

Effects of Systematic Desensitization on Mathematics anxiety among Junior Secondary School Students

BY

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Abstract

The issue of mathematics anxiety among some secondary school students has been a source of worry among the stakeholders in education. In this study therefore, the researchers examined the effects of systematic desensitization on mathematics anxiety of junior secondary school students in Awka South local government of Anambra state. A quasi experimental design which adopted a pre-test, post-test and control group method is used in this study. The population of the study comprise of 576 secondary school students who are mathematics anxious. The sample size for the study is 83 students, 45 for the experimental group while 38 is for the control group. These students are sampled through purposive sampling technique. The study used Abbreviated Mathematics Anxiety Scale (AMAS) instrument developed by Hopko, Mahadevan, Bare and Hunt which was adapted and revalidated in Nigeria by Adebule for data collection. The data collected was analysed using using the arithmetic mean and standard deviation. The findings of the study discovered that systematic desensitization techniques have positive effects on the mathematics anxiety of the students and that there is no significance different between the male and female students used in the study with regard to mathematics anxiety. It is recommended among other things that counsellors should extend the use of systematic desensitization and self-management techniques on reduction of mathematics anxiety of students.

Keywords: Effects, systematic desensitization, techniques, mathematics and anxiety.

INTRODUCTION

Mathematics is one of the core subjects in Nigerian educational system from primary level to university. It plays an important role in forming the basis of all other sciences which deal with the material substance of space and time. It is that branch of science that uses numbers and symbols. Numbers and symbols are arranged using systematic mathematical rules. These figures and numbers sometimes create shock; fear or shivering and even fast heartbeat among some secondary school students, causing them to be exhibiting anxiety towards the subject. The shock, fear, shivering and fast heartbeat of the students that arise as a result of mathematics figures or symbols signifies abnormal behaviour which may affect one's life if not eliminated. Abnormal behaviours are of concern to counsellors and psychologists. The

behaviours are abnormal because they deviate from the general norms and values and also are capable of distracting the academic line and performance of the students now and in future. It is this fear and tension towards mathematics subject is known as mathematics anxiety and it is a specific anxiety.

Mathematics anxiety appears to be one of the psychological problems that have been affecting some students today in their choice of career, gaining admission into tertiary institutions, and getting gainful employment. However, these negative attitudes towards mathematics are serious obstacles for young people in all levels of schooling today in the pursuit of their life ambitions; therefore, it needs the work of experts to look into such a

debilitating problem and find out ways to ameliorate its effects among students.

anxiety is defined as stress, tension, and strain brought into one's body and mind as unpleasant emotion, characterised by terms like apprehension, worry, dread, and fear which threatens the well-being of the individual (Ifeagwazi 2011). Freedman (2013) defined it as emotion characterised by an unpleasant state of inner turmoil which is often accompanied by nervous behaviour. Ordinarily, anxiety is a normal reaction of humans to stress and difficulties in life but it falls under the classification of behavioural problem when it becomes excessive. Russell (2017) opined that mathematics anxiety is actually common and it is quite similar to stage fright. For him, it conjures up fear of some type. It is the fear that one will not be able to do maths or the fear of failure which often stems from having a lack of confidence. In addition, Dowker; Sarkar, and Yenlooi (2016) concur that mathematics anxiety is a feeling of tension and fear that interfered with the manipulation of numbers and the solving of mathematical problems both in ordinary life and academic situations. The researchers have observed that children within the ages of 12 to 17 years are prone to having one type of anxiety or the other. This implied that some secondary school students within these age brackets are experiencing mathematics anxiety.

Behaviourists are of the view that learning deals with a change in behaviour and that it is achieved through a large amount of repetition of desired actions and a strong belief of how an individual manages self on given tasks (Ogugua 2016). This is in line with the belief that reward encourages good habits while bad habits are reprimanded and discouraged. Behaviourists like Ivan Pavlov, Joseph Wolpe, and Sigmund Freud have adopted the following techniques towards eliminating anxiety among individuals: exposure therapy, systematic desensitization, self-management, modeling, and reinforcement in reducing anxiety of some other kinds, and they seem to have eliminated anxiety to some extent in their localities.

However, Yezici & Ertekin (2010) popularised the notion that women and girls were suffering from mathematics anxiety than male and called for the establishment of mathematics clinics at post-secondary level to attract women to mathematical study. The present Researchers opine that mathematics anxiety is anxiety about one's ability to do mathematics. And it is among the phenomenon that is being considered when examining students' problems in mathematics.

The present study adopts systematic desensitization techniques towards eliminating mathematics anxiety among secondary school students. The choice of systematic desensitization technique is motivated by its effectiveness in handling maladaptive behaviours (Johns; Schmader-Martens (2012). Besides, individuals are capable of controlling their behaviour if taught how to and when this is done, the result will seem to be more lasting than when the control measures is being applied by external person.

Systematic desensitization (SD) is a technique developed by Wolpe (Conway, 2015). It is aimed for alleviating maladaptive behaviours and it involves pairing relaxation with imagining scenes depicting

the situations client indicated that are causing the feeling of anxiety. The therapist usually operates on the assumption that if the client is taught to relax while imagining the anxiety-provoking scenes, he will feel less anxious and the real-life situation will cause the client much less discomfort. This is based on the premise that relaxation and anxiety cannot be manifested at the same time. For instance, a person who is presented with a mathematics test seems to feel anxious if he is not prepared but the same person if he has learnt to relax while visualising self, will feel less anxious if the skills to manage self are taught to him. For some secondary school students, mathematics anxiety created depression for them. Therefore, if systematic desensitization therapy is applied, it is expected that it may be reduced to a barest minimum.

The word desensitization is a process of eliminating or decreasing an organism's negative reaction to a substance or stimulus. When the desensitization becomes systematic, it becomes a therapy technique which guidance Counsellors make use of in eliminating undesirable behaviours. There is different definitions for systematic desensitization for different authors based on their orientations. For instance, Systematic desensitization is a therapy aimed at removing or diminishing the feared response of a phobia and substituting it to a relaxation response to the conditioned stimulus, gradually using counter-conditioning (Ogugua 2016). Dubord (2011) defined systematic desensitization as a behaviour modification therapy that involves the use of classical conditioning methods in relaxing an individual who is anxious. Systematic desensitization is a type of behaviour therapy based on the principle of classical conditioning which is developed by Wolpe (McLeod 2016). He explained that it is a therapeutic intervention skill that will reduce the learned link between anxiety and objects or situations that are typically fear-producing. He also stated that it is aimed at reducing or totally eliminating the fears that those suffering, view as distressing that prevents them from functioning properly in their daily dealings.

Moreover, Duffy (2011) opined that systematic desensitization is a form of phobic treatment in which the client is taught the skills of relaxation and then be given the opportunity to practice the learnt skills through gradual introduction to the feared object or situation. The technique is being used as a part of cognitive behavioural therapy program.

However, in Austria, a quasi-experimental parallel study was carried out by Rothbaum (2009), on therapeutic treatments for reducing mathematics anxiety among undergraduate students. The study was based on finding out if students' test performances could improve when self-report are administered immediately after the pre-test. Twenty-one (21) test-anxious undergraduate students made up the sample size (12 males and 9 females). Their ages ranged from 19-24 years. They were exposed to two therapeutic treatments: systematic desensitization and cognitive modification treatment. These treatments are adopted to find out which technique is more effective in reducing mathematics anxiety in a two weeks counseling session. In the first week of the study, all the students are exposed to insight-oriented therapy to analyse the level of awareness of their anxiety-endangering thought. Through random selection, 11 students (6 males and 5 females) are placed in

the systematic desensitization group and 10 students (6 males and 4 females) are placed in the cognitive modification group. Both groups are also exposed to coping imagery on how to handle anxiety and self-instructional training is given to attend to the task about oneself are also employed. Method of data collection is through the use of the Spielberger Two Component Anxiety Scale and data is analysed using the mean of 20 and standard deviation of 7.2. Results after a period of 6 weeks indicates that the systematic desensitization group is slightly more effective in reducing mathematics anxiety of the students as assessed by (a) test performance obtained in an analogue test situation and (b) self-reports given immediately after post-treatment.

Also, Apple, Billingsley, and Schwartz (2005), compared individual and group versions of vicarious desensitization with direct systematic desensitization. The study was carried out using correlation survey design which seeks to determine what differences exist in decreasing scores on anxiety using vicarious desensitization or direct desensitization. They observed that the variables that significantly correlated with adolescents' self-esteem included individuals' behaviour towards peer and level of fear exhibited. Seventy-three adolescents participated in the study comprising of thirty-eight (38) females and thirty-seven (37) males, with mean age as 18. They found that both approaches were equally effective in decreasing scores on a test anxiety measure and increasing performances on a reading test.

Procedural use of Systematic desensitization

This is a procedure through which new behaviours are learned in response to stimuli that previously elicited other behaviours. Information giving, relaxation training, establishment of hierarchies, and counter-conditioning procedures are included in the strategy. Systematic desensitization has the following three steps:

- The first step is to teach the student relaxation techniques, typically with teaching the students to tighten and relax various groups of muscles. This should be practiced for ten to fifteen minutes (10 – 15 minutes) every day to become comfortable with the technique.
- Following this, the students and the therapist will develop a fear hierarchy. In the hierarchy, the students will develop a list of 15-20 items that become increasingly more fearful on a scale of 0-100.
- The third and final step is to have the students imagine each of the items on the hierarch in order from least fearful to the most while engaging in the relaxation technique taught by the therapist.

However, desensitization research has suggested the important facilitative effects of relaxation training and the use of hierarchies, neither of which is needed for extinction. Berger (2012) opines that the process of systematic desensitization requires that the anxious client learns three distinct skills and actively practice them over the course of time. The three skills are as follows:

- Identification and expression of subjective degree of anxiety

- Prioritization of steps towards the feared objects from least to most anxiety-inducing.
- Acquisition and pairing of relaxation skills.

For this procedure to be effective, the individual is first taught the relaxation techniques. These include deep breathing, meditation, and learning how to relax the mind by relaxing each muscle in the body beginning from the head muscles. The feeling of relaxation is made to be associated with any of the objects or situation (stimulus) that causes the fear. Slowly and steadily, the mind learns to associate the positive feeling with the negative stimulus in some kind of systematic step-by-step approach, and gradually, the feared stimulus is overcome. In this technique, the principle adopted and the goal to be realised is to get the feeling of relaxation to dominate over the feeling of fear and anxiety for certain critical situation in the person's life so that the person can function much better with a relaxed mindset.

One principle in adopting the systematic desensitization therapy according to Piane (2009) is that the individual in an anxiety state cannot experience anxiety if in a relaxed state. For instance, if an individual suffering from mathematics anxiety begins to imagine self about to start the mathematics examination with some form of relaxation, at the time the real examination is presented the same reaction will be exhibited with minimal anxiety. It is expected that this will help such a person to improve on self and perform much better than when he is anxious. Zettle (2014) in one of his works used systematic desensitization to improve the self-confidence of a number of students who were anxious and who were not willing to participate in an oral arithmetic class test. According to him, anxiety during such tests could cause one to lack focus on derivative goals both in the present and future purposes.

The use of the hierarchy is merely for providing the client gradual practice in his self-control skill with a relevant and important anxiety source. Thus, it is better during desensitization to emphasize the self-control approach and evidence existed to suggest this is the case (Berger 2012). Despite the different theoretical interpretations of desensitization, the therapist should do the following:

- During relaxation training, emphasis should be laid on the client learning to discriminate the differences between relaxation and non-relaxation. For example, anxiety and tension.
- The client should learn how to use relaxation as a self-control skill in dealing with anxiety. This should be done in a variety of ways: during counter-conditioning with imagined scenes and later in vivo assignments. Otherwise, desensitization should be carried out as described above.

An advantage of behaviour modification is that in many situations, it can be applied to group of people at a time, thus saving time and expense. To apply desensitization in group, it is necessary to have a hierarchy common to all the clients. This is usually easiest accomplished if the fear is relatively common, specific, and not complicated with other psychological problems.

The second requirement is that the rate through the hierarchy should be geared towards the lowest anxiety-provoking item. In other words, one would not advance to the next item until everyone in the group has been desensitized with the current item (Berger 2012).

Research Questions

The following two (2) research questions guide the study:

1. What is the mean response to mathematics anxiety of students in the systematic desensitization and control groups at pre-test and post-test?
2. What is the difference in the mathematics anxiety mean scores of male and female students treated with SDT at post-test?

Methodology

Research Design

This study was a quasi-experimental research. A quasi experimental research is a research design which is not pure or true experimental research. The reason for adopting the research design is because quasi-experimental design allows the researcher to have control over assignments to the treatment condition by using some criteria other than random assignment (for instance, a cut-off score), to determine which participants receive the treatment, or the researcher may have no control over the treatment condition assignment and the criteria used for assignment may be unknown. Also, Morgan (2010) argued that a quasi-experimental research design typically allows the researcher to control the assignments to the treatment conditions and could be used in a school setting where it is not always possible to use pure experimental designs. Many quasi-experimental methods are available but the one that will be used for this study is the non-randomised pre-test post-test control group design. Two groups of subjects are involved, one experimental group and one control group. The participants are drawn from two co-educational secondary schools. All of them are pre-tested. One experimental group received treatment on mathematics anxiety using systematic desensitization techniques respectively while the control group received conventional method by the maths class teacher. In the context of this study, a non-randomised pre-test-post-test and control group are used. The sample size of the study comprised of 83 junior secondary school (JSS) students who were mathematics anxious, in two co-educational secondary schools. These students are sampled through purposive sampling using Abbreviated Mathematics Anxiety Scale (AMAS) instrument. Non-random sampling technique is used in assigning treatment models to the two groups, students with mathematics anxiety in school ‘A’ regarded as the treatment group one (45 students) are treated with systematic desensitization technique while students with mathematics anxiety in school B (38 students) known as the control group are given conventional guidance. The instrument for data collection is Abbreviated Mathematics Anxiety Scale (AMAS) developed by Hopko, Mahadevan, Bare, and Hunt (2003) but was revalidated in Nigeria by Adebule (2003). The AMAS is structured on a five (5) point rating scale ranging from: 1=low anxiety, 2= some anxiety, 3= moderate anxiety, 4= quite some anxiety, and 5= high anxiety.

Scores that are above the Nigerian norm mean score $M=21.1$ and the Standard Deviation (SD) = 7.0 indicated the presence of mathematics anxiety while scores below this showed no problem of mathematics anxiety. Only students with mathematics anxiety participated in the two treatments. The AMAS manual identified gender effects as follows: Females: $M=21.9$ and $SD=6.9$ while that of males: $M=19.5$ and $SD=6.9$. The students who scored below these scores are regarded as non-mathematics anxious students and therefore, did not participate in the study.

The researcher adopted the instrument as it is and did not do any validation since it has been revalidated in Nigeria. The Co-efficient of reliability obtained from the Nigerian samples ranges from 0.78-0.80 (Adebule 2003). The researchers, therefore, considered the value good enough for the study.

Method of Data Collection

The researchers used one Guidance Counsellor and a maths teacher as research assistants. The data collected using the Abbreviated Mathematics Anxiety Scale (AMAS) administered to the students both in the experimental and control groups are analysed to determine the mean scores. The mean gain and mean loss scores are used to ascertain the effects of systematic desensitization techniques on mathematics anxiety. The researchers identified and controlled the extraneous variables. The completed instruments are scored following the scoring instructions provided by the AMAS manual. The data relating to the research questions is analysed using the mean and standard deviation. The completed instrument is scored following the scoring instructions provided by the AMAS manual. Scores that is above the Nigerian norm relating to the component analysis as specified in the manual shows that JSS students who scored 21.9 for females and 19.5 for males indicate mathematics anxiety while the scores that is below the above range indicates absence of mathematics anxiety.

RESULTS

Answer to Research Question 1

Result of Analysis Concerning the Mean Response to Mathematics Anxiety of Junior Secondary School Students in Systematic Desensitization Technique and Control Groups at Pre-test and Post-test

Table 1A
Means, Standard Deviations of SDTG and CG at Pretest and Posttest, the Calculated F-value, p-value, the Critical F-value, and the Decision

Group	Pretest		Posttest	
	\bar{X}	S	\bar{X}	S
SDTG	29.51	3.83	11.02	1.10
CG	29.29	2.34	29.29	2.34

Table 1A was used to present data on the mean responses to Mathematics anxiety of students exposed to Systematic Desensitisation Technique group (SDTG) and the Control group at pre-test and post-test. The mean responses to Mathematics anxiety of the students in SDTG at the pre-test and post-test are 29.51 and 11.02 respectively. Similarly, their respective standard deviations

at pre-test and post-test are 3.83 and 1.10. The mean responses to Mathematics anxiety of the students in CG is 29.29 at the pre-test and post-test. Similarly, their standard deviation is 2.34 at pre-test and post-test. The mean responses at post-test showed that SDTG had some effect on Mathematics anxiety of the students, as these mean at post-test is below the benchmark of 21.10 for those exhibiting anxiety. The small standard deviation values at pre-test indicate that the Mathematics anxiety scores of the individuals in the groups at pre-test are spread around the mean. However, the standard deviation of the students in SDTG at post-test is small, indicating that the Mathematics anxiety scores of the students in SDTG are spread around the mean. This indicates there is significant difference between the mean response to mathematics anxiety of the students in Systematic desensitization technique and control groups at post-test.

Result of Analysis Concerning the Difference between Mean Response to Mathematics Anxiety of Male and Female Junior Secondary School (JSS) Students in Systematic Desensitization Technique at Post-test

Table 1B

Adjusted Means and Standard Deviations of Male and Female Students in SDTG at Posttest, the Calculated F-value, p-value, the Critical F-value, and the Decision

Group	Female		Male	
	\bar{X}	S	\bar{X}	S
SDTG	11.234	1.05	10.758	1.12

The result in table 1B shows that the adjusted mean responses of male and female students in SDTG respectively are 10.758 and 11.234, while their respective standard deviations are 1.12 and 1.05. The result in table 1B shows that the mean difference between male and female students exposed to SDT is .476 when the mean response to mathematics anxiety of male students is subtracted from that of female students. However, this mean difference is negative (-.476) when the mean response to mathematics anxiety of female students is subtracted from that of male students. This negative sign may suggest that the mean response to mathematics anxiety of female is higher than that of male. In another term, the negative sign may suggest that male students responded better to treatment with systematic desensitization technique than their female counterpart. Therefore, the mean responses to mathematics anxiety of male and female students exposed to Systematic desensitization technique do not differ significantly at post-test.

Discussion of Findings

Discussion of Findings on the Mean Response to Mathematics Anxiety of Junior Secondary School (JSS) Students in Systematic Desensitization Technique and Control Groups at Pre-test and Post-test

The findings of the study on the mean response to Mathematics anxiety of Junior Secondary School students in systematic desensitization technique (SDT) and control groups at pre-test and post-test revealed that the mean responses at post-test showed that SDT had positive effect on Mathematics anxiety of the students, as these mean at post-test is below the benchmark of 21.10 for those

exhibiting anxiety. The standard deviation of the students in SDTG at post-test is small, indicating that the Mathematics anxiety scores of the students in SDTG are spread around the mean. This shows that majority of all the students exposed to systematic desensitization technique had their Mathematics anxiety behaviours improved by the treatment. These findings are in line with the findings of Dickinson & O’Connell. (2010) and Oliha & Audu (2012) who found systematic desensitization technique as an effective technique in the reduction of test anxiety among students.

Discussion of Findings on the Difference between Mean Response to Mathematics Anxiety of Male and Female Junior Secondary School Students Exposed to Systematic Desensitization Technique at Post-test.

The findings of the study on the difference between mean response to mathematics anxiety of male and female students exposed to systematic desensitization technique at post-test showed that the mean difference when the mean response to mathematics anxiety of female students is subtracted from that of male students is negative. The negative sign may suggest that the mean response to mathematics anxiety of female is higher than that of male or those male students responded better to treatment with systematic desensitization technique than their female counterpart. However, the mean responses to mathematics anxiety of male and female students exposed to Systematic desensitization technique do not differ significantly at post-test. This finding is in line with the findings of Egbochukwu, Obodo, and Obadan (2010) who found that sex of the students was not a barrier to the effects of systematic desensitization technique on test anxiety of the students.

Implications of the Study

The findings of this study have certain implications, especially for counseling practice and educational system. In the first place, with this known conviction that mathematics anxiety which is one of the educational problems secondary school students are experiencing could be reduced through the applications of systematic desensitization techniques on the students. This study has provided useful link both in theory and practice. The theoretical propositions behind the treatment techniques used in this study are tested and they have positive effects on mathematics anxiety. This indicated that mathematics anxiety which is an impediment to learning mathematics is treatable using systematic desensitization techniques. Its implication is that Guidance Counsellors can henceforth be making use of systematic desensitization techniques in treating mathematics anxiety and other anxieties that are confronting students, having seen the procedure for using them from this study.

Counselors can also, identify students with mathematics anxiety by administering the anxiety scale used in this study. The implication is that if mathematics anxiety is identified, the problem can be modified within the duration period of eight weeks, using the techniques in this study by the counsellor.

Finally, the positive results achieved in modifying mathematics anxiety of students using these techniques implied that the problem can be modified within eight weeks; teachers are to be encouraging the students experiencing likely problems to see the counsellors.

Recommendations

From the findings of this study, the following recommendations are made:

The researcher recommended that counsellors should be making use of systematic desensitization techniques towards reducing the mathematics anxiety of students.

Every secondary school should have an equipped counselling centre that must be under the guidance of professional counsellors. This will enhance proper diagnoses and treatment of the students exhibiting behavioural problems in the schools.

Government should have counsellors posted to every secondary school in the state for them to be using appropriate techniques in modifying behavioural problems of students.

Also, teachers should observe their students closely during and after class lessons in order to identify those who are manifesting symptoms of anxiety of any type so that they will be directed to the counsellors for proper attention towards eliminating the unacceptable behaviour.

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