

## **Efficacy of Two Therapeutic Techniques on Mathematics Anxiety of Pupils with Attention Deficit Hyperactivity Disorder in Emu, Edo State, Nigeria**

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### **ABSTRACT**

*This study aims at determining the efficacy of two therapeutic techniques on mathematics anxiety of pupils with Attention Deficit Hyperactivity Disorder (ADHD) in Emu, Edo State, Nigeria. The study adopts pretest, posttest, control, group quasi-experimental research design with a 3x2x2 factorial matrix. Multi-stage sampling technique is used to select 120 participants from three randomly selected public primary schools in Emu, Edo State, Nigeria. The participants are randomly assigned to treatment and control groups. Participants in the two treatment groups are exposed to eight weeks of Co-operative Learning Strategy and Self-Efficacy Training. Two instruments used are: Vanderbilt ADHD Diagnostic Teacher Rating Scale and Mathematics Anxiety Rating Scale. Two hypotheses are tested at 0.05 level of significance and data analysis is done using Analysis of Covariance and Duncan post hoc. Findings reveal that there is a significant main effect of treatment on mathematics anxiety of pupils with ADHD. Also, Co-operative learning strategy is more effective in reducing mathematics anxiety of pupils with ADHD than self-efficacy training technique. However, there is no significant interaction effect of age and gender on mathematics anxiety of pupils with ADHD used in the study. Therefore, it is recommended that teachers teaching Pupils with ADHD expressing mathematics anxiety should use diverse teaching methods that would interest and meet the needs of Pupils with ADHD.*

**Keywords:** *Attention Deficit Hyperactivity Disorder, Co-operative learning strategy, Mathematics anxiety, Primary school pupils, Self-efficacy.*

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## INTRODUCTION

Attention Deficit Hyperactivity Disorder (ADHD) is a mental disorder that is characterised by problem paying attention, excessive activity, or difficulty controlling behaviour which is not appropriate for a person's age (American Psychiatric Association, 2013). The symptoms appear before a person is twelve years old, are present for more than six months, and cause problems in at least two settings (such as school, home, or recreational activities). In children, problems paying attention may result in poor school performance (American Psychiatric Association, 2013). This implies that the corresponding effect of mathematics anxiety on pupils who express Attention Deficit Hyperactivity Disorder (ADHD) could result in deficit behaviour in form of low self-esteem, expressed helplessness and poor adjustment to teaching and learning situation in the classroom.

Thus, the negative impact of mathematics anxiety on the educational development and academic success of Attention Deficit Hyperactivity Disorder (ADHD) pupils cannot be overemphasized. Pupils with Attention Deficit Hyperactivity Disorder (ADHD) generally have poor scholastic outcomes, including grade retentions and school dropout (Fergusson and Horwood, 1995). Barry, Lyman, and Klinger (2002) have examined the impact of mathematics anxiety on academic underachievement of children diagnosed with ADHD and found that the greater the severity of behavioural disposition in children with ADHD, the greater the negative impact on their school performance. The effect of mathematics anxiety on ADHD pupil is a very important concern given the value of acquired mathematical skills to human capital development.

Ashcraft (2002) defines mathematics anxiety as a feeling of tension, apprehension, or fear that interferes with mathematics performance. Hembree (1990) conducts a meta-analysis of 151 studies concerning mathematics anxiety. The study determines that mathematics anxiety is related to poor mathematics performance on mathematics achievement tests and that mathematics anxiety is related to negative attitudes concerning mathematics. Hembree also suggests that mathematics anxiety is directly connected with mathematics avoidance. Ashcraft (2002) posits that highly anxious mathematics students will avoid situations in which they have to perform mathematical calculations. Unfortunately, mathematics avoidance results in less competency, exposure and mathematics practice, leaving students more anxious and mathematically unprepared to achieve. In college and university, anxious mathematics students take fewer mathematics

courses and tend to feel negative towards mathematics. In fact, Ashcraft found that the correlation between mathematics anxiety and variables such as confidence and motivation are strongly negative. According to Beilock and Willingham (2014), an individual with mathematics anxiety does not necessarily lack ability in mathematics; rather they cannot perform to their full potential due to the interfering symptoms of their anxiety. Mathematics anxiety manifests itself in a variety of ways, including physical, psychological, and behavioural symptoms, capable of disrupting a student's mathematical performance. The strong negative correlation between high mathematics anxiety and low achievement is often thought to be due to the impact of mathematics anxiety on working memory. Working memory has a limited capacity, and when solving mathematical problems, a large portion of this capacity is dedicated to problem solving. However, in individuals with mathematics anxiety, much of this space is taken up by anxious thoughts, thus compromising the individual's ability to perform (Ashcraft and Krause, 2007) and these are evident with ADHD pupils.

Barry, Lyman and Klinger (2002) further compare a group of 33 children, who met the Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association, 1994) criteria for ADHD, with a control group of 33 non-ADHD children. The two groups have average intellectual abilities and ranged in age from 8.9 to 14.5 years. In their study, the group of children with ADHD due to expressed anxiety in teaching and learning situation performed significantly below prediction in mathematics skills and demonstrated a greater discrepancy between actual and predicted achievement than did the group of non-ADHD children. Barry, Lyman and Klinger (2002) state that anxious children with ADHD experience deficits in some of the abilities constituting the executive functions such as planning, organizing, maintaining an appropriate problem-solving skill(s) to achieve a future goal, inhibiting an inappropriate response or deferring a response to a more appropriate time representing a task mentally (i.e., in working memory), cognitive flexibility, and deduction based on limited information.

Children with a diagnosis of Attention Deficit Hyperactivity Disorder commonly present a wide range of characteristics and problems including expressed anxiety and academic underachievement. In fact, it has been estimated that approximately 80% of children with ADHD experience academic underachievement and approximately one-third of children with ADHD have specific learning deficiency in mathematics due to express anxiety in classroom learning activities (DuPaul and Volpe, 2009). Barkley (1990) posits that one essential element in the effective management of mathematics anxiety among

ADHD pupils experiencing learning difficulty in mathematics is the development and implementation of intervention strategies. Thus, behavioural approaches represent a broad set of specific interventions that have the common goal of modifying the physical and social environment to alter or change behaviour (American Psychiatric Association, 2001). They are used in the treatment of ADHD to provide structure for the child and to reinforce appropriate behaviour. Types of behavioural approaches include a systematic programme of contingency management (e.g. positive reinforcement, "time outs," response cost, and token economy), co-operative learning (training in problem-solving and social skills), and cognitive-behavioural treatment (e.g., self-monitoring, verbal self-instruction, development of problem-solving strategies, self-reinforcement) (American Psychiatric Association, 2001).

Diona (2008) asserts that co-operative learning strategy is an important strategy suitable for behaviour modification in teaching and learning situation(s). According to Diona (2008), this strategy is far from being teacher-centered but allows children to be more active throughout the day. Also, co-operative learning strategy has been explained by Slavin (1991), as instructional strategy in which children work in heterogeneous learning teams to help one another to learn academic subjects. Thus, academic success comes from the co-operation of each learner in the group and there are no losers, creating an emotionally safe climate for these children, who have already experienced more than their share of traumatic losses. Self-efficacy is an important concept in social cognitive theory, which has been widely recognized as one of the most prominent theories about human learning (Ormrod, 2008). First developed by Bandura (1977; 1986), self-efficacy refers to learners' beliefs about their ability to accomplish certain tasks.

Many researchers, including Bandura, have demonstrated that self-efficacy affects human motivation, persistence, efforts, action, behaviour, and achievement (Bandura, 1977). Bandura (1982) posited that expressed self-efficacy is one's personal judgement of how well one can execute courses of action required to deal with prospective situations. Expectations of self-efficacy determine whether an individual will be able to exhibit coping behaviour and how long effort will be sustained in the face of obstacles. Stajkovic and Luthans (1998) averred that individuals who have high self-efficacy will exert sufficient effort that, if well executed, leads to successful outcomes, whereas those with low self-efficacy are likely to cease effort early and fail. Psychologists have studied self-efficacy from several perspectives, noting various paths in the development of self-efficacy; the dynamics of self-efficacy, and lack thereof, in many different settings.

According to Luszczynska and Schwarzer (2005) Self-efficacy affects every area of human endeavour. By determining the beliefs a person holds regarding his or her power to affect situations, it strongly influences both the power a person actually has to face challenges competently and the choices a person is most likely to make. These effects are particularly apparent, and compelling, with regard to behaviours affecting health. Researchers have indicated that higher self-efficacy is predictive of higher performance (Bong and Skaalvik, 2003). Studies have provided strong evidence that self-efficacy is a positive predictor of performance outcomes in different subjects (Usher and Pajares, 2008). For instance, Usher and Pajares (2008) argue that self-efficacy "predicts students' academic achievement across academic areas and levels.

Adams (1999) examines the relationship between behavioural problems and academic attainment in a large UK primary school. A school population - 364 children aged 8 to 11 years was assessed on a range of cognitive ability tasks. These included standardized tests of reading, arithmetic and verbal and non-verbal intelligence. Underachievement was assessed using different criteria. To assess behaviour, teacher completed the Strengths and Difficulties Questionnaire for each participating child. Finally, academic progress of subset of children was assessed after one year and the results indicated that there was a significant relationship between behaviour and academic achievement.

Also, prosocial behaviour was positively correlated with reading and arithmetic, while hyperactivity and conduct problems were negatively correlated. This association was especially strong in the children rated by the Questionnaire as hyperactive, and among these children, around 1 in 5 had a specific reading deficit. Barbra and Cosentino (2011) report revealed that girls with ADHD displayed higher levels of mood and anxiety disorders (consistent with those seen in boys with ADHD) than in children without ADHD. Contrary to previous studies which found that girls with ADHD demonstrated greater cognitive impairment than boys, Barbra and Cosentino (2011) report reveal that the magnitude of cognitive impairments was consistent with reports on boys with ADHD.

Attention Deficit Hyperactivity Disorder (ADHD) affecting 4% to 10% of school age children (Skounti, Philalithis, Mpitaraki, Vamvoukas and Galanakis, 2006), is associated with substantial academic underachievement in mathematics and reading (Elia, Ambrosini, and Berrettini, 2008; Spira and Fischel, 2005). For example, about 25% of children with ADHD express poor mathematics achievement (Mayes and Calhoun, 2006). However, in contrast to co-occurring

reading difficulties, mathematical difficulties in ADHD have received scant attention from either clinicians or researchers, despite its functional significance. To fill this gap, this study examines the efficacy of two therapeutic techniques on mathematics achievement of pupils with attention deficit hyperactivity disorder in Emu, Edo State, Nigeria.; as it is believed that effective treatments are needed to manage this behaviour and to improve the academic achievement of pupils with this condition. The experience of persistent failures often have compounding and devastating effect on the academic and intellectual well-being of pupils with Attention Deficit Hyperactivity Disorder (ADHD) expressing deficiencies in mathematics in school as they could feel they have less control over their situations. The consequences of this traumatic experience most times are the display of violence, aggression, truancy, self-isolation and other complex deviant behaviours.

The purpose of this study is to experimentally determine the efficacy of two therapeutic techniques on mathematics achievement of pupils with Attention Deficit Hyperactivity Disorder (ADHD) in Emu, Edo State, Nigeria. Also, this study seeks to determine which of the two experimental programmes is more effective on mathematics achievement of pupils with ADHD. Equally, it seeks to ascertain the impact of the moderating effects of age and gender on mathematics achievement of pupils with this Disorder in Emu, Edo State, Nigeria. The findings of this study could help teachers and other practitioners know how best to support children with ADHD and accompanying learning difficulty in mathematics to develop academic competence or skills that would enable them adjust to school and academic task. This study will form synergy with many practices and procedures that will be helpful for educating pupils with Attention Deficit Hyperactivity Disorder expressing deficiencies in mathematics. The findings would equally bring to the awareness of the government the need to employ more trained and special education teachers in primary schools to help resolve the challenging needs of pupils with ADHD expressing deficiencies in mathematics.

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

1. There is no significant main effect of treatment on the mathematics anxiety scores of pupils with ADHD.
2. There is no significant interaction effect of age and gender on the mathematics anxiety scores of pupils with ADHD



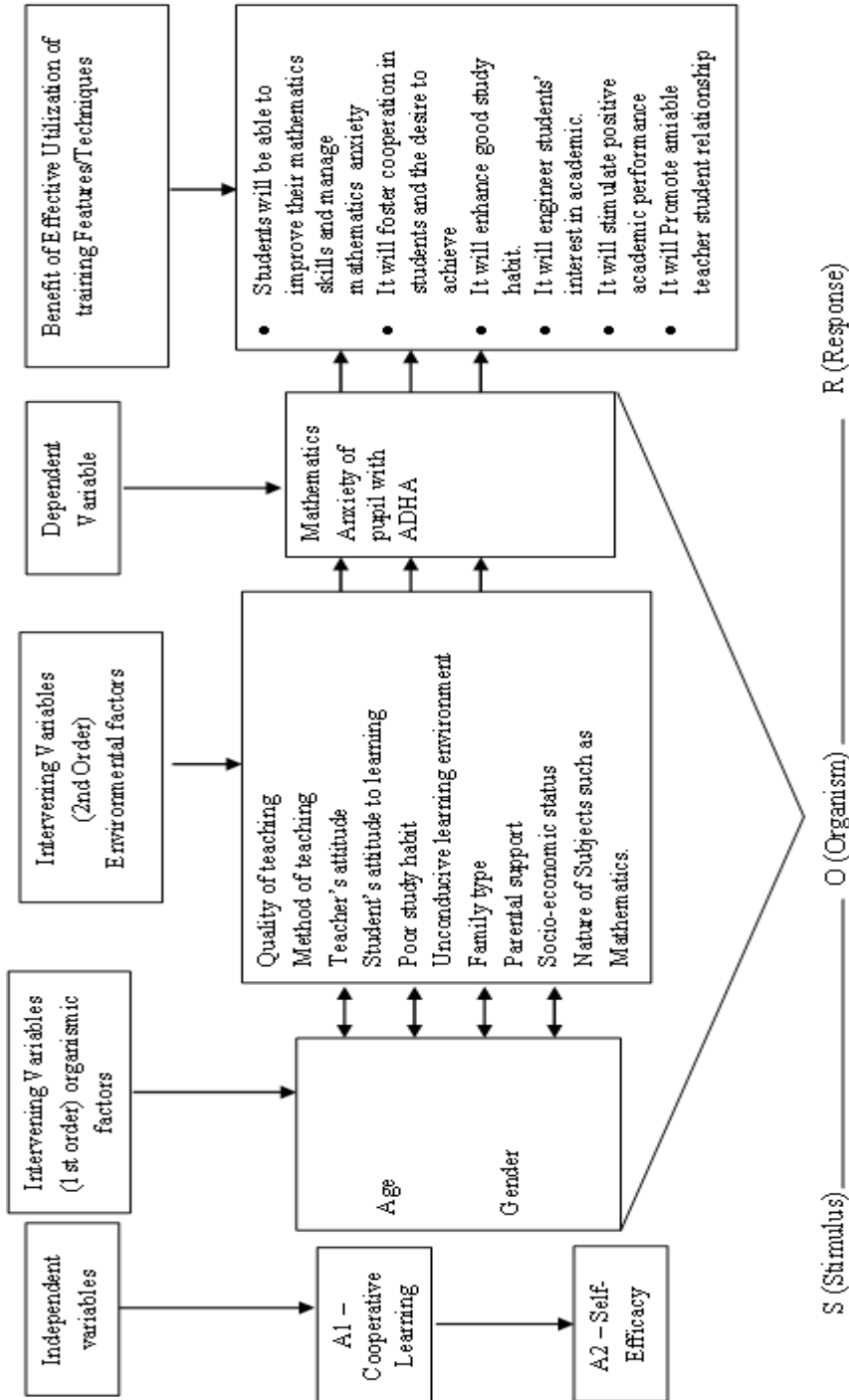


Figure 1: Conceptual Model For The Study

## METHOD

The study adopted a pre-test, post-test, control group quasi-experimental research design with a 3x2x2 factorial matrix. The pre-test, post-test control group design is used in the study because the design has been recognized for its ability to establish causes and effects of relationships due to intervention. It is also able to show the potential for controlling all threats to validity so that a cause and effect relationship could be established. The population consists of all primary five ADHD school pupils expressing mathematics anxiety in Emu, Edo State, Nigeria. The sample for this study consists of one hundred and twenty (male and female) primary five ADHD pupils expressing mathematics anxiety in Emu, Edo State Nigeria. They were selected through multi-stage sampling technique from three randomly selected primary schools used for the study.

The Vanderbilt ADHD Diagnostic Teacher Rating Scale (VADTRS) is a standardized diagnostic teacher rating scale (Wolraich, Hannah, Pinock, Baumgaertel & Brown, 1998) used for the screening of ADHD pupils and selection of ADHD pupils expressing learning disabilities in mathematics as sampled participants for the study. It includes all 18 of the DSM-IV criteria for ADHD. 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

Mathematics Anxiety Rating Scale by Yucedag-Ozcan and Brewer (2011) was used in this study. The scale has 24 questions and is scored from 1 to 5, where 1 indicates no anxiety and 5 indicates high anxiety. There are two factors in the scale. The first factor is Learning Mathematics Anxiety, which includes items that measure anxieties experienced during activities that deal with learning mathematics, such as listening to another student explain a mathematics formula. The second factor is Mathematics Evaluation Anxiety, which contains eight items that measure the anxiety experience of being evaluated, such as taking an exam in a mathematics course. The scale has a Cronbach’s alpha of  $\alpha = .93$ .

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 difficulty 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. The three primary schools used for the study were far apart to avoid possible contamination. The treatment groups were trained while the control group members were engaged with their school work. 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 researcher agreed on suitable days of the week when the training sessions were held. The days and time were (Wednesday and Friday between 11.30am – 12noon). This period serves as their extra-curricular activity period. To avoid mortality effect of participants, positive reinforcement strategies were used in the like of giving out pencils, biros and note books to participants who responded positively to the treatment activities as a measure to motivate them.

In controlling extraneous variables that possibly could affect the results of the study, null hypotheses were tested to guide against experimental biases. Thus, equal numbers of participants were randomly assigned to experimental and control groups. Rosenthal effect was controlled by keeping the control group busy with their usual daily school routine during the experimental sessions. Also, the method of data analysis employed, Analysis of Covariance (ANCOVA) was used to control extraneous variables beyond the reach of the design and other procedure of research. ANCOVA (Analysis of Covariance) and Duncan post hoc were the statistical tools used data analysis.

## **RESULTS AND DISCUSSION**

The result in table 1 shows that there was significant main effect of treatment in the pretest/post-test mathematics anxiety scores of pupils with ADHD in the experimental and control groups ( $F_{(2,117)} = 117.701, p < .01$ ). This implies that pupils with ADHD in the experimental groups benefited from the treatment package as they were able to reduce their anxiety and improve on their mathematical skill competences better than pupils with ADHD in the control group who were not exposed to any treatment package. Therefore, the hypothesis that there is no significant main effect of treatment on the mathematics anxiety scores of pupils with ADHD is rejected.

**Table 1:** Summary of Analysis of Covariance (ANCOVA) of Pre-Post Test Interactive Effects of Mathematics Anxiety Scores of Pupils with ADHD in the Treatment Groups, Age and Gender

Source	Sum of Squares	DF	Mean Square	F	Sig.	Remark
Covariates	3211.115	1	3211.115	22.307	.000	
Main effects	36223.690	4	9055.923	62.910	.000	
Treatment	33886.160	2	16943.08	117.701	.000	Sig.
2-ways Interactions						
Age x Gender	151.191	2	75.596	.525	.416	N.S.
Explained	41491.241	11	3771.931	26.203	.000	
Residual	15546.618	108	143.950			
Total	57037.859	119	479.311			

\*Significant at 0.01 (2tailed) \*\* Significant at 0.05 (2tailed)

As observed in Table 2, Duncan Post-Hoc analysis reveals the differential-values of the pre and post treatment outcome and equally shows the effectiveness of the treatment package over the control (i.e. non-treatment group). The control group had the highest adjusted posttest mean score ( $\bar{x} = 37.20$ ) followed by self-efficacy group with the adjusted mean score (= 24.70) while the Co-operative learning strategy group had the least adjusted posttest mean score (= 22.61). Therefore, the result indicates that the impact of mathematics anxiety is much on ADHD pupils in the control group and less on self-efficacy and cooperative learning strategy groups respectively.

**Table 2:** Duncan Post-Hoc multiple range comparison of the posttest mean scores of treatment on mathematics anxiety of pupils with ADHD.

Measure	Treatment Groups	CLS, SE, Control Mean
Mathematics Anxiety	Cooperative Learning Strategy	22.61
	Self-Efficacy	24.70
	Control	37.20

To test the hypothesis that there is no significant interaction effect of age and gender on the mathematics anxiety scores of pupils with ADHD, Table 2 shows that in 2-way analysis interaction there was no significant interactive effect between age and gender ( $F_{(2, 117)} = .525, P > .05$ ). This implies that the impact of the interaction of age and gender on the mathematics anxiety scores of pupils with ADHD is not high enough for it to be significant. Therefore the null hypothesis was accepted.

The result of the findings reveals that there was significant main effect of treatment on the pre-posttest mathematics anxiety scores of pupils with ADHD in the experimental and control groups. This indicates that the two treatment programmes were efficacious in reducing mathematics anxiety of pupils with ADHD. The findings prove that if pupils with ADHD expressing mathematics anxiety are exposed to corrective interventions as measures to help them explore and maximally use their potentials, it could go a long way to help them reduce the expression of mathematics anxiety and improve their academic achievement in mathematics and also, raise their self-confidence and belief that they have what it takes to succeed in school. The results of the findings also reveal that pupils with ADHD who are expressing mathematics anxiety in cooperative learning strategy group performed better in their ability to reduce their expressed mathematics anxiety than their counterparts in self-efficacy training group. This can be explained in terms of the effectiveness of each of the training programmes in managing the mathematical challenges of pupils with ADHD experiencing learning difficulty in mathematics. This finding corroborates the report of Barkley (1990) who posited that one essential element in the effective management of mathematics anxiety among ADHD pupils experiencing learning difficulty in mathematics is the development and implementation of intervention strategies.

Thus, behavioural approaches represent a broad set of specific interventions that have the common goal of modifying the physical and social environment to alter or change behaviour (American Psychiatric Association, 2001). They are used in the treatment of ADHD to provide structure for the child and to reinforce appropriate behaviour. Types of behavioural approaches include a systematic programme of contingency management (e.g. positive reinforcement, “time outs,” response cost, and token economy), co-operative learning (training in problem-solving and social skills), and cognitive-behavioural treatment (e.g., self-monitoring, verbal self-instruction, development of problem-solving strategies, self-reinforcement) (American Psychiatric Association, 2001). Also, Diona (2008) asserted that co-operative learning strategy is an important strategy suitable for behaviour modification in teaching and learning situation(s).

According to Diona (2008) this strategy is far from being teacher-centered but allows children to be more active throughout the day. Also, co-operative learning strategy has been explained by Slavin (1991) as instructional strategy in which children work in heterogeneous learning teams to help one another to learn academic subjects. Thus, academic success comes from the co-operation of each learner in the group and there are no losers, creating an emotionally safe

climate for these children, who have already experienced more than their share of traumatic losses.

The result on table 2 further shows that there was no significant interactive effect in the interaction between age and gender in the posttest mathematics anxiety scores of pupils with ADHD expressing deficiencies in mathematics achievement. Therefore, the hypothesis is accepted. This implies that age and gender had no moderating influence on the mathematics anxiety scores of pupils with ADHD expressing deficiencies in mathematics achievement. This could be premised on the fact that either being older or younger, boy or girl pupils with ADHD expressing deficiencies in mathematics achievement do express the same feeling of worthlessness, confusion and helplessness based on this, they equally exhibit same trait of anxiety, class disruptions, lack of concentration and lack of confidence. Hence, this could likely be the reason why age and gender did not have significant interactive effect on the mathematics anxiety scores of pupils with ADHD expressing deficiencies in mathematics achievement. Supporting this point of view is the report of Barbra and Cosentino (2011) which revealed that girls with ADHD displayed higher levels of mood and anxiety disorders (consistent with those seen in boys with ADHD) than in children without ADHD. Contrary to previous studies which found that girls with ADHD demonstrated greater cognitive impairment than boys, Barbra and Cosentino (2011) report reveal that the magnitude of cognitive impairments was consistent with reports on boys with ADHD.

## CONCLUSION AND RECOMMENDATIONS

Cooperative learning strategy and contingency contracting technique were effective in improving the mathematics competency skills of pupils with ADHD expressing deficiencies in mathematics. Therefore, teachers should use these methods appropriately during teaching and learning experience. Pupils with ADHD expressing deficiencies in mathematics achievement should be given adequate academic orientation and re-orientation on the need for them to develop positive attitude to school and learning. Teachers teaching Pupils with ADHD expressing deficiencies in mathematics achievement should use diverse teaching methods that would interest and meet the needs of Pupils with ADHD. Counselling / psychological intervention programmes should be put in place to help pupils with ADHD expressing deficiencies in mathematics achievement to self-rediscover their potentials and improve their academic attainment.

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