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Efficacy of psychoeducation and problem-solving therapy on mathematics anxiety among selected secondary school students in Ilesa, Osun state, Nigeria

Samson Femi Agberotimi, Abayomi Oladele Olaseni, Olaitan Temitayo Oladele

ABSTRACT

Aims: This study examined the efficacy of psychoeducation and problem-solving therapy on mathematics anxiety among secondary school students in Ilesa, Osun state, Nigeria. it was further aimed to investigate if male and female students differ on math anxiety before and after treatment. Methods: A pre test, post test control group quasi-experimental design was used. 45 students comprising 16 (35.6%) male and 29 (64.4%) female whose ages ranged between 14 and 18 years (X = 15.91, S.D. = 1.07) participated in the study. Data were collected with a structured questionnaire. Analysis of covariance and independent sample *t*-test were used for statistical analysis. Results: Results revealed that treatment has a significant main effect on reduction of students' math anxiety (F (2, 38) = 28.98, *p* <0.05), gender does not significantly influence students' math anxiety (F (1, 38) =0.01, *p* > 0.05), treatment and gender do not interactively and significantly have effect on students' math anxiety (F (2, 38) = 0.51, *p* > .05). Conclusion: In conclusion, the two treatments conditions employed in this study were effective in treating math anxiety among secondary school students.

Keywords: Mathematics anxiety, Problem-solving therapy, Psychoeducation

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INTRODUCTION

The concept of mathematics anxiety has over the years attracted many researchers; hence, it has been defined in various ways. Dreger and Aiken were first to describe the phenomenon as student's attitudinal difficulties with mathematics following their observation of undergraduate college students reacting emotionally to arithmetic and mathematics [1]. They labeled it 'number anxiety'. Richardson and Suinn defined mathematics anxiety as a feeling of tension and anxiety that interfere with the manipulation of mathematical problems in varied situations in ordinary as well as academic life purported further that the anxiety felt while dealing with the numbers is not restricted to the classroom setting but cut across every daily life activities in which numbers is involved [2, 3].

Mathematics anxiety was further described in terms of negative attitude towards mathematics that is found in people with math anxiety [4]. It can also be explained as a sense of discomfort while working on mathematical problems [5, 6]. Factors such as helplessness, panic, and paranoia which often incapacitate math anxious individuals from performing at their potential have also been identified with math anxiety [7].

In addition to avoidance behavior which is often observed in math anxious individuals, Beilock and Carr also reported certain behavioral manifestations in individuals with math anxiety which include becoming jittery, sweating profusely, and having quick, and shallow breathing [8].

Research on the causes of math anxiety set forth many reasons for the grounds of the anxiety. Reasons why people become math anxious have been broadly classified into three. In a review, adverse encounters especially with teachers in the course of learning mathematics was considered environmental factor [9–11], also identified personal attributes such as low self-esteem, lack of confidence and the effect of past negative experiences with mathematics as the second main cause of math anxiety. Finally, cognitive causes which include inborn attributes such as low intellectual or poor cognitive abilities needed to perform well in mathematics were highlighted by [10]

The prevalence of math anxiety appears to be high. For instance, Jones [12] found that 25.9% of over 9,000 American students had a moderate to high need of help with maths anxiety. Investigating the prevalence of math anxiety among college students in Wichita state university, Zettle and Raines also found that majority of students who enrolled in college algebra and courses preparatory to it rated themselves to be math anxious [13]. Math anxiety has been reported more among the female gender than the male. Several studies among high school and college students found that women rate themselves as more math anxious than men [14–17]. However, Arigbabu et al. observed that male students were more anxious than their female counterparts [18]. In another study among senior secondary school students in Ogun state, Nigeria, O.A. Asikhia concluded that sex affect math anxiety among students and that both male and female do not equally become anxious of mathematics [19]. Despite many reports on gender difference on math anxiety, some researchers have argued that there is no significant difference in mathematics anxiety between males and females [20, 21].

Previous research has identified low confidence and poor performance in tasks that require mathematics skills by math anxious individuals as compared to their peers who did not score high on math anxiety [22–25]. Beilock et al. observed among young children that not only do they experience math anxiety, but their anxiety is associated with poor performance in math [4]. In a similar study among 10th grade high school students, Karimi and Venkatesan found that math anxiety has significant negative relationship with math performance [17].

However, it has been earlier reported that math anxiety is not a function of intelligence because students who excelled in other subjects have been found to exhibit anxiety about mathematics, thus had negative influence on their choice of career [26].

Okoiye and Falaye further explained that mathematics anxious individuals tend to perform below their intellectual capability because of the high level of stress and tension that characterized mathematics anxiety [27]. They further noted difficulty in finding solution to problems and feeling of helplessness in math anxious individuals. Students with math anxiety have also been found to demonstrate pain and frustration in response to mathematics [28].

In a bid to offer lasting solution to the problem of math anxiety, researchers and experts have over the years explored different kinds of approaches to intervention. Such approach involves dealing with math anxiety as a specific phobia, hence taking the affective, cognitive, abstract perspective in the treatment of math anxious students. However, cognitive behavior therapy has been found to be an effective approach in treating math anxiety especially in adolescent and adult age category because of the intellectual capacity required to take certain cognitive behavior therapy principles. For example, cognitive behavior group therapy was reported highly effective in reducing math anxiety among high school students after receiving treatment for 15 sessions of 1.5 hours – two times in a week [17]. R.D. Zettle reported a significant reduction in math anxiety after exposing math anxious individuals to acceptance and commitment therapy and systematic desensitization [29]. Furthermore, the reduction was noted for both interventions were maintained during two months of follow-up.

In Nigeria, Okoiye et al. reported that Rational Emotive Behaviour Therapy (REBT) was effective in reducing mathematics anxiety among in-school adolescents in Owerri [30]. They further observed that gender did not have a significant effect on mathematic anxiety, implying that both male and female were similar on math anxiety. In another study, cognitive restructuring was found effective in reducing students' math anxiety [19].

Despite several kinds of efforts by individuals and government agencies in response to the consistent poor performance in mathematics in the West African Senior School Certificate Examination (WASSCE) and National Examination Council (NECO), the country continues to witness the poor performance in mathematics. For instance, while announcing the result of the WASSCE 2014, Dr Chales Eguridu, the Head of National Office of WAEC reported that there has been a sequential decrease in the rate of passes recorded in mathematics by candidates who sat for May/June WASSCE from 38.81% in 2012 to 31.28% in 2014 [31]. In line with this situation and previous studies which has strongly linked math anxiety with performance, the present researchers embarked on this intervention study to assist secondary

school students with math anxiety to become less anxious and thus perform better in mathematics.

MATERIALS AND METHODS

Study Design

This study adopted the pre-test, post-test control group quasi experimental design involving a 3x2 factorial matrix. Treatment group (problem solving therapy, psychoeducation and control) were crossed with gender (male and female), while pretest math anxiety was controlled for.

Study Setting

The study was conducted in St. Lawrence's Grammar School, Ilesa, Osun State Nigeria. Ilesa is a city located in the south west of Nigeria; it is also the name of a historic state centered on that city. The state was ruled by a monarch bearing the title of Owa Obokun Adimula of Ijesaland comprises total population of 139,445.

Study Participants

One hundred and seventy-five students were screened for math anxiety with Revised Mathematics Anxiety Rating Scale (RMARS). Based on the norm of 33 points for classification into high level of mathematics anxiety, eighty-two (82) students were found to be high on mathematics anxiety and showed interest in the study. Forty-five students were subsequently randomly selected as participants for the study. The participants comprised 16 (35.6%) male and 29 (64.4%) female, their ages ranged between 14 and 18 years with mean 15.91 and standard deviation 1.07. The participants were randomly assigned into three groups (15 students in each group).

- Inclusion criteria
  - Students in the senior secondary school category in the SS2 class.
  - Students who signed and returned the inform consent letter given to them
  - Participants who score higher than average on the RMAS (this criterion is specific to the second phase – intervention phase – of the study.

Instrument

A structured questionnaire format was used to collect data in the present study. The questionnaire is made up of two sections. Section one elicited demographic data.

Section two is the Revised Mathematics Anxiety Rating Scale (RMARS) [32]. The scale is a 16-item instrument designed to measure the level of mathematics anxiety in secondary school students. The RMARS is highly related to the MARS with the estimated correlation at 0.97, and yields a coefficient alpha reliability estimated at 0.98 [32]. RMARS has two subscales: Learning Mathematics Anxiety, which relates to the anxiety about the activity or process of learning math, and Mathematics Evaluation Anxiety, which relates to the anxiety about the evaluation of mathematics learning. In this study, the subscale for Learning Mathematics Anxiety was used to assess students' anxiety during mathematics learning activities and implemented before and after the intervention. The scale has five response options ranging from "not at all" with 0 point to "very much" with 4 points. Cronbach's alpha of 0.91 was determined by Q Wei, while α 0.85 was established in the present study [33].

Psychoeducation Guidelines

- Definition of math anxiety
- Identifying signs and symptoms of math anxiety
- Discussing the etiology of math anxiety
- Discussing the maintaining factors of math anxiety, as well as its consequences
- Explaining treatment options as curative measures
- Review progress/Evaluate the outcome

Problem solving therapy module

- Identifying and clarify the problem (Math anxiety)
- Establishing the objectives and achievement goals
- Workout solution alternatives for the identified problem
- Discuss Pros and Cons of solutions and create decision guidelines.
- Choose the preferred solutions
- Implementing a SMART Action Plan to the preferred solution
- Review progress/Evaluate the outcome

Study Procedure

The study was conducted in three phases which include (a) pre-test, during which participants were screened on math anxiety and baseline data for the study was collected, (b) intervention, during which participants who were in the treatment groups were exposed to either problem-solving therapy or psychoeducation, and (c) post-test, the final phase at which participants in the three groups of the study were measured on math anxiety again.

A letter of approval was obtained from the school principal. Every student in the senior school class 2 was given equal chance to be part of the study, and no student was forced by any measure to participate in the research. The researchers and other two trained research assistants administered questionnaires to selected students in a classroom setting after the purpose of the study had been explained to them. Confidentiality of response provided was also assured by the researcher. Participants were randomly assigned into three groups – two treatment

groups and one control group. One intervention group was exposed to problem-solving therapy using the Problem Solving Therapy manual developed by Arthur Nezu and Thomas D'Zurilla, while the second group was exposed to psychoeducation. Intervention was conducted in group for nine weeks of 60 minutes per session in a week. During the intervention phase of the study participants were instructed not to share any information about their various group activities.

Control Group: During the intervention, participants in the control group were engaged in the normal classroom activities for nine sessions, each session lasting for 60 minutes. After the study, however, participants in the control group were briefly exposed to the intervention used in the study in order for them to also benefit from the study.

Control of extraneous variables: Extraneous variables were controlled for the setting of inclusion criteria for selection of participants, setting up of study environment that is conducive for experiment, and randomization procedure used by the researcher in assigning participants to groups.

Data collected was subjected to the SPSS 20.0. Stated hypotheses were analyzed using the analysis of covariance. Hypotheses were accepted at $p < 0.05$.

RESULTS

Hypothesis 1

Hypothesis one stated that there will be a significant main effect of treatment on math anxiety. The hypothesis was tested with a 3x2 analysis of covariance. The result in Table 1 shows that there is significant main effect of treatment on students' math anxiety after controlling for the pretest math anxiety score (F (2, 38) = 28.98, p <0.05). The result implied that the math anxiety scores of the students exposed to different treatment conditions are significantly different. Therefore, the stated hypothesis is accepted.

In order to establish the magnitude of the mean differences across the groups, the result of the adjusted mean scores was used. The result in Table 2 shows that with a total adjusted mean of 26.09, the students exposed to problem solving therapy had the least math anxiety closely follow by the students exposed to psychoeducation with a total adjusted mean of 28.33. The students in the control group had the highest math anxiety score with total adjusted mean of 39.75.

The result (Table 3, 4) further revealed that both the psychoeducation group (contrast 1, p =0.000) and problem-solving therapy group (contrast 2, p =0.00) had significantly different on total math anxiety scores than the control group. It can be concluded that receiving problem solving therapy (p =0.00, 95% CI [-17.54–9.77]), and psychoeducation (p =0.00, 95% CI [-15.37–7.48]) significantly reduced math anxiety compared to not taking any treatment.

There is a significant difference between the control group and both the problem solving therapy (p =0.00) and psychoeducation (0.00). The problem solving therapy and psychoeducation groups did not significantly differ (p = 0.59).

Hypothesis 2

Hypothesis two stated that there will be a significant influence of gender on math anxiety. The result as given in Table 1 showed that there is no significant main influence of gender on students' math anxiety (F (1, 38) =0.01, p > 0.05). This implied that the male and female students who participated in the study were not significantly different in math anxiety. The hypothesis stated was therefore rejected.

Hypothesis 3

The third hypothesis stated that there will be a significant interaction effect of treatment and gender on math anxiety. The result in Table 1 showed that there is no significant interaction effect of treatment and gender on students' math anxiety (F (2, 38) = 0.51, p > 0.05). This result implied that math anxiety score of the students did not significantly different based on the possible combination of treatment groups and gender. The hypothesis was therefore rejected.

Table 1: Summary table of analysis of covariance of students' math anxiety according to treatment and gender

Source	Sum of Squares	Degree of freedom	Mean Square	F score	Signi-ficant value
Pretest	107.264	1	107.264	4.297	0.045*
Treatment	1446.926	2	723.463	28.979	0.000*
Gender	.268	1	0.268	0.011	0.918
Treatment* Gender	25.523	2	12.761	0.511	0.604
Error	948.659	38	24.965		
Total	2498.978	44			

*Denotes significance at p <0.05

Table 2: Adjusted post-test math anxiety mean scores of students across the three groups

Group	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Control	39.746	1.330	37.054	42.438
Psychoeducation	28.325	1.392	25.508	31.142
Problem solving therapy	26.091	1.370	23.317	28.866

Abbreviations: Std. Error Standard Error

Table 3: Contrast Results

Group Simple Contrast Post			Dependent Variable Test Math Anxiety
Psychoeducation vs. Control	Contrast Estimate		-11.421
	Hypothesized Value		0
	Difference (Estimate - Hypothesized)		-11.421
	Std. Error		1.949
	Sig.		0.000
	95% Confidence Interval for Difference	Lower Bound	-15.366
		Upper Bound	-7.475
Problem solving therapy vs. Control	Contrast Estimate		-13.655
	Hypothesized Value		0
	Difference (Estimate - Hypothesized)		-13.655
	Std. Error		1.917
	Sig.		0.000
	95% Confidence Interval for Difference	Lower Bound	-17.535
		Upper Bound	-9.774

Table 4: Sidak Post-Hoc showing pair-wise significant differences among the various groups on the students math anxiety

	(I) Groups	(J) Groups	Sig.
Post-test Students' Math Anxiety	Control	Psychoeducation	0.000
		Problem solving therapy	0.000
	Psycho-education	Control	0.000
		Problem solving therapy	0.591
	Problem solving therapy	Control	0.000
		Psychoeducation	0.591

*. The mean difference is significant at the 0.05 level.

DISCUSSION

The present study examined the efficacy of psychoeducation and problem solving therapy on mathematics anxiety among selected secondary school students in Ilesa. It was established that problem solving therapy and psychoeducation were both effective treatment for math anxiety among secondary school students. Students who received treatment were found to be significantly less anxious after the intervention than their counterparts who did not receive any form of intervention. Similarly, [30] had found that rational emotive behavior therapy was effective in treating math anxiety among secondary school students in Nigeria. The present study also aligned with the findings who reported cognitive restructuring as an effective treatment for math anxiety among students [19].

The researchers also found that students who received problem-solving therapy and those who received psychoeducation did not significantly different in post-test math anxiety. This suggests that students in both groups of intervention responded similarly to the forms of intervention they received. A similar report was given by [17], who reported a significant decrease in math anxiety scores from pre-test to post-test session in the secondary school students irrespective of the treatment groups. R. D. Zettle also reported no significant differences between acceptance and commitment therapy and systematic desensitization on math anxiety [29].

There was no agreement in the growing body of evidence on gender difference in math anxiety. Our findings are consistent with previous assertion that both male and female students exhibit math anxiety in similar ways and level [21, 18]. However, several other researchers have found significant difference between male and female on math anxiety. For instance, Karimi and Venkatesan observed that boys and girls scored significantly differently on measure of math anxiety in a post-test assessment, suggesting that the boys and girls responded differently to math anxiety treatment [17]. In addition, Zettle and Raines reported that among students who registered for math oriented courses, more women rated themselves as math anxious than men [13].

Randomization in sampling and assignment of participants to groups, careful collection of data by researchers trained in research methods and data collection, appropriate analysis of data, as well as treatment provided to participants were considered strengths of this study. However, in spite of the findings of this study, it should be noted that the researcher could not conduct a follow-up study to assess the math anxiety of the participants in order to know the extent of long-term post therapeutic effect of the study. In addition, there is a possibility of participants sharing crucial information about activities in their various group because the students attend the same school and some even shared the same classroom which gave an opportunity of the participants interacting freely outside the study time. These two situations were considered limitation of the study.

It is recommended that similar future studies should consider carrying out a follow-up study which will include post study assessment and possible intervention on the measure. Furthermore, students should be provided with relevant information on the nature of mathematics anxiety in order to become aware of the phenomenon and better skilled at managing it. Finally, based on the importance of sufficient proficiency in mathematics which is a prerequisite requirement to studying certain

important discipline in tertiary institutions, secondary school students should be encouraged to practice the basics of problem solving with students in order to boost their confidence in dealing with mathematics and other mathematical oriented subjects.

CONCLUSION

This study investigated the efficacy of psychoeducation and problem-solving therapy on mathematics anxiety among selected secondary school students. From the findings of the study it was established that problem-solving therapy and psychoeducation were effective in treating math anxiety among secondary school students. Interestingly within a period of nine weeks, both treatments conditions were found to have similar effect on the measure.

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Guarantor
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Conflict of Interest
Authors declare no conflict of interest.

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