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Effects of Cooperative Learning and Contingency Contracting on Attention Deficit Hyperactivity Disorder Among Pupils With Learning Disabilities in Mathematics in Owerri, Nigeria

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Abstract

The study adopted pretest-posttest, control group quasi-experimental design with a 3x2x2 factorial matrix. Multi-stage sampling technique was used to select ninety participants from three randomly selected public primary schools in the three local governments in Owerri. The participants were randomly assigned to treatments and control groups. Participants in the two treatment groups were exposed to eight weeks of cooperative learning strategy and contingency contracting technique. Two instruments used were: Vanderbilt ADHD Diagnostic Teacher Rating Scale ($\alpha = 0.93$) and Woodcock-Johnson III Mathematics Fluency Achievement Tests Scale ($\alpha = 0.84$). Two hypotheses were tested at 0.05 level of significance. Data were analysed using Analysis of Covariance. There is a significant main effect of treatment on ADHD pupils with learning disabilities in mathematics ($F_{(2, 78)} = 127.29$, $p < 0.05$). Cooperative learning strategy was more effective in improving Mathematics competence skills ($\bar{x} = 96.6$) of ADHD pupils with learning disabilities in mathematics than contingency contracting technique. Furthermore, there is no significant interaction effect of treatment, age and gender on ADHD pupils with learning disabilities in mathematics in the study. Therefore, the findings of the study suggest that teachers should endeavour to use appropriate teaching methods, cooperative learning strategy and contingency contracting technique to reinforce positive attitude to teaching-learning situations among ADHD pupils with learning disabilities in mathematics.

Key words: Cooperative learning strategy; Contingency contracting technique; Mathematics disabilities

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INTRODUCTION

Attention Deficit Hyperactivity Disorder affects many children around the world, as it occurs across all socio-economic, cultural, and racial backgrounds. Also, it affects children of all intelligence levels. In view of this, it is of note that pupils with attention deficit hyperactivity disorder experience great difficulty with the academic structure and demands of school and they consistently achieve below their potentials (Lauth, Heubeck & Mackowiak, 2006; Lucangeli & Cabrele, 2006). Not surprisingly, there appears to be a correlation between the severity of the symptoms of ADHD and achievement. Thus, the more severe the symptoms, the greater the negative impact on school performance (Deshazo-Barry, Lyman & Klinger, 2002).

Learning disabilities could lead to low self-esteem, isolation, dejection and behaviour problems. Another issue is the fact that learning disabilities could be extremely frustrating for children because of its unique characteristics. Imagine a child having trouble with a skill all his friends are tackling with ease. This could lead to worrying about embarrassing himself in front of the class. He might equally struggle to express himself. Supporting this assertion, Lerner, (2004) posits

that learning disabilities affect the manner in which individuals with normal or above normal intelligence take in, retain, and express information. It is commonly recognized as a significant deficit in one or more of the following areas: oral expression, listening comprehension, written expression, basic reading skills, reading comprehension, mathematical calculation, or problem solving. Individuals with learning disabilities also may have difficulty with sustained attention, time management, or social skills (Lerner, 2004; Okoro, Nwamuo & Opara, 2016).

The Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) categorizes learning disabilities into four types: reading disorders, mathematics disorders, disorders in written expression, and learning disorders not otherwise specified (American Psychiatric Association 1994). Mabbott and Bisanz (2008) claim that children with identifiable learning disabilities in Mathematics are distinguished by poor mastery of number facts, fluency in calculating and working memory, together with a slower ability to use 'backup procedures', concluding that overall dyscalculia may be a function of difficulties in computational skills and working memory. Jenkins and O'Connor, (2003) found that cooperative learning strategies are effective in attending to the needs of ADHD pupils expressing Mathematics learning disabilities at the classroom level because it aids in classroom management and provides a means to deliver differentiated instruction. Likewise, Fuchs and Fuchs (2005) posit that many studies of Mathematics disabilities have shown that pairing pupils who have stronger academic skills with those with weaker skills from kindergarten help improve outcomes for all pupils and provides opportunities for practice that help acquisition of new knowledge and transfer of skills and content knowledge.

Contingency contracting is an agreement between a student and teacher, which states behavioural or academic goals for the student and reinforcers or rewards that the student will receive contingent upon achievement of those goals. Acker and O'Leary (1987) hypothesized that positive attention such as teacher's praises, would be important at the start of the school year while the teacher and students are establishing rapport, and would lead to appropriate classroom behaviour of children with behavioural difficulties such as hyperactivity. Response cost is another classroom contingency contracting intervention technique that has been shown to be effective in managing classroom behaviour (Kerr & Nelson, 1983). Response cost has been defined as a punishment procedure which involves the loss of positive reinforcement (privileges, points, rewards) contingent on misbehaviour or failure to meet specified behavioural or academic criteria (Abramowitz & O'Leary, 1991).

Conditioned positive reinforcers may be removed in response to inappropriate behaviour.

Likewise, Ofovwe, Ofovwe and Meyer (2006) conducted a study to establish the prevalence of ADHD among school aged children in Benin City, Nigeria using a total of one thousand, three hundred and eighty four (1384) primary school pupils, aged between 6 and 13 years, who were recruited from six primary schools. Teacher's ratings of the DSM-IV symptoms of ADHD were collected and analyzed as a function of gender and subtype. The results reveal that male pupils who participated in the study with learning disabilities had a higher prevalence rate of ADHD and this support a documented trend in ADHD reports that male children have a higher rate of ADHD (Rief 1997). They concluded that the results strengthen earlier observations that there is no significant geographical variation on the prevalence of ADHD among pupils with learning disabilities if common definitions and diagnostic tools are employed.

Statement of the Problem

Attention Deficit Hyperactivity Disorder is a frustrating phenomenon associated with primary school pupils expressing learning disabilities in mathematics. These children do poorly in mathematics tasks and have higher rate of failure than children that do not express symptoms of ADHD. Thus, Attention Deficit Hyperactivity Disorder impacts children negatively in a myriad of ways. For example, this makes many children with ADHD display low frustration tolerance, tendency to become bored very easily or often, lack of motivation for all but the most stimulating activities, and a relative inability to recognize future consequences of behaviour or to learn from mistakes.

Research Hypotheses

In this study, the following hypotheses were tested at 0.05 level of significance:

There is no significant main effect of treatment on the Mathematics scores of ADHD pupils with learning disabilities in Mathematics.

There is no significant interaction effect of treatment, age and gender on the Mathematics scores of ADHD pupils with learning disabilities in Mathematics.

METHODOLOGY

Research Design

A 3x2x2 factorial matrix design was used for this study. The variables considered are psychological treatments which exist at three levels (i.e. cooperative learning strategy, contingency contracting technique and control group); age (older and younger) and gender (male and female) pupils. This is highlighted below in table 1.

Table 1
A 3x2x2 Factorial Matrix Design for managing attention deficit hyperactivity disorder (ADHD) in pupils with learning disabilities in Mathematics

Treatment	Gender				Total
	Male		Female		
	Pupils	Younger	Older	Younger	
	Pupils	Pupils	Pupils	Pupils	
	9-10yrs	7-8yrs	9-10yrs	7-8yrs	
A1 Cooperative Learning	A1 B1n=10	A1 C1n=5	A1 B2n=8	A1C2n=7	30
A2 Contingency Contracting	A2 B1n=12	A2 C1n=3	A2 B2n=9	A2 C2n=6	30
A3 Control Group	A3 B1n=8	A3 C1n=7	A3 B2n=6	A3 C2n=9	30
Total	30	15	23	22	90

Population

The population consists of all ADHD pupils manifesting learning disabilities in Mathematics in Owerri, Imo State, Nigeria.

Sample

The sample for this study consist of ninety (male and female) primary three pupils who display the symptoms of ADHD as responsible for their expressed learning disabilities in Mathematics in Owerri, Imo State, Nigeria.

Sampling Technique

The multi-stage sampling technique was used to select the participants from the three schools used for the study through screening at various stages of the sampling procedure. The class teachers first screened out two hundred and sixty one (261) primary three ADHD pupils at the first stage using Vanderbilt ADHD Diagnostic Teacher Rating Scale and then screened for the second stage, one hundred and ninety five (195) primary three ADHD pupils with learning disabilities in Mathematics using same instrument which has a Colum for rating academic performance that are problematic, (average or above average) based on Mathematics. Also, the teachers screened for the third stage, one hundred and fifteen (115) primary three ADHD pupils with learning disabilities in Mathematics that are (problematic or average in performance) using same instrument which has a Colum for rating academic performance that are (problematic, average or above average). Furthermore, the teachers then screened for the fourth stage, ninety (90) primary three ADHD pupils with learning disabilities in Mathematics that are (problematic) using same instrument which has a Colum for rating academic performance that are (problematic, average or above average). Through this multi-stage sampling technique, ninety pupils were selected from three primary schools that were randomly selected for the study.

Descriptions of Instrument

The VADTRS is a standardized diagnostic teacher rating scale (Wolraich et al 1996) used for the screening of

ADHD pupils and selection of ADHD pupils expressing learning disabilities in mathematics as samples participants for the study. It includes all 18 of the DSM-IV criteria for ADHD. In addition, 7 criteria for oppositional defiant disorder (ODD) and 5 criteria for conduct disorder (CD) are included, along with 5 criteria from the Pediatric Behaviour Scale (Lindgren & Koepl, 1987) that screen for anxiety and depression. The wording has been simplified so that the reading level is slightly below third grade. The diagnosis is considered present if scores of 2 or 3 on a 0–3 scale (indicating that behaviour is “often” or “very often” present) are checked for the requisite number of criteria based on the DSM-IV definition of ADHD diagnosis. The performance section of the VADTRS is an eight-item scale with three items relating to academic performance: (a) reading, (b) mathematics, and (c) written expression. Another five items to evaluate classroom behavioural performance: (e) relationship with peers, (f) following directions/rules (g) disrupting class (h) assignment completion and (i) organizational skills. The teacher rates each of these on a 5-point scale from “problematic” to “above average.” It has an internal consistency reliability of .93

Woodcock 111 Mathematics Fluency Achievement Tests Scale by Woodcock, McGrew and Mather (2007) was used to measure learning disabilities in Mathematics among ADHD pupils used for the study. The scale contains simple addition, subtraction and multiplication as thus, 1+7; 4x3; 7-0; etc. The test has an internal reliability of 0.90. However, ten of the items were adapted and modified to suit the curricula of the pupils to be used for this study. The items were revalidated through a pilot study (testing its suitability with similar audience) using a test-retest to ascertain its reliability. The test-retest produced an internal reliability coefficient of 0.84.

Procedure

Permission to carry out this research was obtained from the school authorities to be used for the study. Preliminary visits were equally made to the three primary schools. Through the visits the researchers got acquainted with the schools, got the class teachers informed of the

purpose of the research work and liaise with them to help in the screening of ADHD pupils and pupils with learning disabilities in Mathematics through the use of a standardized ADHD teacher screening instrument to get participants for the study. This was done through the multi-stage sampling technique.

Similarly, the initial visit to the schools was used as a pilot study. The three primary schools used for the study were far apart to avoid possible contamination. Two schools were used as the treatment groups while one school served as the control group. The treatment groups were trained while the control group members were engaged with their school works. The training was conducted during the participants' extra-curricular activities period. The study was completed within a school term so as to avoid time lag effects on the study. Thus, the researchers conducted training sessions with the two experimental groups for a period of 8 weeks at half an hour each. The participants and the researchers agreed on suitable days of the week when the training sessions were held. The days and time were (Mondays Tuesdays, and Thursdays between

11.00am – 11.30am). This period serves as their extra-curricular activity period.

Method of Data analysis

The following statistical designs were used in this study: Descriptive statistics: These include expressive account of the mean, standard deviation and variance: t-test, Duncan Post Hoc, ANCOVA (Analysis of Covariance) and MCA.

RESULTS

Hypothesis One

There is no significant main effect of treatment on the Mathematics scores of ADHD pupils with learning disabilities in Mathematics.

To test this hypothesis, Analysis of Covariance (ANCOVA) was employed to analyse the post test scores of ADHD pupils with learning disabilities in Mathematics, using the pre-test scores as covariates to find out if post experimental differences were significant. The result obtained was tested at 0.05 significant levels as presented in tables 2

Table 2
Summary of Analysis of Covariance (ANCOVA) of pre-post test interactive effects of Mathematics scores of ADHD pupils with learning disabilities in Mathematics in the Treatment Groups, Age and Gender

Source	Sum of Squares	DF	Mean Square	F	Sig.	Remark
Covariates	4231.015	1	4231.015	19.952	.000	
Main effects	55223.790	4	13805.948	65.104	.000	
Treatment	53986.260	2	26993.130	127.290	.000	Sig.
Trt x Age x Gender	141.991	1	141.991	.670	.416	N.s.
Explained	61598.241	11	5599.840	26.407	.000	
Residual	16540.648	78	212.060			
Total	78138.889	89	877.965			

The result in table 2 showed that there is significant main effect of treatment in the pre-post Mathematics Scores of ADHD pupils with learning disabilities in Mathematics in the experimental and control groups ($F_{(2,78)} = 127.29, p < .05$). This means that there was a significant main effect of treatment in the mean posttest Mathematics scores of participants exposed to treatment and the control group. This implies that ADHD pupils with learning

disabilities in Mathematics in the experimental groups benefited from the treatment package as they were able to improve on their Mathematical skill competences better than ADHD pupils with learning disabilities in Mathematics in the control group who were not exposed to any treatment package. Therefore, the hypothesis is rejected. In order to find out the magnitude of groups mean scores, Table 3 is presented.

Table 3
Multiple Classification Analysis (MCA) showing the direction of the results in the pre-post Mathematics Scores of ADHD pupils with learning disabilities in Mathematics in the Treatment Groups
Grand Mean=76.11

Variable + Category	N	Unadjusted deviation	Eta	Adjusted for independent + covariates deviation	Beta
Treatment Groups:					
Cooperative Learning	30	18.56		20.50	.94
Contingency Contract	30	17.22		18.59	
Control	30	-35.78	.86	-39.08	
Multiple R-squared					.761
Multiple R					.872

The MCA as observed Table 3 showed the performance of all the groups in Mathematics. The Control group had the lowest adjusted posttest mean score ($\bar{x} = 37.0$)

followed by Contingency contracting group with the adjusted mean score ($\bar{x} = 94.7$) while the Cooperative strategy group had the highest adjusted posttest mean score

($\bar{x} = 96.6$). Therefore, the result indicated that the impact of ADHD is most on participants in the control group and less on contingency contracting and cooperative learning strategy groups respectively. The cooperative learning strategy and contingency contracting treatment groups had adjusted posttest scores that were higher than the grand mean while the control group had an adjusted posttest mean score that is below the grand mean. Therefore the direction of increasing main effect of treatment on learning disabilities in Mathematics is cooperative learning strategy >contingency contracting > control.

Hypothesis Two

There is no significant interaction effect of treatment, age and gender on the Mathematics scores of ADHD pupils with learning disabilities in Mathematics. Table 2 showed that in the 3-way interactions, no significant interaction is found ($F_{(1, 78)} = 0.670, P > .05$). This implies that the impact of the interaction of treatment, age and gender on the Mathematics scores of ADHD pupils with learning disabilities in Mathematics was not significant. Therefore the null hypothesis is accepted.

DISCUSSION OF RESULT

Hypothesis One

There is no significant main effect of treatment on the Mathematics scores of ADHD pupils with learning disabilities in Mathematics at post test. The result of the findings revealed that there was significant main effect of treatment on the posttest Mathematics Scores of ADHD pupils with learning disabilities in Mathematics in the experimental and control groups. Therefore, the hypothesis is rejected. This implies that the two therapeutic programme proved to be effective in improving ADHD pupils with learning disabilities in Mathematics competence and ability to adjust to the challenges of applying necessary Mathematical skills to solving Mathematical sums which appear tasking to them before the training. The results of the findings also revealed that ADHD pupils with learning disabilities in mathematics in the cooperative learning strategy group performed better than their counterparts in the contingency contracting technique group. This can be explained in terms of the effectiveness of each of the training programmes in managing the Mathematics challenges of ADHD pupils with learning disabilities in mathematics. This could be attributed to the manner of the utilization of diverse techniques such as homework, revision, discussion and question used in the delivery of the training programmes. Based on their uniqueness, these training programmes are expected to produce varying degree of effectiveness in enhancing the effective management of Mathematical skill deficiencies of ADHD pupils with learning disabilities in mathematics.

Giving credence to this assertion, Jenkins and O'Connor, (2003) found that cooperative learning strategies, is effective in attending to the needs of ADHD pupils expressing learning disabilities in mathematics at the classroom level because it aid in classroom management and provide a means to deliver differentiated instruction. Likewise, Fuchs and Fuchs (2005) posit that many studies of Mathematics disabilities have shown that pairing pupils who have stronger academic skills with those with weaker skills from kindergarten improves outcomes for all pupils and provides opportunities for practice that help acquisition of new knowledge and transfer of skills and content knowledge. Also, as observed, the result is an indication that the training intervention effectiveness could help develop in ADHD pupils with learning disabilities in mathematics resourceful potential that would be useful to them in managing their academic challenges. The result therefore attests to the fact that learning disabilities in mathematics experienced and expressed by ADHD pupils could be managed with the effective use of cooperative learning strategy and contingency contracting technique.

Hypotheses Two

There is no significant interaction effect of treatment, age and gender on the Mathematics scores of ADHD pupils with learning disabilities in mathematics. The result showed that there was no significant interactive effect in the interactions between treatment, age and gender of the posttest Mathematics scores of ADHD pupils with learning disabilities in Mathematics. This suggests the fact that age and gender did not influence the treatment. Therefore the null hypothesis is accepted. However, the likely reason why treatment, age and gender did not interactively have significant effect on the Mathematics scores of ADHD pupils with learning disabilities in Mathematics could be adjourned to the fact that they all experience and express similar measure of inattentiveness, lack of concentration, difficulty in understanding how best to apply or use appropriate Mathematics skills to solve Mathematical problems when the situation arises during classroom teaching and learning situation. Concurring, Deshazo-Barry, Lyman and Klinger (2002) posit that there appears to be a correlation between the severity of the symptoms of ADHD and achievement. Thus, the more severe the symptoms, the greater the negative impact on school performance. This equally supports the fact that the corresponding effect of attention deficit hyperactivity disorder could result to displayed deficit in pupil's self-esteem, expressed helplessness and poor adjustment to teaching and learning situation in classroom.

Recommendations

The family, society and significant others should take time to appreciate and understand the academic and developmental challenges faced and experienced by

ADHD pupils with learning disabilities in Mathematics as to device appropriate measures to help them overcome their challenges and adjust well to teaching-learning situations in the classrooms.

Counselling / psychological intervention programmes should be put in place to help guide ADHD pupils with learning disabilities in Mathematics to self-rediscover their potentials, abilities and capabilities and improve their academic attainment.

CONCLUSION

The findings of this study revealed that the treatment programmes had significant main effect in its interactive effect between treatment, age and gender of ADHD pupils with learning disabilities in Mathematics. Also, learning disabilities in Mathematics can be managed and Mathematics competency skills of ADHD pupils with learning disabilities in Mathematics could be positively improved upon to foster academic success of ADHD pupils with learning disabilities in Mathematics in schools.

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