Effects of Cognitive Restructuring and Systematic Desensitization Techniques on Students' Mathematics Anxiety in Senior Secondary Schools in Gombe Metropolis, Gombe State

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Abstract

This study examined the effects of cognitive restructuring technique and systematic desensitization technique on students' mathematics anxiety in senior secondary schools in Gombe Metropolis, Gombe State, Nigeria. A quasi-experimental design of non-equivalent pretest-posttest control group design was adopted. The target population was 5780 SS2 students in Gombe State out of which 146 students were drawn as sample. Three schools were purposefully selected for the study. The selected schools were assigned randomly into experimental groups and control group. Since treatment was done in group, an intact SS2 class was randomly selected in each of the groups. The experimental group were given seven weeks cognitive restructuring and systematic desensitization techniques while those in the control group were taught with the conventional method. Data was collected using the Students' Mathematics Anxiety Questionnaire (SMAQ). The study's findings revealed a significant effect of cognitive restructuring technique (F = 8.324, p = .005), a significant effect of systematic desensitization technique on mathematics anxiety among students (F = 637.605, p = .000) and a significant combined effects of cognitive restructuring and systematic desensitization techniques on mathematics anxiety among students (F =

406.025, p = .000). Both techniques were effective in the reduction of mathematics anxiety among the participants. Recommendation was made based on the findings of the study that counsellors should cognitive restructuring technique and systematic desensitization technique in addressing students' mathematics anxiety.

Keywords: Cognitive Restructuring, Systematic Desensitization, Mathematics Anxiety,

Introduction

Mathematics is an important subject that has been made compulsory for admitting candidates into almost all the disciplines in tertiary institutions in Nigeria. It is one of the core subjects for all students at all levels and a foundation of all scientific processes. Fajemidagba, Salman and Ayinla (2012) stated that mathematics is a compulsory and equally an important subject which is seen as a tool for the development of any science-based discipline that includes; technology, astronomy, graphics, industry and analytical reasoning in daily living. It is seen to be a subject for everyday use, in the marketplace, school or even at home. Adeneye and Abisola (2020) observed that mathematics not only enhance problem solving and analytical skills of students but promote their logical, functional and aesthetic skills. As stated by Martins, (2013), it can also be seen as the mother of all the school subjects since it is found in all the school curriculum. In the secondary schools, it is envisaged that students develop phobia towards mathematics or performing academic tasks thereby judging themselves as incapable of undertaking such tasks.

Mathematics education in Nigeria has been experiencing one form of problem or the other, which include students' unparalleled hatred, indifference, phobia and poor attitude towards the subject (Adebule 2004). It is also observed that one of the major causes of low performance in math subject among secondary school students is anxiety. It is a state of fear for subject, a living or something uneasy. Okigbo (2010) noted that anxiety is an academic illness whose cause has not yet been adequately diagnosed for an effective treatment in the class with its symptoms usually manifested on the faces of mathematics students in their classes. According to Ihendinihu, (2013) students who believed that mathematics is a task demanding subject are most of time not serious in the learning of the subject and therefore perform low in tests and/or examinations. Such students are believed to develop phobia /fear on mathematics which may hamper their academic performance.

Mathematics anxiety is a real problem facing students and teachers today. In view of Boruah and Saika (2014) mathematics anxiety is the fear that hinders mathematics

performance. According to Bursal and Paznokas, (2006) mathematics anxiety is a multidimensional construct with cognitive as well as affective roots characterized by feelings of tension, panic, and fear when confronted with mathematics. In addition to physical symptoms, students with mathematics anxiety frequently exhibit avoidance behaviours when faced with situations related to mathematics. It is an attitudinal learning problem resulting from perceived difficulty in mathematics. It is also reported that factors which make students develop fear towards mathematics may include friends, who sometimes say mathematics is not easy, parents who say to the children's hearing that, they see mathematics as highly complicated and teachers who may pass the bias to the pupils by making them believe that there is a connection between the marks they get in the mathematics class and self-confidence (Baloglu & Kocak 2003). Students with mathematics anxiety are also less likely to continue working on problems if they fail to understand it the first time. It is believed that victims of mathematics anxiety manifest symptoms of mathematical fear, boredom, worry, poor performance, failure to do assignment and class and teacher avoidance (Zalmon, Daso, & Njoku, 2021). It is believed that mathematics anxiety is now common among both male and female students and to a large extent more females experience mathematics fear than males (Peteros, Gamboa, Etcuban, Dinauanao, Sitoy, & Arcadio, 2020).

Gender is seen as one of the major predictors of human conduct and differences on attitude and behaviour that do affect academic performance of males and females, (Block, 2006). Mathematics anxiety among male and female students is influenced when they feel unsatisfied about in the course of subject study. Their belief that one understands about math leads to success is contributory to their phobia. Moreover, their phobia is also affected when feelings are discontent about their whole being. As stated by Ma and Cartwright, (2003) all students experience some sort of mathematics anxiety but the overall level of mathematics anxiety appears to be greater in females than in males. According to Mutodi and Ngirande (2014) there is a high level of mathematics anxiety among female students than male students. In another point on view, it is believed that that females excel at a higher rate when learning mathematics through rules and those young girls are socialised to be dependent. They receive more protection and more assistance in doing tasks from their parents and teachers than boys receive which remove their fear of mathematics. It is

observed that some of the causes of low academic performance in mathematics among male and female students include negative attitude toward mathematics, fear, inadequate qualified/trained teachers and insufficient instructional aids (Isack 2015).

The poor performances in mathematics over the years have been worrisome which have been linked to the fear of the subject by students. Considering the relevance of mathematics in getting admission into higher institutions of learning, there is a need to identify students with mathematics anxiety so as to help them reduce their fear in mathematics. Similarly, there has been a consistent downward trend in the performance of students in Gombe State in the subject mathematics which may be related to anxiety. The consequences of having anxiety about mathematics point out the need and urgency in helping students overcomes their fear. For instance, the rate of failure in the Examinations results in Nigeria conducted by NECO, NABTEB and WAEC respectively is worrisome. It is also observed that the reoccurring failure in the performance of secondary school students in mathematics has been a source of great concern to all stakeholders and as such attracted much research interest (Aliyu, 2021). The analysis of SSCE results from year 2011 to 2018 in Gombe State is an example which revealed that only in year 2017 those candidates of the state who got 5 credits and above including Mathematics reach up to 25% (M.O.E, EMIS, 2019). This shows that there is still the need for much improvement which calls for counselling intervention (Aliyu, 2021). The interventions in this study are through two therapeutic counselling techniques: Cognitive restructuring and systematic desensitization.

Cognitive Restructuring (CR) and Systematic desensitization (SD) techniques are behavioural techniques for helping students overcome typical behaviour and various challenges. Similarly, each technique was used in reducing mathematics anxiety of secondary school students and has been reported to be effective to suit the aim in times past. For instance, Ernest-Ehibudu, (2017), Olubusayo (2014) and Ernest-Ehibudu, and Wayil, (2017) reported effectiveness of the two techniques on mathematics anxiety of secondary school students, as such, the two techniques were employed in this study to ascertain their relative effectiveness between them in reducing mathematics anxiety.

Cognitive restructuring was originally developed by Albert Ellis and Aaron Beck. It is a psychological and therapeutic process of learning aimed to identify and change

irrational or unwanted thoughts and feelings. Cognitive restructuring is a useful technique for understanding unhappy feelings and moods, and for challenging the sometimes-wrong automatic beliefs that can lie behind them. As such, it can be used to reframe the unnecessary negative thinking and fear that one experiences from time to time. It is a relatively short term treatment process of recognizing, challenging, changing cognitive distortions and negative feelings with the help of a therapist trained in cognitive therapy or cognitive behavioural therapy (Rupke, David & Marjorie, 2006). The emphasis during the treatment is to help a student modify his distorted perception of the world caused by negative mind set. The technique focuses on interaction of thoughts, feelings and emotions. Cognitive restructuring helps in monitoring, cognitive distortions, imaginable exposure, behavioural activation and homework assignments to achieve reduction (Huppert, 2009).

The second technique used in this study is systematic desensitization, which aims to remove the fear that is related to being capable of performing and accomplishing a task, and substitute a relaxation response to the conditional stimulus gradually using counter conditioning. According to Egbule (2009), systematic desensitization is a therapeutic intervention technique based on social learning principles for the treatment of phobias and anxieties on various populations with various maladaptive fears and other objects or situations that are typically fear producing based on principles of behaviour modification. Systematic desensitization technique is effective when dealing with anxiety and other fear-related problems. The individual is given small doses of what is feared until a relaxed response is built up (Mayange, 2014). Desensitization may remove some various fears and give the child the courage to attempt unfamiliar tasks.

Moreover, while acknowledging the fact that some studies like Karfe and Ntasin (2018), Ernest-Ehibudu and Wayil, (2017), Egbochuku and Obodo, (2005) and Ifeanyi, Anyamene, and Nwokolo (2015) have demonstrated the effects of cognitive restructuring technique in the reduction of mathematics anxiety and other unwanted behaviours, there is still the need to apply two techniques; cognitive restructuring and systematic desensitization techniques in addressing mathematics anxiety of senior secondary school students. It is based on this background that this study investigated the effects of cognitive restructuring and systematic desensitization techniques on mathematics anxiety among senior secondary school students in Gombe Metropolis, Gombe State.

Purpose of the Study

1. To determine the effect of cognitive restructuring on mathematics anxiety among senior secondary school students in Gombe Metropolis.
2. To determine the effect of systematic desensitization on mathematics anxiety among senior secondary school students in Gombe Metropolis.
3. To determine the combined effect of cognitive restructuring and systematic desensitization on mathematics anxiety among senior secondary school students in Gombe Metropolis.

Research Hypotheses

The following research hypotheses were tested at 0.05 level of significance

1. **H_{01}:**There is no significant effect of cognitive restructuring on mathematics anxiety among senior secondary school students in Gombe Metropolis.
2. **H_{02}:** There is no significant effect of systematic desensitization on mathematics anxiety among senior secondary school students in Gombe Metropolis.
3. **H_{03}:** There is no significant combined effect of cognitive restructuring and systematic desensitization on mathematics anxiety among senior secondary school students in Gombe Metropolis.

Methodology

This study employed the use of a quasi-experimental design namely; non-equivalent pretest posttest control group design. The population of this study comprised all public senior secondary school two (SS2) students in Gombe Metropolis, Gombe State. The said population as at 2021/2022 academic session is 5,780 (3219 males and 2561 females). (EMIS Gombe, 2022). Three schools were purposefully selected for the study. The criteria for selection was that the schools must be co-educational, have provision for guidance and counselling in their time-table, and at least one career master/para counsellor/counsellor. The selected schools were randomly assigned into experimental groups and control group. Since treatment was done in group, an intact class SS2 class was randomly selected in each of the groups (Cognitive Restructuring Technique, Systematic

Desensitization Technique, and Placebo). The participants in those intact classes constituted the samples for the study as reported in the table 1.

Table 1: Sample Distribution by School

S/n	Schools	Groups	Male	Female	Samples
1.	GDSSS GOMBE II	Exp. 1	29	22	51
2.	GDSSS GABUKKA	Exp. 2	25	17	42
3.	GDSSS GANDU	Ctrl	32	21	53
	Total		86	60	146

Source: Field Study

A preliminary test was administered to the students found in the selected intact classes so as to identify students with mathematics anxiety using the Students' Mathematics Anxiety Questionnaire (SMAQ) designed by the researchers. Only those that have mathematics anxiety as obtained from the preliminary test participated in the study as seen in table 1.

The instrument used in this study is a researcher designed questionnaire named Student mathematics anxiety Questionnaire (SMAQ). The instrument is 17-item instrument which sought from the respondents' information regarding their opinion on learning mathematics on a four response format scored as follows: Almost never = 1, Sometimes = 2, Often = 3, Almost often = 4. The minimum obtainable score is 1 x 17 = 17 while the maximum obtainable score is 68. A score below 43 is seen as low mathematics anxiety while a score of 43 and above reflects greater mathematics anxiety. Data collected were analyzed using analysis of covariance (ANCOVA) at 0.05 level of significance.

Results

The results are as presented below

H_{01}: There is no significant effect of cognitive restructuring on mathematics anxiety among senior secondary school students in Gombe Metropolis.

Table 2: ANCOVA Statistics on the Effects of CRT on Mathematics Anxiety
Univariate Tests
Dependent Variable: POSTTEST

	Sum of Square	Df	Mean Square	F	Sig.	Partial Eta Square
Contrast	154.475	1	154.475	8.324	.005	.084
Error	1688.673	100	18.557			

Source: Field Study

The result in table 2 revealed that there is a significant effect of cognitive restructuring technique on mathematics anxiety among senior secondary students (F = 8.324, P = .005), that is a univariate F-ratio of 8.324 which was found to be significant beyond the predicted 0.05 level of significance. Hence the null hypothesis that there is no significant effect of cognitive restructuring technique (CRT) on mathematics anxiety among senior secondary school students in Gombe metropolis was rejected. This implies that cognitive restructuring technique is effective in reducing mathematics anxiety among students.

H_{02}: There is no significant effect of systematic desensitization on mathematics anxiety among senior secondary school students in Gombe Metropolis.

Table 3: ANCOVA Statistics on the Effects of SDT on Mathophobia
Univariate Tests
Dependent Variable: POSTTEST

	Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Contrast	12582.198	1	12582.198	637.605	.000	.864
Error	1973.355	91	19.734			

Source: Field Study

The result in table 3 revealed that there is a significant effect of systematic desensitization technique on mathematics anxiety among senior secondary students (F = 637.605, P = .000), that is a univariate F-ratio of 637.605 which was found to be significant beyond the predicted 0.05 level of significance. Hence the null hypothesis that there is no significant effect of systematic desensitization technique (SDT) on mathematics anxiety among senior secondary school students in Gombe metropolis was rejected. This implies that systematic desensitization technique is effective in reducing mathematics anxiety among students.

H_{03}: There is no significant combined effect of cognitive restructuring and systematic desensitization on mathematics anxiety among senior secondary school students in Gombe Metropolis.

Table 4: ANCOVA Statistics on the Combined Effects of CRT and SDT on Mathematics Anxiety

Univariate Tests

Dependent Variable: POSTTEST

	Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Contrast	17261.387	2	8630.693	406.025	.000	.851
Error	3018.434	142	21.257			

Source: Field Study

The result in table 3 revealed that there is a significant combined effect of cognitive restructuring and systematic desensitization techniques on mathematics anxiety among senior secondary students (F = 406.025, P = .000), that is a univariate F-ratio of 406.025 which was found to be significant beyond the predicted 0.05 level of significance. Hence the null hypothesis that there is no significant combined effect of cognitive restructuring and systematic desensitization techniques on mathematics anxiety among senior secondary students in Gombe metropolis was rejected. This implies that cognitive restructuring and systematic desensitization techniques combined reduced mathematics anxiety among students.

Discussion of findings

The findings of this study revealed that there is a significant main effect of cognitive restructuring technique on mathematics anxiety among senior secondary school students. The observed could mean that CRT was effective in reducing the level of mathematics anxiety among students. The findings also revealed significant reduction of mathematics anxiety among students exposed to systematic desensitization technique. The students in the experimental group were exposed to CRT and systematic desensitization techniques to reduce their levels of mathematics anxiety after which they showed a significant difference in their post test scores when compared to the control group whose participants exhibit no significant difference in their post-test scores.

The findings of the present study corroborate with the findings of Ernest-Ehibudu (2017), on the effectiveness of cognitive restructuring in the Management of mathophobia among secondary school students in Khana Local Government Area of Rivers State, Nigeria. The findings of the present study also corroborate with the findings Olubusayo, (2014) on the effect of cognitive restructuring on the reduction of mathematics anxiety among senior secondary school students in Ogun State, Nigeria. Similarly, the findings also corroborate with the findings of Ernest-Ehibudu and Wayil (2017) on the effect of cognitive restructuring and systematic desensitization in the management of mathophobia among secondary school students in Khana Local Government Area of Rivers State, Nigeria. The findings also corroborates with findings of Askhia (2014) on the effectiveness of cognitive restructuring on mathematics anxiety among students in Ogun State.

Conclusion

Based on the findings of this study it can be concluded that CR is an effective counselling technique in the management of mathematics anxiety among secondary school students. It was also established that systematic desensitization is effective on the reduction of students' mathematics anxiety. Moreover, the findings also revealed that systematic desensitization had a greater positive effect in reducing mathematics anxiety than cognitive restructuring when the two techniques were compared. It is also concluded that gender difference exists in the fear of mathematics among senior secondary school students.

Recommendations

It was recommended that

i. School Guidance counsellors should use Cognitive Restructuring Technique (CRT) to reduce mathematics anxiety among senior secondary school students in Metropolis, Gombe State.
ii. Mathematics teachers should also be discouraged from using discouraging comments on students with mathematics anxiety, but assist them using these two techniques.

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