Cooperative Learning As An Intervention Strategy For Improving Achievement Of Dyscalculics In Numbers And Numeration Among Basic Education Students In Federal Capital Territory, Abuja, Nigeria

Iji, C. O.;Udenyi, Andrew; Abakpa, B. O.;and Anyor, J. W.
Department of Mathematics EducationFederal University of Agriculture, Makurdi, NIGERIA
Corresponding author: Udenyi Andrew

ABSTRACT: *This study examined cooperative learning as an intervention strategy for improving achievement of dyscalculics in numbers and numeration among basic education students in Federal Capital Territory. Three research questions were asked with three research hypotheses formulated to guide in carrying out the study. A total of 113 students among basic eight students were identified to have dyscalculia in four schools in the Federal Capital Territory, Abuja and were used for the study. Two instruments were used for data collections, the Numbers and Numeration Achievement Test (NNAT) andDyscalculia Diagnostic Test (DDT) with their reliability indices established using Cronbach-Alpha (α) and Kuder-Richardson formula 20 (K-R$_{20}$). The research questions were answered using mean and standard deviation while the formulated hypotheses were tested at 0.05 level of significance using ANCOVA. The result showed that dyscalculicsachieved higher when taught with cooperative learning than with conventional method. The use of cooperative learning enhanced the achievement scores of dyscalculics among basic education students in numbers and numeration over the conventional teaching method. There is no significant difference in male and female dyscalculics basic education students' achievement scores using cooperative learning as the condition is not gender biased. There was also no interaction effect of cooperative learning and gender on achievement scores of basic education students with dyscalculia in numbers and numeration. It was therefore recommended that diagnostic measures be put in place at the basic level to identify dyscalculics, cooperative learning integrated and used in teaching while isolation be discouraged.*
Keywords: Cooperative Learning, Achievement, Dyscalculics, Numbers and Numeration, Basic Education

I. INTRODUCTION

Considering the importance for Mathematics learning, Omenka (2010) asserts that no nation can achieve permanent numeracy and scientific thinking without Mathematics. The needs of man in modern days have not changed differently but adaptation has only been modified to suite the challenges of trying to achieve a better standard of living and Mathematics is still very central to attaining these needs.

The report of Nigeria Education Research and Development Council (NERDC, 2013) stipulates that every child in Nigeria should acquire appropriate mathematical skills and knowledge in solving human problems in all spheres of life. It is therefore expected that every child be acquainted with mathematical skills within the early stage of education which starts with the universal basic education programme in Nigeria.

The universal basic education programme is an intervention measure of the Federal Government of Nigeria since 2001 aimed at providing uniform and qualitative basic education for every child of primary and junior secondary school age. The Universal Basic Education Commission (UBEC) (2013) report observed that Mathematics is among the subjects not liked by students in their first year of secondary schools.

Children of school age that aredyscalculic are battling with severe Mathematics difficulties caused by their disease condition. Dyscalculic are those suffering from dyscalculia. Dyscalculic are born with the condition and others who are not dyscalculic at birth but shows symptoms similar to those of dyscalculic are regarded as one.Department for Education and Skills (DfES, 2001) stated that dyscalculic lacks ability to acquire arithmetical skills and have difficulty understanding simple number concepts, lack an intuitive grasp of numbers, and have problems learning number facts and procedures.

Sharma (2013) is of the view that dyscalculia is sometimes considered synonymous with mathematical difficulties stemming from environmental factors such as lack of motivation, inappropriate teaching method, non-mastery of subject matter by instructors and non-availability of appropriate instructional materials.

However, children who exhibit the same difficulties as dyscalculic students because of such factors are described as having acquired dyscalculia.

The teaching of Mathematics has been done through various methods and approaches depending on the instructor and his/her mastery of the subject matter vis-à-vis the area of Mathematics being taught. Caine (2012) notes that if teachers are to avoid producing an entire generation of cognitive cripples, they must introduce creative teaching methods to enhance creativity in the classroom. One of such method to be explored by Mathematics teachers is cooperative learning.

Poor performances of students in external examinations such as the basic education certificate examination (BECE) require a shift from the teacher centered method used in the teaching of Mathematics.This widespread low achievement of students in Mathematics according to Odual (2013) is ascribed largely to how instruction in Mathematics is presented to the students.

Cooperative learning is a teaching strategy in which small teams, each with students of different levels of ability, use a variety of learning activities to improve their understanding of a subject. It is a specific kind of collaborative learning. In cooperative learning, students work together in small groups on a structured activity and are individually accountable for their work, as the work of the group as a whole is also assessed. Cooperative learning groups work face-to-face and learn to work as a team.Cooperative learning is an educational approach which aims to organize classroom activities into academic and social learning experiences.

Achievement is an individual's or group's performance after a specified course of instruction. It is the individual status in a specified content area or course of instruction after the individual has undergone tutoring in a programme.

Numbers and numeration form the basic foundation of Mathematics and it involves the process of counting and naming numbers, the system of writing number and the method of calculating. The most fundamental branch of Mathematics is having a clear idea on number sense and numeration. It consists of understanding place values, adding, subtracting, multiplying, and dividing numbers.

According to Geary (2017), between 3 and 8 percent of school-aged children show evidence of dyscalculia. The early signs of this form of disability include a poor understanding of number magnitude (e.g., that $8 < 9$), and use of immature strategies during the solving of arithmetic problems. One of the most common and long-term problems is difficulty remembering basic arithmetic facts such as adding two positive numbers to give another number greater than any of the given numbers.

According to Butterworth, Marchesini and Girelli (2003), dyscalculic students themselves recognize that they fail to understand the basic concepts of number. They claimed also that detailed case studies of individual pupils and adults with Mathematics learning difficulties shows that those with limited capacities as measured by performance on tasks of number comparison and dot counting almost invariably have had profound difficulties at school in learning Mathematics.

Male and female students learn under a single umbrella of education and are therefore faced with the growing challenges that go along with it as well as the benefit accruing from educational training. Women without formal education are denied the opportunity to develop their full potential and to play a productive and equal role in their families, their societies, their country and their world at large (Ahmad &Najeemah, 2013).
The underlying probe in the work in focus is whether the predominance of dyscalculia is a more male or more female problem. It is also to ascertain whether the interest and achievement of students vary significantly on gender basis within the basic education level through the use of cooperative learning. This study was carried out in the Federal Capital Territory, Abuja in Nigeria at the basic education level

II.   METHODOLOGY

This research work adopted a quasi-experimental design. The design is non-randomized pre-test post-test control group because intact classes were used for the research work which did not give room for random selection of subjects so as not to disrupt classroom schedules and activities in the schools where the study was conducted.

The population of the study comprised all the 41,912 universal basic education students in basic eight classin the 165 Universal Basic Education Board (UBEB) schools in the six Area Councils within the Federal Capital Territory. This population is made up of 20,467 male and 21,445 female students.

The sample of 113 dyscalculic students was drawn from 362 based on the administration and performance on the dyscalculia diagnostic test (DDT). Multi-stage sampling method was usedTwo research instruments were used for data collection; Numbers and Numeration Achievement Test (NNAT)and Dyscalculia Diagnostic Test (DDT).The numbers and numeration achievement test is a teacher made test, each item of the multiple choice questions have options lettered A – D. The items in the (NNAT) are strictly based on the basic education curriculum for basic eight class.

The dyscalculia diagnostic test (DDT) is adapted from two international standard tests called Dyscalc and Dyscalculia Screener. The DDT was structured by the researcher to 30-items multiple choice questions. The

DDT had four sections called general, dot enumeration, numerical stroop and ordering of numbers. The general section is designed to check the general ability of dyscalculic, the dot enumeration section is to check the ability of dyscalculic to subitize, the numerical stroop section to check number comparison ability of dyscalculic in term of number appearance in relation to their magnitudes while the ordering section is to test the general ability of dyscalculic to arrange numbers in either ascending or descending order of magnitude.

The study lasted for six weeks. The first was used for training of research assistants, establishment of validity and reliability of instrument as well as administering of the pre-test to the subjects of the study. The essence of the pre-test was to ensure that subjects of the study were all at the same ability level before the commencement of the study. Four weeks were for the actual conduct of the study while the remaining last was used for post-test immediately after the instructional procedure.

The mean and standard deviation was used as the statistics to answer the research questions while the research hypotheses were tested using analysis of covariance (ANCOVA) at 0.05 level of significance.

Research Questions
1. What is the mean achievement scores of dyscalculicbasic education students taught numbers and numeration using cooperative learning and dyscalculic basic education students taught with conventional method?
2. What is the mean achievement scores of male and female dyscalculicbasic education students taught numbers and numeration using cooperative learning?
3. What is the interaction effect of cooperative learning and gender on the achievement of dyscalcuicbasic education students in numbers and numeration?

Research Hypotheses
1. There is no significant difference between the mean achievement scores of dyscalculicbasic education students taught numbers and numeration using cooperative learning and dyscalcuic basic education students taught with conventional method.
2. There is no significant difference between the mean achievement scores of male and female dyscalculicbasic education students taught numbers and numeration using cooperative learning.
3. There is no significant interaction effect of cooperative learning and gender on the achievement of dyscalculicbasic education students in numbers and numeration.

III. RESULTS

Table 1: Mean and Standard Deviation of achievement scores of basic education students with dyscalculia taught numbers and numeration using cooperative learning and those with dyscalculia taught with conventional method

GRP	N	Pre-NNAT $\overline{X}$	SD	Post-NNAT $\overline{X}$	SD
Coop - LN	61	14.80	6.09	25.15	7.11
Conv - LN	52	13.71	5.10	18.67	7.57
Mean Diff.		1.09		6.48	
Total	113				

From observationin Table 1 it shows that the mean achievement scores for cooperative learning in the pre-NNAT is14.80 with a standard deviation of 6.09 while the corresponding mean for conventional method is 13.71 with standard deviation of 5.10. The mean difference across the two groups in the pre-NNAT is 1.09. In the post-NNAT, the mean for cooperative learning is 25.15 with a standard deviation of 7.11while the corresponding mean for conventional method is 18.67 with a standard deviation of 7.57. The mean difference across the post-NNAT groups is 6.48.

Table 2:Mean and Standard Deviation of Achievement Scores of Male and Female Basic Education Students with Dyscalculia Taught Numbers and Numeration using Cooperative Learning

GRP	N	Pre-NNAT		Post-NNAT	
		X	SD	X	SD
Male	23	15.13	6.92	25.13	8.42
Female	38	14.61	6.10	25.16	7.12
Mean Diff		0.52		0.03	
Total	61				

From observationin Table 2 it shows that the mean achievement scores from cooperative learning for male students in the pre-NNAT is15.13 with a standard deviation of 6.92 while the corresponding mean for female students is 14.61 with standard deviation of 6.10. The mean difference across gender in the pre-NNAT is 0.52. In the post-NNAT, the mean for male students is 25.13 with a standard deviation of 8.42 while the corresponding mean for female students is 25.16 with a standard deviation of 7.12. The mean difference across gender for the post-NNAT is 0.03.

Table 4: ANCOVA Result of Achievement Scores Of DyscalculicBasic Education Students Taught Numbers and Numeration Using Cooperative Learning and Dyscalculic Taught With Conventional Method.

Source	Type III Sum of Squares	df	Mean Square	F	P-value (Sig.)
Corrected Model	3108.617[a]	2	1554.308	38.724	.000
Intercept	2166.745	1	2166.745	53.982	.000
Group	**901.279**	**1**	**901.279**	**22.454**	**.000**
PreNNAT	1931.926	1	1931.926	48.132	.000
Error	4415.188	110	40.138		
Total	63055.000	113			
Corrected Total	7523.805	112			

P = 0.00 < 0.05

From Table 4, $F_{(1,112)} = 22.454$, p = 0.00 < 0.05 level of significance. The null hypothesis is therefore rejected. This means that there is a significant difference between the mean achievementscores of basic education students with dyscalculia taught numbers and numeration using cooperative learning and those taught with conventional method. Therefore the use of cooperative learning resulted in high achievement of students' knowledge innumbers and numeration during the period of this study.

Table 5: ANCOVA Result of Achievement Scores Of Male and FemaleDyscalculicBasic Education Students Taught Numbers and Numeration Using Cooperative Learning.

Source	Type III Sum of Squares	df	Mean Square	F	P-value (Sig.)
Corrected Model	923.087	2	461.543	10.688	.000
Intercept	2352.373	1	2352.373	54.475	.000
Gender	**1.765**	**1**	**1.765**	**.041**	**.840**
PreNNAT	923.076	1	923.076	21.376	.000
Error	2504.585	58	43.183		
Total	42004.000	61			
Corrected Total	3427.672	60			

P = 0.840 > 0.05

From Table 5, $F_{(1,60)} = 0.41$, $p = 0.840 > 0.05$ level of significance. The null hypothesis is therefore not rejected. This means statistically that there is no significant difference between the mean achievement scores of male and female basic education students with dyscalculia taught numbers and numeration using cooperative learning.

Table 6: ANCOVA Result of Interaction Effect of Cooperative Learning and Gender on the Achievement of DyscalculicBasic Education Students with Dyscalculia Taught Numbers and Numeration Using Cooperative Learning.

Source	Type III Sum of Squares	df	Mean Square	F	P-value (Sig.)
Corrected Model	3111.808	4	777.952	19.043	.000
Intercept	2133.528	1	2133.528	52.226	.000
PreNNAT	1934.828	1	1934.828	47.362	.000
Group	834.654	1	834.654	20.431	.000
Gender	.139	1	.139	.003	.954
Group * Gender	**2.952**	**1**	**2.952**	**.072**	**.789**
Error	4411.998	108	40.852		
Total	63055.000	113			
Corrected Total	7523.805	112			

P = 0.789 > 0.05

From Table 6, $F_{(1,112)} = 0.072$, $p = 0.789 > 0.05$ level of significance. The null hypothesis is therefore not rejected. That is, there is no significant interaction effect of cooperative learning and gender on the achievement of basic education students with dyscalculia in numbers and numeration.

Summary of Major Findings
Based on the data collected and collated for this study, the major findings are made.
1. Basic education students with dyscalculia taught numbers and numeration using cooperative learning in an inclusive Mathematics classroom during the period of this study improved upon their Mathematics achievement more than those taught with conventional method.
2. Male and female basic education students with dyscalculia taught numbers and numeration using cooperative learning in an inclusive Mathematics classroom during the period of this study improved equally in their Mathematics achievement.
3. The interaction effect of gender and instructional method on achievement due to the use of cooperative learning is not bias.

IV.   DISCUSSION
The use of cooperative learning in an inclusive Mathematics classroom to teach basic education students with dyscalculia was found to bring significant achievement in their Mathematics achievement during the period of this study. This finding is in line with Awolafo, Fatade and Ola-Oluwa(2012) who found that cooperative learning is better than Individualistic Goal-Structure in Mathematics. It is also in support of Collerone (2016) who found that a functional inclusive education setting is require for overcoming Mathematics learning difficulties through methodological practices.
The prevalence of dyscalculia as a learning difficulty is not a male or female dominant deficit but cut across gender. The result showed that the achievement of dyscalculia students is not influenced by gender.

V.   RECOMMENDATIONS
The findings of this research have necessitated the following recommendations
1. Diagnoses of dyscalculia be introduced into basic education entrance requirement during admission of students into basic schools using any diagnostic tool including the (DDT).
2. Cooperative learning as a pedagogy be integrated into the Mathematics curriculum at the basic education level for pre-service Mathematics teachers.

3. Examination bodies such as NECO should allow for special examination centres for dyscalculic and other learning disorder to allow for adequate time for such examinations.

VI.   CONCLUSION

It is therefore concluded from the study that dyscalculic students could be identified using the dyscalculia diagnostic test at the basic education level.The use of cooperative learning enhanced the achievement scores of basic education students experiencing dyscalculia as a learning deficit in numbers and numeration using cooperative learning over the conventional teaching method. There is no significant difference in male and female dyscalculic basic education students' achievement scores using cooperative learning,nor interaction effect of teaching method and gender on achievement scores of dyscalculicbasic education students in numbers and numeration.

REFERENCES

[1].   Agarwal, D &Ahuja S. (2015).Issues related to the diagnosis of developmental dyscalculia. Indian Journal of Applied Research, 5, 558 - 561
[2].   Ahmad, K &Najeemah B, M. Y., (2013).Cultural traditions and practices of the parents asbarriers to girl-child education in Zamfara State Nigeria.International Journal ofScientific and Research Publications, 3(11) 2250-3153
[3].   Butterworth, B., Marchesini, N. &Girelli, L. (2003).'Organisation of multiplication facts inmemory: Developmental trends'. In: Baroody, A. and Dowker, A. (Eds.) The Development of Arithmetical Concepts and Skills. Mahwah, NJ: LEA.
[4].   Butterworth B., Varma S., &Laurillard D. (2011). Dyscalculia: From brain to education. Science, 332(6033), 1049–53. doi: 10.1126/science.1201536Department for Education and Skills (DfES, 2001)
[5].   Geary,D.C (2017). Dyscalculia at an Early Age.ceecd / skc-ecd | learning disabilitiesNigeria Education Research and Development Council - NERDC (2013).Office of the executive secretary, Abuja – Nigeria.
[6].   Odual, N. N (2013). Relationship between mathematical ability and achievement inmathematicsamong female secondary school students in Bayelsa State Nigeria. Procedia – Social and Behavioural Sciences, 106, 2230 – 2240.
[7].   Omenka, J.E.(2010). Effect of ethno mathematics approach on achievement and attitude towardsnumber and numeration among the Junior Secondary school students.UnpublishedPh.D thesis, Benue State University, Makurdi.
[8].   Sharma, M., C. (2013). Number concept, numbersense, and numeracy in common corestatestandards. Paper presented at NHSAA 2013 best practices conference oncurriculum, instruction, and assessment, New Hampshire. Universal Basic Education
[9].   Universal Basic Education Commission (2013) .Final Report of 2011 national assessmentoflearning achievements in basic education. Abuja: UBE