

# **ASSESSMENT OF THE EFFECTIVENESS OF CONCRETE REPRESENTATIONAL ABSTRACT STRATEGY ON THE MATHEMATICS ACHIEVEMENT OF PUPILS WITH DYSCALCULIA.**

**BY**

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## Abstract

*The purpose of this study was to experimentally determine the effects of Concrete Representational Abstract (CRA) strategy on the mathematics achievement of pupils with dyscalculia in Federal Capital Territory (FCT) Abuja putting into consideration gender as a variable. Two research questions were articulated and two hypotheses were formulated to guide the study. The study employed a quasi-experimental research design. Specifically, the nonequivalent control group design was used. The population for the study was all the 97 primary three pupils with dyscalculia in three model inclusive primary schools as identified by the special education unit in AMAC local education authority Federal Capital Territory Abuja. Purposive sampling technique was employed to select the two case schools where the large number of children with dyscalculia would be found. Then two of the schools sampled were randomly assigned to experimental group and the control. In the schools selected, two intact classes comprising 21 primary three pupils made up of 10 males and 11 females were used for the study. The instrument for data collection was a 10-item Mathematics Achievement Test (MAT), which was researcher developed and was face and content validated. Using Kendall's Coefficient of Concordance (W), the reliability co-efficient of .88 was obtained for the MAT. Lesson plans for both the experimental and control groups were developed by the researcher based on the table of specification and used for classroom instruction. Two research questions and two null hypotheses guided the study. The result of the study revealed that: CRA strategy has significant effect on the mean achievement scores of pupils with dyscalculia in mathematics; There is a significant influence of gender on the mathematics achievement scores of pupils with dyscalculia. Based on the findings some recommendations were made.*

**Key words:** dyscalculia, mathematic skills, concrete representational abstract, addition, subtraction, multiplication, division, gender.

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## Introduction

Mathematics is the systematic treatment of magnitude, properties, relationships between figures and forms, and relationship between quantities and sets expressed using numbers and symbols. Asikhia in Adimora, Onyishi and Nwokenna (2014) defined mathematics as a broad domain addressing the measurement, properties and relations of quantities as expressed in numbers or symbols. There are basic mathematic skills that have daily importance and application in our lives whose functions include; addition, subtraction, multiplication, and division of numbers. These are necessary to advance in mathematics for the learners to move on to more demanding mathematics such as algebra, geometry, calculus (Belyavskaya 2014). According to National Key Result Area (NKRA) (2010), if the problems of mastering mathematics skills in primary schools were ignored continuously, cumulative academic failure will be difficult to be improved when the student enters a higher schooling stage. The consequence of this is worse off for persons with dyscalculia

The term 'dyscalculia' as used in this study, can be defined as a significant discrepancy between specific mathematic performance and performance in other domains that cannot be explained by intellectual/sensory disabilities, inappropriate schooling or poor social environment. In general children with dyscalculia have difficulties understanding mathematics concepts and solving even simple mathematical problems (National Institutes of Health (NIH) 2011).

Students in secondary schools still register continually poor results at junior secondary certificate examination (JSCE) in mathematics. This is evidenced in the reports given by the director of Education Resource Center (ERC) a body in charge of the Junior Secondary School Certificate Examination in Federal Capital Territory, Abuja (2011 – 2014).

In spite of various attempts by researchers in conducting intervention to identify the most effective instructional practices to tackle the problem of dyscalculia in Nigeria, the pitiable academic condition, still remains almost the same. This led the researcher to employ concrete representational abstract strategy as an intensive remedial intervention to investigate if there could be any improvement in the mathematics achievement of pupils with dyscalculia in primary schools in the area of addition, subtraction, multiplication and division of numbers.

Witzel (2005) defined concrete representational abstract (CRA) as a three-staged learning process where students learn through physical manipulation of concrete objects in the first stage, followed by learning through pictorial representations of the concrete manipulations in the second stage and ending with solving problems using abstract notation, numbers and symbols in the third stage.

The issue of gender is an area that has been of interest to researchers on mathematics achievement of learners. It then becomes imperative to investigate the innovative strategies such as CRA to find out whether they affect the pupils with dyscalculia's mathematics achievements on the basis of gender.

### **Statement of problem**

Studies indicate that current teaching approaches in mathematics underestimate the amount of scaffolding practice, use of manipulatives and pictures children need to consolidate

new concepts and skills. Furthermore it is noted that there is a paucity of research on effective instructional methods for teaching those basic mathematics concepts and skills to pupils with dyscalculia in the Federal Capital Territory in particular and Nigeria in general. Hence this study intends to address this issue for the purpose of helping primary three pupils with dyscalculia to improve their mathematics achievement. The problem of this study therefore is: could the use of CRA strategy improve the mathematics achievement of pupils with dyscalculia in Federal Capital Territory Abuja. Furthermore what role will gender play in affecting mathematics achievement of these pupils?

### **Research Questions**

The following research questions guided the study:

1. What are the effects of CRA and lecture method on the mathematics achievement of pupils with dyscalculia?
2. What is the influence of gender on mathematics achievement of pupils with dyscalculia?

### **Hypothesis**

The following null hypotheses will be tested at 0.05 level of significance to guide the study:

- Ho<sub>1</sub>. There is no significant difference between the mean achievement scores on mathematics of pupils with dyscalculia exposed CRA and those exposed to lecture method.
- Ho<sub>2</sub>. There is no significant influence of gender on the mathematics achievement of pupils with dyscalculia.

### **Research Method**

This study used a quasi-experimental control group design. This design was adopted because intact or pre-existing groups were used. In particular, different schools were used, one as experimental, the other as control group. The population was all primary III pupils with dyscalculia of the model inclusive primary schools in AMAC, Federal Capital Territory Abuja and the sample was 21 primary III pupils with dyscalculia drawn from the two purposively selected inclusive primary schools in AMAC. AMAC was purposively chosen because in the whole of FCT, the model inclusive primary schools that admit both regular pupils and those with special needs are in AMAC. LEA primary school Nyanya consisting of 5 boys and 6 girls with dyscalculia and LEA primary school Garki consisting of 5 boys and 5 girls with dyscalculia were randomly assigned to treatment (CRA) and control (lecture method) groups respectively.

Instrument for data collection was mathematics achievement test (MAT) which comprised 10 essay questions. The instrument was developed by the researcher based on the content of the instructions. The instrument was face-validated by three experts: one in special education, one in measurement and evaluation and one in mathematics education. The pupils' responses from the trial-testing were subjected to internal consistency. Using Kendall's Coefficient of Concordance (W) the reliability co-efficient of .88 was obtained for the MAT based on the result of the trial testing since the questions were inter-rater scored.

The pupils with dyscalculia were pretested before commencement of the treatment. The treatment lasted for a period of six weeks. Lessons were taught in all the sampled classes of primary 3 in the schools selected using the method of instruction assigned to each class by the researcher in order to avoid experimental bias/ Hawthorne effect. At the end of the treatment, the same instrument (MAT) was reshuffled and administered to the pupils as post-test. Mean and

standard deviation were used in answering the research questions while Analysis of Covariance (ANCOVA) was used in testing the hypotheses at 0.05 level of significance.

## Results

The results are presented in tables according to the research questions and their corresponding hypotheses that guided the study.

**Research Question 1:** What are the effects of concrete-representational-abstract (CRA) and conventional method on the mean achievement scores of pupils with dyscalculia in mathematics?

**Table 1: Pretest and posttest scores of the effect of concrete-representational-abstract (CRA) and conventional method (CM) on the mean achievement scores of pupils with dyscalculia in mathematics**

Variable		Pre test		Post test		
Instructional Strategies	N	$\bar{x}$	SD	$\bar{x}$	SD	Mean gain
CRA	11	8.18	5.60	49.09	10.91	40.91
CM	10	8.00	5.37	15.50	7.25	7.50

The result on table 1 shows that the pretest mean achievement scores obtained for pupils exposed to CRA (experimental group) was 8.18 with a standard deviation of 5.60 and a posttest mean of 49.09 with a standard deviation of 10.91. The difference between the pretest and posttest means was 40.91. The result in Table 3 also shows that the pupils with dyscalculia exposed to CM had a

pretest mean achievement scores of 8.00 with a standard deviation of 5.37 and a posttest mean of 15.50 with a standard deviation of 7.25. The difference between the pretest and posttest means was 7.50. For both groups exposed to CRA and CM, the posttest means were greater than the pretest means. However, pupils with dyscalculia who were exposed to CRA (experimental group) had a mean gain of 40.91 which is higher than 7.50 for their counterparts who were exposed to the CM. This implies that the use of CRA appears to improve the mean achievement scores of pupils with dyscalculia in mathematics than the conventional method (CM).

### Hypothesis 1

There will be no significant difference in the mean achievement scores of pupils with dyscalculia in mathematics when exposed to CRA and those exposed to conventional method.

**Table 2: Analysis of Covariance (ANCOVA) of the significant difference in the mean achievement scores of pupils with dyscalculia in mathematics when exposed concrete-representational-abstract (CRA) and those exposed to conventional method**

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	6299.431 <sup>a</sup>	4	1574.858	19.773	.000
Intercept	4013.855	1	4013.855	50.394	.000
Pretest	375.621	1	375.621	4.716	.045
Groups	5806.246	1	5806.246	72.898	.000
Gender	1.544	1	1.544	.019	.891



Groups * Gender	7.224	1	7.224	.091	.767
Error	1274.379	16	79.649		
Total	30575.000	21			
Corrected Total	7573.810	20			

The result on Table 2 shows that an F-ratio of 72.898 with associated probability value of 0.000 was obtained with regard to the difference in the mean achievement scores of pupils with dyscalculia in mathematics exposed to CRA and those exposed to the conventional method (CM). Since the associated probability (0.000) was less than 0.05 level of significance set as the criterion for taking a decision, the null hypothesis ( $H_{01}$ ) was rejected. The conclusion drawn was that there is a significant difference in the mean achievement scores of pupils with dyscalculia in mathematics when exposed to CRA and those exposed to the CM.

**Research Question Two:** What is the influence of gender on mathematics achievement of pupils with dyscalculia?

**Table: 3** Mean and standard deviation analysis of influence of gender on mathematics achievement of pupils with dyscalculia

Gender	N	Mean	SD
Male	20	19.50	18.42
Female	22	21.59	19.78

The result on table 3 above shows that the male respondents had a mean of 19.50 and standard deviation of 18.42 while the female respondents had a mean of 21.59 and standard deviation of 19.78. The difference in the mean scores of the two groups was calculated as 2.09 which was

statistically low. Therefore, there was influence of gender on mathematics achievement of pupils with dyscalculia.

**H<sub>02</sub>:** There is no significant influence of gender on the mathematics achievement of pupils with dyscalculia.

**Table: 4** Analysis of covariance (ANCOVA) of gender on the mathematics achievement of pupils with dyscalculia

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	4948.333 <sup>a</sup>	8	618.542	4.546	.012
Intercept	9863.060	1	9863.060	72.490	.000
Male–Female	4948.333	8	618.542	4.546	.012
Error	1496.667	11	136.061		
Total	14050.000	20			
Corrected Total	6445.000	19			

a. R Squared = .768 (Adjusted R Squared = .599)

On the above table, the Male–Female had a p-value of 0.12 is greater than the level of significance of 0.05. This resulted to the rejection of the null hypothesis. Therefore, there was significant influence of gender on the mathematics achievement of pupils with dyscalculia.

## Discussion

Result of data analysis on table 1 has shown that pupils taught with CRA performed significantly better in the mathematics achievement test than their counterparts who were taught using the conventional lecture method. Also the observed probability value of 0.000 on table 2 which was

significant at 0.05 level of confidence testifies to the result. This result is in agreement with the results of Witzel, et al (2003), and Strozier (2012) whose studies showed that CRA significantly improved mathematics achievement of pupils with mathematics learning disabilities.

The reason for the higher performance by the experimental group may have been related to the visual nature of instruction and the fact that the pupils were more actively involved in the CRA processes which involved using manipulatives in computations, drawing pictures and diagrams to represent objects and also progressing to working with symbols and numbers which were absent with the control group through out their lesson periods. Also the teacher and pupils participatory roles in the CRA is unique which made for better achievement by the experimental group than the conventional method group. The active participation of the pupils involving the use of several sense organs invariably should arouse greater pupils' interest leading to greater achievement. Given these prevailing circumstances under which the CRA and the CM are employed in the classroom instruction, it is not surprising that the treatment group (CRA) out – performed the control group in the mathematics achievement test (MAT).

From the results presented on table 3, in respect of the influence of gender on the mathematics achievement, the mean scores of pupils with dyscalculia is such that the female pupils' score was higher than that of the male pupils'. This was concluded on table 4 as a statistical significant influence of gender on the mathematics achievement scores of pupils with dyscalculia when tested at 0.05 level of significance in favour of the females. This goes in line with study by (Kimball, in Kiptum, Rono, Too, and Too (2013) who argue that females tend to earn better grades than males in mathematics. However, it is contrary to the study carried out in Nigeria by Onu, Eskay, Igbo, Obiyo and Agbo (2012), whose results revealed that boys obtained better fraction achievement scores than girls.

## **Conclusion**

The findings of the study revealed that pupils with dyscalculia taught using CRA achieved significantly better than those taught using CM. Also gender was found to have significant influence on the achievement scores of pupils with dyscalculia when taught using CRA strategy

## **Recommendation**

Based on the findings of this study, the following recommendations are made:

- Mathematics teachers should adopt CRA strategy for their pupils with dyscalculia during mathematics instruction to enable them use manipulatives, drawings and also symbols in learning mathematics. This will no doubt equip the students with necessary skills that help them overcome their problem of consistent failure in mathematics.
- CRA should be incorporated into teacher Education programmes in order to equip the potential teachers with the skills involved in instruction bearing in mind that one cannot give what he does not have.
- The Government and stakeholders in special education and mathematics education should organize workshops and seminars for the in-service teachers to educate them on the use of Concrete Representational Abstract strategy.

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