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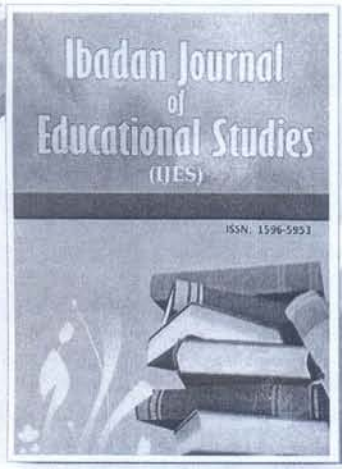

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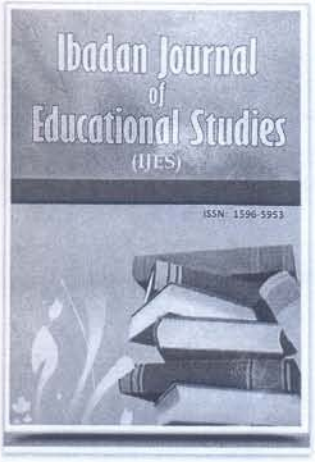

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Assessment and Management of Poor Performance in Mathematics: Using Academic Self-Efficacy and Cognitive Restructuring Techniques

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Abstract

The study investigated the effect of cognitive restructuring therapy on poor performance in Mathematics among Secondary School Students. Sixty Senior Secondary School (SSS II) students were used for the study. The research adopted a pretest, posttest and control group quasi experimental design with a 2x2x2 factorial matrix. Two schools were randomly selected from two different Local Government Areas in Ibadan. 30 participants each were randomly selected for the treatment and control group from the two selected schools. The major instruments used for the study were Academic Self-Efficacy Scale (ASES) r= .80 and Mathematic Performance Test (MPT) r = .77. The data were analysed with the aid of Analysis of Covariance (ANCOVA) tested at the 0.05 level of significance. The finding indicates that the participants exposed to Cognitive Restructuring Therapy showed a significant improvement in their mathematics performance than those in control group. It was also found that Academic Self-Efficacy when properly managed has a significant effect on mathematics performance of students. It is recommended that Cognitive Restructuring Therapy should be used by the Counselling Psychologists to intensify their effort to make use of the intervention in their strategies for counselling.

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Assessment and Management of Poor Performance in Mathematics: Using Academic Self-Efficacy and Cognitive Restructuring Techniques

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Abstract

The study investigated the effect of cognitive restructuring therapy on poor performance in Mathematics among Secondary School Students. Sixty Senior Secondary School (SSS II) students were used for the study. The research adopted a pretest, posttest and control group quasi experimental design with a 2x2x2 factorial matrix. Two schools were randomly selected from two different Local Government Areas in Ibadan. 30 participants each were randomly selected for the treatment and control group from the two selected schools. The major instruments used for the study were Academic Self-Efficacy Scale (ASES) r= .80 and Mathematic Performance Test (MPT) r = .77. The data were analysed with the aid of Analysis of Covariance (ANCOVA) tested at the 0.05 level of significance. The finding indicates that the participants exposed to Cognitive Restructuring Therapy showed a significant improvement in their mathematics performance than those in control group. It was also found that Academic Self-Efficacy when properly managed has a significant effect on mathematics performance of students. It is recommended that Cognitive Restructuring Therapy should be used by the Counselling Psychologists to intensify their effort to make use of the intervention in their strategies for counselling.

Keywords: Cognitive restructuring therapy, Mathematics performance, Academic self-efficacy Secondary school students

Introduction

The poor achievement of students in Mathematics examinations in Nigeria has become a source of great concern to parents, teachers, educationists, educational institutions and all stake holders in education. Mathematics is a very important subject and it has very many applications in our everyday life. Humans use Mathematics consciously and unconsciously

every day of our lives. It is being studied in secondary schools as a compulsory subject. For a nation that wants to achieve rapid technological development, academic performance in Mathematics is central to the attainment of this laudable goal. Mathematics is the foundation science subject for the other science subjects like, Physics, Chemistry, Biology, and Additional Mathematics, while English Language is an indispensable tool of expression and communication.

In Nigeria, Mathematics is a powerful tool in achieving the Millennium Developmental Goals. The Millennium Developmental Goals (MDGs) was adopted in the United Nations headquarters in the year 2000, with Nigeria as a signatory. The goals comprise eight major issues which include; halving extreme poverty and hunger; achieving Universal Basic Education; promoting gender equality and women empowerment; reducing child mortality; improving maternal health ; combating HIV/AIDS, malaria and other diseases; ensuring environmental sustainability and developing a global partnership for development (Adeogun, 2007). Nigeria as a nation has put in much effort in achieving these goals especially in proving the Universal Basic Education and in the promotion of gender equality.

However, the role of Mathematics in achieving these goals cannot be overemphasized as Mathematics has been identified as an indispensable tool in many other disciplines, which have been developed because of their importance to modern life. Such disciplines apart from the physical sciences include Economics, Sociology, Biology, Linguistics, Computer sciences, Information theory, Cybernetics, among others (Badmus, 2002). It is no exaggeration therefore to assert that Mathematics has become an important social factor in the development of a nation.

The importance of Mathematics cannot be over emphasized as the knowledge of Mathematics is required by every facet of our daily lives. It is absolutely indispensable in the world of science and technology and which no nation can develop without its appropriate knowledge. Despite its importance, it is disheartening that students performance in the subject at external examinations like WAEC, NECO and NABTEB have been consistently, persistently and unrelentingly poor consecutively (Popoola and Olarewaju, 2010). From national level, available data has shown that in the Secondary School Certificate Examination (SSCE) of 2012, (38.81%) of the candidates failed mathematics; (36.57%) failure was recorded in 2013; while that of 2014 was (31.28%).Similarly, (38.68%) failure was recorded in 2015; and (38.5%) in 2016 (WAEC; extracted from Federal Republic of Nigeria, 2016).

Education has been viewed as the tool for eradicating poverty and effecting national development and mathematics was considered to have a pivotal role in actualizing this purpose (Betiku 2001; Tikly 2001 cited in Imam 2012). In the twentieth century, Mathematics was conventionally viewed as a touchstone of intelligence and whetstone of scientific and technological innovations due to it connection to all field of sciences (Udousoro 2002; Adeoye 1991; Edukugho 2010). Consequently, this study explores the strategies that could be used to improve students' performance in mathematics. Students experience a variety of emotional reactions after passing or failing any examination. As experiences show, students who fail, see themselves less happy and satisfied and feel

incompetence, apart from this, the students find a negative emotional state when they fail and they find a positive emotional state when they succeed.

To change the students' irrational beliefs and assumption that impede on their academic performance there is need to restructure their cognition orientation. The term cognitive restructuring technique was pioneered by Aaron Beck and Albert Ellis, among others (Ellis, 1989). It is a psychotherapeutic process of learning that focused more on thoughts to identify and dispute irrational or maladaptive thoughts. There are many methods used in cognitive restructuring, which usually involve identifying and labelling distorted thoughts, socratic questioning, thought recording, identifying cognitive errors, examining the evidence (pro-con analysis or cost-benefit analysis), understanding idiosyncratic meaning/semantic techniques, reattribution, guided imagery and listing rational alternatives (Huppert, 2009).

Ellis (1962) stated that human beings made themselves victim of irrational thinking and could virtually destroy themselves through irrational and muddled thinking. Beck (1976) also stated that cognitive restructuring involved a process of re-orientating one's thought process to reality, of requiring one's mind to think truthfully, factually and logically. Cognitive restructuring is sometimes used synonymously with reframing, re-appraisal, re-labelling and attitude adjustment (Brain, 2006). It is a technique that can help people identify, challenge and alter anxiety provoking thoughts patterns and beliefs (Baxter, 2010). This is the process of learning to identify and challenge irrational or maladaptive thoughts using strategies such as logical disputation. Various types of therapy utilize the process of cognitive restructuring, such as cognitive behavioural therapy and rational emotive therapy (Colin, 1997; Hope, Burns, Hyes, Herbert & Warner, 2010).Students who develop false assumption that they cannot pass examination without cheating or seek help or assistance from others may not be properly motivated to study hard for examination and once a false assumption has been made, it will then often be used as a basis for prompting behaviours that end up acting in response to the false assumption as if it were true (Ngwoke, Numonde, Eskay & Ngwoke, 2013). According to Baxter (2010), irrational thought like this and their accompanying behaviour, play a vital role in the onset of anxiety. In this study cognitive restructuring means the process of learning to dispel faulty thinking patterns and replacing them with more profitable one.

In investigating cognitive behavioural techniques, Amiri (2005) compared the effectiveness of cognitive-behavioural therapy techniques, learning the proper ways of study skills and the mixed method in reducing test anxiety. However, results showed that all three experimental groups compared with the control group showed a significant decrease in anxiety scores, but the simultaneous application of cognitive-behavioural therapy and study skills training compared with its separate application caused a significant decrease in the score of students' test anxiety. The main goal of cognitive therapy is helping people to achieve reaction compromised with test anxiety while cognitive restructuring helps students to learn to maintain focus on the task and decentralization to unrelated responses. Thus, teaching cognitive restructuring therapy as well as the proper ways of training is important to prevent and reduce symptoms of anxiety in students (Ghamari, Rafeie, & Kiani, 2015).Cognitive

restructuring helps students to learn to maintain focus on the task and decentralization to unrelated responses. Thus, teaching cognitive restructuring therapy as well as the proper ways of training is important to prevent and reduce symptoms of anxiety in students. Performance in Mathematics could also be informed by the type of self-beliefs students have in themselves. It has been asserted when students have less belief in themselves, they tend perform below expectation but the reverse is also the case.

Another variable of interest in this study is academic self-efficacy. Academic self-efficacy was used as a moderating variable in this study. Academic self-efficacy is known as the belief in ones capabilities to organize and execute the resources required to manage prospective situations (Bandura, 1997). Zimmerman (2000) and Brophy (2004) discuss the role of self-efficacy in influencing motivation through activity choice, effort and persistence. The contribution of academic self-efficacy to educational performance is based both on the increased use of specific cognitive activities and strategies and on the positive impact of efficacy beliefs on the broader, more general classes of metacognitive skills and coping abilities. Self-Efficacy predicts intellectual performance better than skills alone, and it directly influences academic performance through cognition. Self-Efficacy also indirectly influences perseverance (Diane, 2003).

The evidence that academic self-efficacy is able to improve performance in specific cognitive areas is well developed, and it is also very clear that self-efficacy is much more than the reflection of content specific ability. In studies of Mathematics problem solving, children with high efficacy were found to persist longer (Bouffard-Bouchard, Parent & Larivee, 2001) and to use more efficient problem-solving strategies (Collins, 2010) than low-efficacy learners. Even more impressive support for the independent contribution of efficacy beyond ability is provided by studies that manipulate, rather than measure, existing levels of efficacy. Bouffard-Bouchard (2000) and Cervone and Peake (2006) manipulated efficacy beliefs of students by providing fictitious performance norms during feedback. Students in the positive feedback (that is, high self-efficacy) condition set higher aspirations, showed greater strategic flexibility in the search for solutions, achieved higher performance, and were more accurate in evaluating the level of their performance than were students of equal ability who received less positive feedback.

Individuals with high self-efficacy attempt challenging tasks more often, persist longer at them, and exert more effort (Schwarzer, 1992). If there are failures, highly efficacious individuals attribute it to a lack of effort or an adverse environment. When they succeed, they credit their achievement to their abilities. The perception that their abilities caused the achievement affects the outcome rather than their actual abilities (Maddux & Stanley, 1986). On the other hand,
those who regard themselves as inefficacious shy away from difficult and challenging tasks, slacken their efforts and give up readily in the face of difficulties, dwell on their personal deficiencies, lower their aspirations and suffer much anxiety and stress. Such self-misgivings undermine performance.

Another important variable worthy of note in the present study is moderating influence of gender on the causal link between academic self-efficacy andMathematics performance.The extent to which gender affects academic performance of students appears not to have been resolved. Findings showed that gender differences in academic performance in mathematics and science subjects with boys performing better than girls (Jahun & Momoh, 2001; Ezeugo & Agwagah, 2000).Pajares (2000) also showed that girls are inclined to underestimate their capacities in science regardless of the fact that their performance is poorer that of the boys. Due to this tendency which continues in school, fewer female students werefound studying science at College level. Again, Aiyedun and Popoola (2004) reported no significant differences in the performance of boys and girls in mathematics. Akaneme and Ngwoke (2010) reported that gender had no significant main effect on students' performance.

The objective of the study is to use cognitive restructuring therapy to reduce poor performance in Mathematics among Senior Secondary School students. The study also examined the moderating effect of academic self-efficacy on the causal link between cognitive restructuring therapy and Mathematics performance of Secondary School students.

Hypotheses

Based on the stated objectives of the study, it was hypothesized that experimental group will not be significantly different from the control group on the measure of mathematics performance of secondary school students in Ibadan, Oyo state, Nigeria.

Methods

Design

The study adopted the pre-test post-test and control group quasi-experimental design with a 2x2x2 factorial matrix. Hence, the row consisted of cognitive restructuring and control group. The row was crossed with Gender varied at two levels (Male and Female) and Self-Efficacy varied at two levels (Low and High).

Participants

Participants were 60Senior Secondary School II students randomly drawn from two public secondary schools in twoLocal Government Areas in Ibadan metropolis. From each school, 30 participants were randomly selected and screened for the study. The participants consisted of Senior Secondary School students in SS II that have persistent poor performance in Mathematics for more than two terms.

Measures

Academic Self-Efficacy Scale (ASES)

This scale consists of ten (10) item instrument rated on four Likert Rating Scale ranging from 1 = Not at all true to 4 = Exactly true. The instrument was adapted from Academic self-efficacyscale developed by Schwarzerand Jerusalem (1995). The instrument has reliability coefficient of .80 with Cronbach's Alpha of .76 to .90. The instrument was however re-validated and Cronbach alpha value of .85 was obtained after a pilot study within the interval of three weeks.

Mathematics Performance Test (MPT)

This test was developed by the researcher; it is made up of (50) multiple choice items with four options ranging from A-D. All the questions were answered by the participants within one hour and thirty minutes. The reliability coefficient of the instrument was determined using Kuder – Richardson formula 20 (KR20). Kudar – Richardson formula 20 (KR20) was used to determine the internal consistency and overall coefficient of the instrument. Item analysis was also used to carry out the difficulty/ability index and discriminatory power of the test using higher achievers and lower achievers. This was done between the upper class score and lower class score of the participants in Mathematics Test. The difficulty of (.73) and the discrimination index of (.91) were obtained after passing through the method of Classical Test Theory (CTT).

However, writing of test items was followed by face and content validation. The face and content validation reduced the items from seventy-five (75) to fifty (50) after giving the test to the experts in Mathematics. Kuder-Richardson formula (KR_{20}) was applied to the scores in order to measure the internal consistency which was found to be .77. Indeed, all schools conducted two continuous assessment tests in each term of the session totaling six continuous assessment scores. Also, each school conducted the end-of-term examination making up three examinations. The two continuous assessment scores have a weight of 40% while the terminal examination has a weight of 60% totaling 100% for each candidate in every subject offered. At the end of the session, the average of the three terms scores are computed for each student to sustain their promotion. Accordingly, subject grade in all the schools is based on the number of percentage passed in the subject(s). thus: 75 and above = A1; 70 - 74 = B2; 65-69 = B3; 60 -64 = C4; 55 - 59 = C5; 50 - 54 = C6; 40 – 49 = D and Below 39= F. Participants for this study were be selected from categories D and F then learning readiness scale was administered to those students who scored below 50 in their school records.

Table 1: Table of specification of Mathematics Performance Test

Mathematics contents Areas	Total Weight	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation	Total
Operations involving the binary system	20%	4	2	1	1	1	1	10
Simplification of algebraic	25%	5	2	2	1	1	1	12
Perimeters and areas of plane shapes	20%	4	2	1	1	1	1	10
Construction	20%	4	2	1	1	1	1	10
Three-dimensional shapes (solids)	15%	3	2	1	1	1	0	8
TOTAL	**100%**	**20**	**10**	**6**	**5**	**5**	**4**	**50**

Procedure

The training programme was conducted in the third term of 2015/2016 academic session among Senior Secondary School II students (SSII). The study was carried out in four stages: recruitment, pretest treatment andcontrol group. At the pre-session, activities include the screening, recruitment and assigning of participants to experimental and control group. A preliminary meeting was organised to familiarize with the interested participants and to solicit their willingness to participate in the study. At the pre-test stage Academic Self-Efficacy Scale (ASES) and Mathematics Performance Test (MPT) were administered to the participants. Participants in the experimental group were exposed to eight sessions of treatment of one session per week and each session lasted for one hour. The control group received no treatment throughout the programme they were only given lecture on the study skill technique. After the post-test, Mathematics Performance Test (MPT) was administered to the experimental and control groups as criterion measure.

Data Analysis

Analysis of Covariance (ANCOVA) was a major statistical tool used to establish initial differences between the participants in the experimental and the control groups. The Duncan Post-hoc analysis was also used in this study to determine the directions of differences and significance identified. Furthermore, estimated marginal means was also used to show the interaction of intervention, moderating variables on poor performance in Mathematics of Secondary School students.

Results

Table 2: Summary of 2x2x2 Analysis of Covariance on participants' Mathematics and control group with Self-Efficacy as Covariate

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Square
Corrected Model	2080.320[a]	2	1040.160	374.622	.003	.352
Intercept	428.448	1	154.309	154.309	.002	.211
Treatment	1999.449	1	1999.449	720.118	.001	.114
Pre-score	3.503	1	3.503	1.262	.266	.047
Self-efficacy	21.310	1	21.310	11.156	.001	.337
Gender	9.877	1	9.877	.987	.001	.032
Treatment*Self-efficacy	33.341	1	33.341	8.156	.001	.320
Treatment*Self-efficacy*Gender	38.341	1	38.341	12.156	.001	.103
Error	158.264	57	2.777			
Total	35139.000	60				
Corrected Total	2238.583	59				

R Squared = .929 (Adjusted R Squared = .927) **Significant at <.05

As indicated in Table 2, the analysis of covariance of the participants' post-test scores on mathematics performance using their pretest as covariates indicates that there was significant main effect of treatment ($F_{(1;57)} = 720.118$, $p<0.05, \eta^2 = .114$). Consequently upon this result, the null hypothesis which states that there would be no significant difference in the mathematics performance of experimental and control group was significant. There was significant main effect of academic self-efficacy on the mathematics performance of the participants ($F_{(1;57)} = 11.156$, $p<0.05, \eta^2 = .337$). There was a two-way significant interaction effect of treatment and academic self-efficacy on the mathematics performance of the participants ($F_{(1;57)} = 8.156$, $p<0.05, \eta^2 = .320$). There was also a three-way significant interaction effect of treatment, academic self-efficacy and gender on the mathematics performance of the participants ($F_{(1;57)} = 12.156$, $p<0.05, \eta^2 = .103$). What the result is suggesting is that cognitive restructuring therapy was effective in enhancing mathematics performance of students and that the causal link between the treatment and criterion measure was not mediated by academic self-efficacy.

Discussion

The findings of this study established the effectiveness of cognitive restructuring in reducing poor performance in Mathematics among Senior Secondary School students. This finding is in accordance with previous studies (Mehryar, 2000; and Amiri, 2005) who found theefficacy of cognitive restructuring on the proper study methods of students' performance to be

effective in reducing poor test performance of students. The findings also agreed with findings of Akaneme and Ngwoke (2010); Kovalski and Horan (1999); Salman, Esere, Omotosho, Abdullahi and Oniyangi (2010)who found that cognitive restructuring significantly improved the achievement orientation of students and their subsequent performance in academic task. The reason for this finding is not farfetched; when a student's cognitive orientation is changed towards a particular school subject; such a student's performance tends to improve.

It is also consistent with explanation of the behaviorist learning theory that irrational beliefs system and mindsets are both passively acquired. Therefore, effective cognitive restructuring training programme would lead one to refute such beliefs, evaluate the basis of such beliefs and mindsets. The direct confrontation of such beliefs with the ability and alternative explanations can to a large extent dislodge the basis of such irrational beliefs and could subsequently lead to a change in disposition.

Another important finding worthy of note in the present study is moderating influence of self-efficacy on the causal link between the intervention and the criterion variable (mathematics performance) is significant. The findings indicate that highly efficacious students in Mathematics perform well than students with low self-efficacy. Self-efficacy is depicted as having a significant effect on Mathematics achievement. The finding is an empirical foundation of Hackett (1985); Lent and Hackett (1987); Bandura's (1986, 1997); Pajares (1996b) that Self-Efficacy beliefs predict academic outcomes and Mathematics achievement. The explanation for this may be that students who believe that intelligence is changeable and may be modified by effort possesses high self-efficacy and confidence in their academic performance. In general, there is ample reason to believe that self-efficacy is a powerful motivation constructs that works well to predict academic self-beliefs and performance at varying levels but works best when theoretical guidelines and procedures regarding specificity and correspondence are adhered to (Bandura, 1997)

The study also established that there was no significant difference in the posttest scores of high and low mathematics anxiety of participant exposed to solution focused therapy and control group. This finding is in consonance with previous research works (Ma & Xu, 2004; Richardson & Suinn, 1972) who deduced that mathematics anxiety is always a factor affecting students' mathematics performance even with the treatment. This indicates that as mathematics anxiety scores increase, achievement scores decrease. Mathematics anxiety could develop as a result of a student's prior negative experiences learning mathematics in the classroom or at home. The probable explanation for this result could be that mathematics anxious

It was found that there is a significant difference between the mean achievement scores of male and female Secondary School students in Mathematics, as male scored higher than the female. This result is in consonance with the work of Osafehinti (1988) who found gender difference in students' Mathematics performance. Although differences in Mathematics performance between male and female Secondary School students is found, this difference

may be less pronounced, Secondary School female students may continue to exhibit weaker Mathematics self-belief, than the males, but these differences may be less pronounced when female are asked to provide a judgment of confidence to solve a specific problem. In other words, their weaker self-beliefs may be more generally experienced and less contextually based (Pajares, 2000).

Conclusion and Recommendation

The use of cognitive restructuring intervention programme significantly improves the students' performance. Therefore, the use of cognitive restructuring intervention is effective in changing false beliefs, assumptions and negative mindset.

Since self-efficacy is one of the most influential factors for learning, it appears to be very important for the teacher to help students develop their self-efficacy. Teachers can enhance the level of student's efficacy through various feasible teaching techniques.

It is recommended that cognitive restructuring should form part of the school curriculum to enable teachers use the techniqueto enhance students' performance.

Workshops and seminars should be organized to train teachers onhow to use cognitive restructuring intervention technique in the classroom to address students' problem in Mathematics.

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