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EFFECT OF CONGNITIVE BEHAVIOUR THERAPY ON MATHEMATICS TEST ANXIETY AND ACHIEVEMENT OF SECONDARY SCHOOL STUDENTS IN OGIDI EDUCATION ZONE ANAMBRA STATE

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Abstract
The study was designed to investigate the effect of Cognitive behaviour therapy on students' mathematics test anxiety and gender in Ogidi education zone of Anambra state. The design of the study is quasi experimental research design, specifically non- equivalent pre- test and post -test control group design. Two research questions and two hypotheses were tested at 0.05 level of significance guided the study. One hundred and seventy-four students in public secondary schools were used to collect the sample using multi stage sampling technique. Four schools, two each were randomly assigned to experimental and control groups respectively. Then 88 students in experimental group were exposed to the use of four corners and a diamond mathematics graphic organizer while conventional method was used for 86 students in the control group. Two instruments namely; Mathematics test anxiety scale (MTAS) and Mathematics achievement test forms 1 and 11 were used for the study. Two training programmes; namely four corners and a diamond mathematics graphic organizer and conventional lesson plans were developed, validated, and used for the study, The mathematics achievement test form 1 and mathematics test anxiety scales were used for pre-treatment assessment while mathematics achievement test form 11 and MTAS(post test) were used for post treatment. Internal consistency reliability coefficients were determined for the two instruments using Cronbach alpha method and reliability indices of 0.94 and 0.62 were got MAT forms 1 and 11 while MTAS yielded reliability estimate of 0.93. Data obtained through the administration of the two instruments were organized and analyzed using mean scores, and standard deviation and analysis of covariance (ANCOVA) which revealed the following. The intervention using four corners and a diamond mathematics graphic organizer significantly improved mathematics achievement and reduced mathematics test anxiety. Since CBT enhances students mathematics achievement, reduced mathematics test anxiety and gender as a factor in the study has no significant effect. It was recommended that both teachers and students should be equipped with this training strategy respectively.
Keywords: Cognitive Behavior, Therapy, Mathematics, Anxiety

Introduction

The contributions of mathematics in industrial and technological development cannot be over emphasized. It pervades every aspect of human endeavours. (Mefor 2014, Davis & Hersh, 2012). Ummameh (2011) maintained that mathematics intimately is connected to our daily life and everybody's lifelong planning.

Humans are always involved in one mathematical operation or the other .Mathematics enhances intellectual skills that enable man to analyze complex situations, re-organize logical thinking between independent factors and formulate general laws on their inter –relationship. It simplifies equation as well as interaction between smallest and farthest objects in the known universe. Mathematics allows Scientists to communicate ideas using universally accepted technology (Yusuf & Emmanuel, 2015).It is the language of the science that makes essential contribution to a good rounded education, playing a vital role in our culture and civilization.

The benefits and outcome of mathematical researches are immeasurable. It has improved communication, medication, farming, transportation and education. No wonder Nigerian government identified mathematics as one of the core subjects in the school curriculum in other to broaden students' knowledge, skills and outlooks.(Federal Republic of Nigeria, 2004).
It is disheartening that in spite of importance of mathematics, students achievement in mathematics in Anambra state has not reach a satisfactory stage. The trend of poor mathematics achievement has been confirmed by the recent West African Examination Council Chief Examiners' reports for the years 2013-2015.These reports indicated that only 67.85%, 65.93% and 61.18% of all the candidates who sat for the examination had five credits and above including English language and Mathematics for the years 2013,2014 and 2015 respectively. These uninspiring achievements are sources of concern to major stakeholders in education such as parents, teachers, researchers and examination bodies. Some researchers have attributed factors (Abudulahi and Onasanya, 2010) Parents factors (Ajayi and Muriana 2011) Psychological factors (Uroko,2010).However no attention has been given to emotive components of test anxiety as a cause of poor mathematics achievement.

Anxiety is an unpleasant emotion experienced as dread with arousal alarm, scare, fright, horror or panic. Many researchers defined anxiety in different ways. Rao (2014) see anxiety as a subjective feeling of tension, apprehension, nervousness and worry associated with arousal of autonomic nervous system. Anxiety is a painful uneasiness of the mind about a perceived threat which an individual cannot escape from. Anxiety can be a trait within a person or state that occurs in response to a specific situation for example examination anxiety or test anxiety. Test anxiety is a form of anxiety specific to situation where by an individual is evaluated on comprehension of a subject.(Ormrod 2011,).It occurs where by a student is expected to show a certain form of anxiety be it high or low which may apply to performance assessment without regard to content or test difficulty.(Cunha & Paiva,2012).

Test anxiety is a set of phenomenological, physiological and behavioural responses that is associated with concern about possible negative consequences or failure on an examination or similar evaluative condition or performance situation. Test anxiety is not entirely bad. In fact a low level of test anxiety is normal and necessary among students in other to ensure students motivation and concentration into action, preparing, plotting and perfecting strategies that will guarantee optimum success in the examination. However a high level of test anxiety could be dangerous and can lead to emotional and physical distress, concentration difficulties and emotional worries.

Test anxiety is conceptualized in terms of interference theory of anxiety and deficit theory of anxiety. Interference theory of anxiety as by Sarasson(1984) portrays test anxious student as one who could not recall already learnt materials as a result of dividing his attention between test taking demands and negative self pre occupation during examination. Lack of retrieval of information is as a result of intrusive thoughts such as fears of failures, self critical thoughts and comparison of self to peers. High test anxious student's experience problems at all levels of information processing that is encoding, storage and retrieval. High test anxiety is accompanied with learned helplessness, failure, avoidance and low personal goal setting. These students are less likely to find coping strategies for their anxiety which reinforces the cycle of low expectation, high level of test anxiety and poor performance on test or examination.

Cognitive processing of test anxious student is over loaded with distracting thoughts that interfere with performance evaluation. Adolescents in secondary school undergo certain emotional stress that is as a result of physical, biological and psychological changes they pass through. These changes are their peak and affect their mood and behaviours. Hence they act strangely. Some researchers see adolescent period as storm and stress. The adolescents are partially cognitively competent to understand what is happening to them and therefore could not deduce what is going on in them. These adolescents need a guidance counselor who is professionally trained to offer interpersonal services that could enable these adolescents adjust properly in their educational, vocational and persona-social aspects of life. One of the counseling techniques to help a test anxious students could be Cognitive behavior therapy (CBT).Research has suggested that CBT help people to develop alternative ways of thinking and behaving which may likely decrease depression, anxiety, fear, irrational beliefs and suicide.

Cognition is involves an intellectual processes such as perception, memory, thinking and language through which information is obtained, transformed, stored,

retrieved and used (Akaneme, 2013).In cognition, information is obtained through the senses, transformed through the interpretative process of memory and used in problem solving and language, (Lahey, 2001) Some students may have heard that mathematics is a difficult subject and only those gifted could perform mathematics operation. This indicated why some students become tensed up and apprehensive any time mathematics is mentioned. Some of these students transfer this assumption to school situation and become apathetic toward learning of mathematics and finally develop anxiety towards learning of mathematics.

Cognitive psychologist like Vygostky (1978) in his theory believed that cognitive skills evolve from social interaction with parents, teachers and other people. Children are born with elemental mental functions which may later be influenced by culture into higher mental functions that could enable them adapt intellectually. The socially transmitted memory, strategies and cultural tools teach children how to use their minds as regards to how to think. Culture also transmits believes, values and thinking process. Akaneme (2010) posited that believes, values and tools of intellectual adaptation includes ones belief in mathematics as a difficult subject, ones interest and the value one places in mathematics. What the students perceives in the environment affect their cognition for example their thinking process and interpretation to events in the environment. Parents, teachers and significant others in the environment inculcate poor beliefs about mathematics in the adolescents unconsciously and consciously. These students may transfer this believes to school situation and develop hatred to mathematics. However if these students are assisted to interpret information rationally they may change their negative thought about mathematics difficulty.

Research evidence has indicated that Beck, J.S .(2011) came up with a thinking pattern to help people come out of their predicament as a result of negative automatic thoughts that can contribute to and worsen emotional difficulties, depression and anxiety. This he called Cognitive Behaviour Therapy (CBT).This therapy is based on the idea that how we think affect our emotion and behaviour. Therefore we can monitor and change how we think in other to change our behaviour. The CBT aims at helping the individuals to recognize and change their faulty thinking pattern, challenge, and replace with more objective and realistic thoughts. To maintain a change, it is required to go beyond identifying the irrational behaviour challenge it and to deal with the anxiety generating schema for example mathematics is difficult. I cannot learn mathematics.

The CBT teaches the individuals on how to identify distorted cognition (thought) through the process of re-evaluation. It teaches individuals to better understand their thinking and feeling in relation to their situation. These include their believe

system that affect their actions and as well as direct their behavior. This will help the students to differentiate between their own thought and stick to reality. According to Amuda, Bokko and Katsala(2017).CBT helps clients to develop alternative ways of thinking and behaving which may reduce their level of depression ,anxiety ,fear, irrational believes and suicide.

The dramatic representation of this model could be likening to ABCDEF model A as the activating event. Something happens in the environment around you. B is the belief (you) individuals hold about the event or situation. C is the consequences or the reaction in response to B belief. The reaction can either be appropriate (rational) or inappropriate (irrational). A the activating event does not cause C (emotional) consequence. Instead B, which is the persons belief about A caused C. Chinweuba (2015) noted that CBT is a form of re-education in which clients are taught how to change their irrational thinking to rational thinking. The client is taught about self- defeating thought and how to deal with it positively. Ellis (1958) extended this model to DEF. The D stands for disputing the rationality or irrationality of the belief. E stands for the effective rational belief which result from disputing the D. F stands for the feeling and behaviours which becomes the final outcome like feeling of satisfaction and confident.(Akaneme,2010).

Adolescents in secondary schools experiences a lot of emotional stress that arises from evaluative measures or performance assessments. This may come from fear of failure and perceived negative consequences during learning and evaluation. It may disturb the individuals in form of intrusive thoughts that disrupts information processing in performance tasks (Brewstar, 2020).This intrusive talks are negative verbalized self talks that can impact on working memory as well as reduce attention resources needed to aid the individual in performance assessment. These negative verbalized talks need to be analyzed in other to help the individuals think rationally and face mathematics without fear and apprehension hence cognitive behavior therapy need professional counsellor who is professionally trained to enable such students with mathematics test anxiety

Student's poor achievement in mathematics has continued to be a concern to stakeholders in education such as parents, educators, government and even students. Researchers in education have come up with different learning strategies and teaching methods (Cognitive domain) to enhance student's achievement. Yet student's mathematics achievement has not improvement. However emotive components of test anxiety have not been researched. Adolescents in schools face different evaluative processes that subject them to tension and apprehension. The adolescent's emotive subjective feelings may be as a result, psychological and biological changes that take place in their body hence they are always in mood

swing. Some researchers see adolescence as a period of storm and stress. Some of these adolescents have not reached a balanced intellectual stage to interpret situations. Hence some of these students are tensed up and apprehensive in performance and evaluative assessment. The tension they experience may likely be as a result of illogical thinking that result from negative self verbalized thought that distort their reasoning and cause anxiety. However if these negative thoughts are analyzed. It may enable the students think rationally and face mathematics tasks confidently.Hence the students may come out with meaningful mathematics achievement.

The problem of this study, therefore is to determine how effective CBT could reduce mathematics test anxiety of senior secondary school students and enhance their mathematics achievement

Scope of study

The study is limited to senior secondary schools in Ogidi Education zone of Anambra state. The study was designed to find out the effect of cognitive behaviour therapy on students mathematics achievement and anxiety.

Research questions

1. What is the effect of cognitive behaviour therapy on mathematics mean achievement scores of students exposed to cognitive behaviour therapy and those exposed to control method.
2. What is the effect of cognitive behaviour therapy on mathematics test anxiety mean scores of students exposed to cognitive behaviour therapy and those exposed to control method

Research hypotheses.

The following null hypotheses were tested at alpha level of .05 significance.

Ho1; There is no significant difference in the mathematics mean achievement scores of students exposed to cognitive behaviour therapy and those to in control method.

Ho2: There is no significant difference in the mathematics mean test anxiety scores of students exposed to cognitive behaviour therapy and those in control method.

Methodology

The design of the study is a quasi –experimental non-equivalent pretest post control group design. According to Nworgu (Nworgu.2015) This design needs no random assignment of subjects as it is not possible to change the existing structure. Therefore intact classes or pre existing groups were used. The researcher used two groups as experimental and control groups respectively. They are not equated.

Therefore pre test is administered before the on set of the study and the pretest data is used for finding out whether the subjects in the different groups are homogeneous or not, while post test was administered at the end of the study to find out the effect of treatment on the subject.

The area of the study wass Ogidi Education zone of Anambra state. The zone is made up of three local government areas. Idemili North and South and Oyi local government areas with 31 secondary schools. The population consists of all the senior secondary school class 11 students in Ogidi Education zone of Anambra state numbering 1723 (2019-2020) academic session (Planning, Research and Statistics, (PRS) unit Post Primary School Service Commission Zonal, Office 2020).The choice of secondary class two students was guided by the assumption that the students were in the middle class of senior secondary school. They were neither adjusting to senior secondary syllabuses as the SS1 students were doing nor were they preparing for external examinations as the SS111 students were doing. These students are also in their adolescence stage when most of them are experiencing stress and storm. Majority of them are emotionally off balance as a result of physiological, psychological and biological changes taking place in their body. The sample size of this study consisted of 174 (80 males and 94 females) senior secondary class 11 students that were drawn from four coeducation senior secondary schools in Ogidi education zone. Multi-stage sampling procedure was employed in drawing the sample for the study. Initially the researcher randomly selected two local government areas in the zone. From the two local government areas, two co-educational schools were randomly selected to take care of the gender variables. From each local government areas, the researcher assigned experimental and control group randomly. The experimental groups received training in cognitive behavior therapy while control groups were handled using conventional approach.

The instruments for data collection were 10 mathematics Achievement Test (MAT) forms 1 and 11 and Mathematics Test Anxiety (MTAS) and two training programmes namely; Cognitive behavior therapy and Control programmes lesson plans were developed, validated and used for the study. The Mathematics Achievement Test form 1 and Mathematics Test Anxiety (MTAS) were used for pre- treatment assessment while Mathematics Achievement Test form 11 and MTAS (post test) were used for post treatment assessment. Internal consistency reliability co-efficient were determined for the two instruments using Cronbach alpha method and reliability of 0.94 and 0.62 were got for MAT forms 1 and 11 while MTAS yielded reliability estimates of 0.93. Data obtained through the administration of the two instruments were organized and analyzed using mean

and standard deviation to answer research questions while hypotheses were tested using Analysis of Covariance (ANCOVA)

Experimental procedure

The researcher sought the co-operation of the principals and teachers of the schools involved to enable them carry out research in their schools. The researcher explained the purpose of the study and the benefits that could be derived if properly conducted.

The principals was not directly involved in the execution of the treatment programmes but gave the validated cognitive behaviour therapy programme to the teachers in the experimental schools and gave control class the same topic using conventional method in teaching them. The two mathematics teachers in the treatment classes received training separately from the other teachers in control groups before involving them in trial testing for the study.

Two weeks before the commencement of the training, the mathematics teachers in treatment or experimental groups used the prepared pre-treatment embedded in Cognitive behaviour therapy to teach the students in the experimental class the skills in the use of Cognitive behavior therapy.

Before the beginning of the actual treatment Mathematics Achievement Test Form 1 and Mathematics Test Anxiety Scale was administered to both experimental and Control groups as pre-test scores which were used as covariates to the students post tests scores.

During the actual treatment, instructions from topics drawn from core curriculum of SS11 were taught to both experimental and control groups. The purpose was to expose the two groups to relevant experiences in the content areas in which they were tested at the end of the study. Each group was taught separately using the appropriate lesson plan design for it. Each group met 40 minutes a day for three weeks .The post test for both treatment and control groups was carried out a week after treatment had stopped for internalization of Cognitive behavior therapy. The results of both the pre- test and post test were collated and subjected for analysis to answer the two research questions and hypotheses.

Results

Research Question 1

What is the effect of Cognitive behaviour therapy on mathematics achievement scores of students exposed to cognitive behaviour therapy and those in control group.

Table:1

Pretest-Posttest Mean Mathematics Achievement Scores and Standard deviation of students exposed to cognitive behaviour therapy

		Pre-Test	**Post Test**	**Mean gain\loss**
Experimental group	Mean	40.10	64.23	24.13
	N	88	88	
	St. Deviation	14.60	17.30	
Conventional group	Mean	41.17	42.44	
	N	86	86	
	St. Deviation	15.75	16.31	

Data presented in table 1 above indicated the pre-test and post mean scores in mathematics achievement of students in the treatment and control groups. The students exposed to cognitive behaviour therapy had a mean pre test score of 40.10 and a standard of 14.60. The post test achievement was 64.23 giving a mean pre test\post test gain score of 24.13.For students in control group, their mean pre test achievement score was 41.17 and a standard deviation of 15.75 and a mean post test achievement score of 42.44 and a standard deviation of 16.31.The mean pretest\posttest achievement gain score was 1.27. The data indicates that students in the treatment group had a higher mean scores in achievement than those in the control group. This implies that the students in the treatment group who were exposed to cognitive behavior therapy achieved better than those in control group who received placebo.

Research Question 2

What is the effect of cognitive behaviour therapy on mathematics test anxiety mean scores of students of exposed to cognitive behaviour therapy and those in control group.

Table 2; Pretest-Posttest Mean Mathematics Test Anxiety scores and standard deviation of students based on their exposure to Cognitive behaviour therapy.

Experimental group	Mean	2.57	2.42	-0.15
	N	88	88	
	Std.Deviation	33	.26	
Control group	Mean	2.57	2.65	0.08
	N	86	86	
	Std.Deviation	.17	.27	

Data in table 2 shows the mean mathematics test anxiety scores and standard deviation of students exposed to CBT and those who were not exposed. From the data one can see that the students in the experimental group had pre test mean score of 2.57 and standard deviation of .33 in their mathematics test anxiety scale; while their post test means mathematics test anxiety score was 2.42 with a standard deviation of .26 giving a mean pre test\ post loss score of -0.15. The students exposed to control group had a pre test mean mathematics test anxiety score of 2.57 with a standard deviation of .17 while their post test mean score was 2.65 with a standard deviation of .27 giving a pretest\post-test mean gain score of 0.08. The experimental group that was exposed to CBT had a lower mean mathematics anxiety score than their pre test score. While students in the control group had a higher post test mean mathematics test anxiety score. The standard deviation of the experimental group were .33 and .26 in the pre test and post test while the control group had standard deviation of .17 and .27 indicating that the respondents were not too far from their respective means and from one another in their responses which adds further validity to their mean.

Hypothesis 1

There is no significant difference in mean mathematics achievement scores of students exposed to CBT and those exposed to control.

Table 3; Summary of the 2 way Analysis of covariance of students on mathematics achievement test

Source	Type 111 sum of squares	Df	Mean squares	F	Sig
Corrected model	194856.132	4	48714.033	324.812	.000
Intercept	177089.747	1	177089.747	1.181	.000
Pre-Math Test	2124.853	1	2124.853	14.168	.000
Treatment	191349.309	1	191349.309	1.276	.000
Gender	122.343	1	122.343	.816	,363
Treatment &Gender	66.532	1	66.532	.444	.506

Error	25345.983	169	149.976
Total	437896.000	174	
Corrected Total	220202.077	173	

a R square=885(Adjusted R squared= .882

The data in the table 3 above shows that CBT as a factor in the study has a significant effect on the mathematics achievement of students. This is because the calculated F-value of 1.276 in respect of the treatment as main the effect has a probability value of .000 and therefore significant at 0.05 level of significance. This implies that exposing students to cognitive behavior therapy during mathematics instruction significantly increased their mathematics achievement. Therefore null hypothesis of significant difference in mean mathematics achievement test of students exposed to CBT and those exposed to control is rejected. Thus there is significant difference in the post test mean mathematics achievement scores of senior secondary school students exposed to CBT and those in control group.

Hypothesis 2

There is no significant difference in the mean mathematics test anxiety scores of students exposed to cognitive behaviour therapy and those in control group.

Table 4; Summary of 2-way Analysis of covariance of mean scores on mathematics test anxiety scale

Source	**Type 111 sum of squares**	**F**	**Mean squares**	**F**	**Sig**
Corrected model	2.141	4	.535	7.559	.000
Intercept	10.807	1	.008	.115	.735
Pre Math test anxiety	.008	1	2.135	30.140	.000
Treatment	2.135	1	.001	.015	.902
Gender	.001	1	.014	.194	.660
Treatment	.014	1	.71		
Error	11.970	1			
Total	1130.804	174			
Corrected Total	14 111	173			

a R square =152(Adjusted R square=152) The data on table 3 above shows that CBT as a factor in the study have a significant effect on the mathematics test

anxiety of students. This is because the calculated F value of 30.140 in respect of the treatment as main effect has a probability value of .000 and therefore significant at 0.5 level of significance . This implies that exposing students to CBT during mathematics lesson significantly reduced mathematics anxiety. Therefore the null hypothesis of no significant difference in the mean mathematics test anxiety scores of students exposed to CBT and control group is rejected .Thus, there is a significant difference in the post test mean mathematics test anxiety scores of students exposed to CBT and those students in control group.

Discussion of results

The findings of the study indicated that students who were exposed to CBT achieved significantly better than those who received placebo .It enabled the students shift from irrational thinking about mathematics to rational thinking in dealing with mathematical operation .This enable the students to be motivated to learn and discover new ideas to solve mathematical problems (Ellis,1998). This is in agreement with findings of Nwgoke and Akaneme (2010) on effects of cognitive restructuring intervention programme on the achievement orientation of schooling adolescent in Aguata Education zone of Anambra state. The findings of the study reveal that CBT intervention therapy reduced the mathematics test anxiety of the students exposed to CBT .It enable the students to calm down and learn mathematics problem solving skills as they shift from irrational thought which is negative self statement that are motivating factors of irrational behaviour .The goals of Ellis and Aaron rational behaviour therapy are to overcome the beliefs of people have which are self destructive and erase tension and apprehension in learning and evaluative situation.

Implication and recommendation

It was recommended that emphasis should be given to orientation of students on cognitive behavior therapy. This is to motivate students who are low in mathematics achievement. Also teacher preparation institutions should incorporate cognitive behavior therapy in relevant areas of their curriculum units and expose both pre service and in service teacher to this strategy for onward transmission to their students.

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