found in this study, to be relatively ineffective, with respect to performance in the learning of 2-D Geometry concepts. Mathematics teachers should therefore, exercise cautiousness and expertise in enriching the Conventional Method of Teaching with innovative strategy such as J4CLS.

Reference

Aronson, E. (2008). *History of Jigsaw*. Retrieved from *https://www.jigsaw.org/history.htm*

Bichi, S. S. (2002). *Effects of problem-solving strategy and enriched curriculum on students achievement in evolution concepts among secondary school students*, An Unpublished Ph.D. Dissertation, Faculty of Education, ABU Zaria.

Friedman, B. A. & Mandel, R. G. (2011). *Motivation predictors of college student's performance and retention Journal of College Student Retention: Research Theory & Practice. 13 (1), 1–15.*

Gerald, I. O. (2012). *Mathematics: A tool for addressing the challenges for security and poverty reduction in Nigeria,* A paper presented at the National Conference organized by Nigerian Mathematical Society held at Ahmadu Bello University Zaria.

Gumel, S. A. (2015). *Effects of jigsaw model of cooperative learning on self-efficacy and achievement in chemistry among concrete and formal reasoning in colleges of education in Nigeria*, Department of Science Education, Ahmadu Bello University, Zaria, 34-40.

Hannon, B. & Ann, M. (2014). Predicting college success: The relative contributions of five social/personality factors, five cognitive/ learning factors, *Journal of Education and Training Studies. 2 (4), 46–58.*

Hassan, A. A. (2007). Critical factors affecting the mathematics teacher in the 21st Century: Possible way forward. *A journal of educational research and development faculty of education Ahmadu Bello University Zaria, 2*(1).

Idris, Y. (2014*). Impact of problem-solving strategy in academic achievement and retention on basic science concept among varied ability students, Kaduna State Nigeria*, Unpublished M.ed Thesis, Department of Science Education, Ahmadu Bello University, Zaria. 3-44.

Johnson, D. W. & Johnson, R. T. (2009). An educational psychology success story: Social interdependence theory and cooperative learning, *Educational Researcher, 38(5), 365-379.*

Kerlinger, F. N. & Leer, H. Z., (2005). *Foundation of behavioral research. fourth edition*, New York: Harcourt Higher Learning Company.

Krejcie, R. & Morgan, R.W. (1970). Determination of sample size for research approach, *Educational Psychology Measurement. 30,* 607-610

Lakpini, M. A. (2006). *Effect of a conceptual change instructional strategy on the achievement, retention and attitude of secondary school biology students with varied ability*, Unpublished PhD Dissertation, Ahmadu Bello University, Zaria.

Nolan, J. M., Hanley, B. G., DiVietri, T. P., & Harvey, N. A. (2018). She who teaches learns: Performance benefits of a jigsaw activity in a college classroom. *Scholarship of Teaching and Learning in Psychology, 4*(2), 93–104. https://doi.org/10.1037/stl0000110

Odilli, G. A. (2006). *Mathematics in Nigeria secondary schools. A teaching perspective. Rex Charles and Patrick Ltd in Okeke. N. F (2008). The effect of activity centered teaching approach*, Using Low-cost Learning Kits in Facilitating Students Achievement and Interest in Mathematics. An unpublished Master's Thesis of faculty of Education, Nnamdi Azikiwe University.

Okeke, C. A. (2011). *New school mathematics for senior secondary schools,* Africana First Publisher's Limited Book House Trust, 1 Africana First Avene Onitsha, Nigeria.

Okpala, J. U. & Asiegbu, F. N. (2016), *Role of mathematics skills in the development of human capacity building in the private sector for national development*, Mathematical Association of Nigeria, Annual National Conference Proceeding, held at Ahmadu Bello University Zaria, Kaduna State.

Piaget, J. (1967). *The Child's conception of the world*, Routledge and Kegan Paul Limited.

Pereira, J. Wijaya, T. T, Zhou, Y. & Purnama, A. (2021). Learning points, lines, and plane geometry with Hawgent dynamic mathematics software, *Journal of Physics: Conference Series 1882(2021) 012057 IOP Publishing doi:10.1088/1742-6596/1882/1/012057*

Tanel, Z., & Erol, M. (2008). Effects of cooperative learning on instructing magnetism: Analysis of an experimental teaching sequence, *American Journal of Physics and Education, 2*(2), 124-136.

Tudunkaya, M. S. & Jamilu, A. A. (2019). Impact of problem-solving strategy on performance in 3-D geometry among SSII in Zaria educational Zone Kaduna State Nigeria, *A Journal of Mathematical Association of Nigeria (M.A.N) Abacus 2019.*

Usman, I. A. (2010). the effects of indoor and outdoor laboratory instructional method on academic performance of Junior Secondary School Students in Zaria Local Government Area of Kaduna State. *Journal of Studies in Science and Mathematics Education 1*(1), 66-73

Vygotsky, L. (1978). Interaction between learning and development. In Gauvain & Cole (Eds.), *Readings on the Development of Children* (34-40). New York: Scientific American Book.

Yero, H. I. (2011). *Effects of computer animation model on students' performance and retention in organic chemistry concepts among colleges of education in Plateau State*. Unpublished M.ed Research Thesis. Ahmadu Bello University Zaria.

Yusuf, M. O. (2011). Perspective on the integration of information and communication Technology in Nigerian School System, *Journal of Science, Technology and Mathematics Education. 7*(2), 229-239. *www.stlouisfed.org.2014/preservaticles.com*12/12/2016