EFFECT OF COGNITIVE RESTRUCTURING INTERVENTION PROGRAMME ON MATHEMATICS ACHIEVEMENT ORIENTATION AMONG SENIOR SECONDARY SCHOOL STUDENTS

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Abstract

The study investigated the effect of cognitive restructuring intervention programme on mathematics achievement orientation among senior secondary school students. One research question and one null hypothesis guided the study. The design of the study was a quasi-experimental non-equivalent pretest-posttest research design involving one experimental and one control group. The sample for the study comprised of 207 (89 males and 118 females) senior secondary school two students drawn from six intact classes in three co-educational secondary schools in mainland Local Educational District IV Sabo of Lagos State. The instrument used for the study is Mathematics Achievement Orientation Questionnaires (MAOQ). Also, an instructional package: Cognitive Restructuring Intervention Programme (CRIP) was developed by the researchers. Mean and standard deviations were used to answer the research question, while analysis of covariance was used to test the null hypothesis. Major findings of the study reveal that exposing students to cognitive restructuring had an enhanced effect on their mathematics achievement orientation. Based on these findings, conclusions were drawn and educational implications discussed. Major recommendations made were: students should be exposed to cognitive restructuring strategies. To achieve this, the teachers should explain, demonstrate and model the strategies to the students. Also, cognitive restructuring strategies should be incorporated in teachers' education programmes adequately to prepare the prospective teachers who may teach the students. Also workshops and seminars should be organised by the government and school administrators for mathematics teachers to sensitize them on the importance and use of cognitive restructuring.

Introduction

Mathematics is very important in our daily lives. It is a subject that affects all aspects of human life at different degrees. The social, economic, political, geographical, scientific and technological aspects of man are

centered on numbers. Mathematics is the science of numbers and of shapes, including algebra, geometry and arithmetic (Longman Dictionary of contemporary English, 2009). Another view of mathematics is that it is a specialized language which deals with form, size and quantity or a science which involves logical reasoning, drawing conclusion from assumed premises, systematized knowledge, and strategic reasoning based on accepted rules, or probabilities (Ramana, 2007). Mathematics is used throughout the world in natural science, engineering, medicine, finance and the social sciences. In this study, mathematics is a study of numbers and arithmetic operations, a body of knowledge that centers on such concepts as quantity, structure, space and change, and also a discipline that studies them.

Mathematics is crucial not only for success in school, but in being an informed citizen, being productive in one's chosen career, and in personal fulfillment. Bulter and Wren (as cited by Ezeahurukwe 2010), assert that mathematics can contribute to the realization of the general aims of education which among others include the development of effective critical thinking and competence in the basic skills necessary for dealing with numbers and forms, as it is indispensable in all commercial transactions, keeping statistical records and for researches. In another related study (Igbokwe 2003), highlights the intricate link of mathematics to science and technology. Learning mathematics improves children's problem-solving skills and enables them build their ability to solve problem by learning to calculate simple arithmetic problems. Every new mathematics problem one tackles requires one to expand one's ability to dissect a problem and solve each individual part (Williams 2004). Again, taking time to work through mathematics problems and arriving at the correct answer teaches children persistence and perseverance. Graeber and Weisman (as cited in Ajayi and Muriana 2011), agree that mathematics helps the individual to understand the individual's environment and to give accurate account of the physical phenomena around the individual.

In today's technology-driven society, greater demands have been placed on individuals to interpret and use mathematics to make sense of information in complex situations. As a result, the teaching and learning of mathematics become the nation's top priority (National Open University of Nigeria, 2006). Awokoya and Fafunwa, (as cited in Maliki, Ngban, and Ibu 2009), agreed that people live in a world where science and technology have become an integral part of the world culture. For any nation to be relevant therefore, it must not overlook the importance of mathematics in her educational system.

Nigeria as a nation is gradually marching towards scientific and technological advancement. The nation's educational system is currently

tailored towards equipping school children with mathematical, scientific, technological and communicative skills pertinent to scientific inquiry and technological developments. As a result of this, Mathematics is made a compulsory subject in the curriculum of the primary and secondary school levels of her educational system (Federal Republic of Nigeria, 2004). However, judging from the achievements level of students in mathematics examinations at the senior school certificate examinations, it may be difficult to achieve the dream of laying a solid foundation for scientific and technological development in the country. Many Nigerian students develop negative attitude to the subject, fear it and perform poorly in mathematics examinations. (Abdulaihi and Onasanya, 2010; Igbokwe, 2003; Akin 2010).

A close analysis of the students' achievement in senior secondary school mathematics examination shows clearly the deteriorating state of secondary school students' achievement in mathematics. A report from the statistics department of West African Examinations Council (WAEC), Jibowu Lagos has it that out of 1,249,028 candidates that sat for mathematics examination in 2007, only 584,024 (46.76%) had credit pass. Similarly, in 2008, 2009, 2010, and 2011 similar results were recorded as only 57.28%, 47.04%, 41.95% and 40.35% obtained credit pass in mathematics respectively. On the other hand, 24.24%, 17.24%,23.41%, 27.20%, 27.93%, 50.58, 54.19 and 61.97 recorded failure in 2007, 2008, 2009, 2010, 2011, 2012, 2013 and 2014 respectively, (Statistic Department WAEC, 2015).

Both Federal and State governments as well as some corporate organizations recognizing the fundamental role of mathematics in economic development have established different programmes to improve students' cognitive and affective outcomes in mathematics. The Federal Government established the National Mathematics Centre (NMC) in 1989 and the Mathematics Empowerment Project at Akure in 2007 to develop, deploy appropriate initiatives and resources of international standing, to rekindle and sustain interest in the study of mathematics and mathematical sciences at all levels. Over the years the centers have made attempts to remedy the failure rate in West African Senior Secondary Certificate Examination, National Examination Council (NECO) and Joint Admission and Matriculation Examination (JAME). In school, the motive that students develop about their academic capabilities help determines their achievement orientation and what they do with the knowledge and skills they have learned (Putwain and Best 2011). Achievement orientation means the drive and passion to accomplish goals, excel and be successful. Achievement orientation is the presence of the motive, the nature of the situation evoking the motive and the goal of the behaviour. The motive is conceived as a desire to excel in reference to a

standard of excellence; the situations which evoke achievement behaviour are those in which competence of performance is central and the general aim of achievement behaviour appears to be that of obtaining positive reinforcement for demonstrated competence (Ames, 1992). According to Aspinwall, Lisa, Taylor and Shelley (1997), achievement orientation refers to how an individual interprets and reacts to tasks resulting in different patterns of cognition, affect and behaviour. Specifically, students with high achievement orientation tend to value competence, expect success and seek challenges, while students with low achievement orientation tend to expect failure and avoid challenges, (Midgley and Timothy 1996).

Achievement orientation in this study is an internalized tendency to strive for standard of excellence. Mathematics achievement orientation is an internalized tendency to strive for standard of excellence in mathematics. Students are reluctant to engage in activities they believe will lead to negative outcomes. This may explain why some students perform poorly in mathematics examinations, since they believe that they cannot make good grades. The fact is that for these students to regain their confidence and have an internalized tendency to strive for mastery something needs to be done. It therefore becomes imperative to find out if the application of cognitive restructuring would enhance achievement orientation of students.

Cognitive restructuring is the process of learning to refute cognitive distortion or fundamental "faulty thinking", with the goal of replacing one's irrational counter-factual beliefs with more accurate and beneficial ones (Au, Chan, Li, Leung, Li, & Chan, in Akaneme (2012). According to Joseph (2003) cognitive restructuring is a way of giving one more control over one's own thoughts, feelings and behaviours. It also involves learning how to think differently, to change fundamental faulty thinking and replace it with more rational, realistic and perhaps positive thinking. Cognitive restructuring according to Ekeh and Obi (2012), refers to the process of replacing cognitive distortion with thoughts which are more logical, accurate and useful. It involves assisting an individual gain more control over his/her own thoughts, feelings and behaviours, and not necessarily an attempt to eliminate all bad feelings. Cognitive restructuring in this study could be seen as a process of helping one to correct negative or faulty belief one has about a given task which makes one not to achieve high on a task. According to Wolpe (1996), cognitive restructuring involves learning how to think differently, to change fundamental faulty thinking, and replace it with more rational, realistic and perhaps positive thinking. In line with the above, the basic steps in cognitive restructuring include identifying the thoughts and beliefs that are influencing the disturbing emotions and evaluating them for their accuracy and usefulness

using logic and evidence and if warranted modifying or replacing the distorted thoughts with the ones that are more accurate and useful. The basic observation in the application of cognitive restructuring is that people's emotions and behaviours can be greatly affected by what they say to themselves and what mental images they present to themselves, they can make themselves happier, kinder, and more productive as well as accomplish several other positive changes (Beck, 1999). In the light of the above, cognitive restructuring is viewed as useful in managing achievement orientation.

Suffice it that several efforts are being made to arrest the problem of students' poor achievement in mathematics especially due to achievement orientation. For some individuals, the problem of mathematics achievement is of such magnitude that professional help is required. Such help according to Ekeh and Obi (2012), could be in the form of providing the students with information about appropriate problem solving strategies and helping them stay away from self-preoccupied worries and negative self-talks. This may be particularly helpful to the low achievement oriented and self efficacy students' cognitive functioning. Improving the cognitive functioning of a low achievement oriented student involves modification of his/her distorted thoughts concerning mathematics. This modification of distorted thoughts and providing appropriate problem solving strategies concerning mathematics could be achieved through cognitive restructuring. This is what this study set out to investigate.

As a result of the increasing demand for technological skills, mathematics education, in particular, has taken on heightened importance and is in the national spotlight. Good knowledge of mathematics for students in secondary school is critical not only to earn them opportunity for admission into higher institutions, but also to make them individuals who will be functional in the society. Yet there have been consistent poor achievement and large failure rate by senior secondary school students in mathematics examinations. The poor achievement of senior secondary school students in this subject is worrisome to students, parents, teachers and examination bodies. Some researchers have attributed this poor achievement to factors such as students' perception of mathematics as a difficult subject, inappropriate teaching strategies, poor study habit, teachers' incompetence, poor mathematics achievement orientation and low self efficacy belief of students. One of the many factors that probably differentiate between high and low achieving students could be the achievement orientation of the learners. Evidence from the developed world suggests that cognitive restructuring has the potential for helping to correct students' negative orientation about mathematics achievement. Unfortunately, the use of cognitive restructuring in

changing students' negative orientation about mathematics achievement and promote their self efficacy belief appears not to have received comprehensive attention in mathematics. More so there is a dearth of literature on the use of cognitive restructuring as intervention strategy in one research. The problem of this study, therefore, posed as a question is "what is the effect of cognitive restructuring on the mathematics achievement orientation of secondary school students in Lagos?

The study determined the effect of cognitive restructuring on mathematics achievement orientation of senior secondary school students. Specifically the study sought to determine.

The following research question and hypothesis served as guided the study:

- What is the effect of cognitive restructuring on students' mathematics achievement orientation?
- There is no significant difference in the effectiveness of cognitive restructuring on students' mathematics achievement orientation in post test mean scores.

Method

The design of this study was a quasi-experimental non-equivalent pretest posttest control group design. The rationale for the use of quasi-experimental design in this study was the lack of true randomization of the subjects since intact classes were used. It also helped not to disrupt the normal class structure and activities. The data collected by administrating the pretest-posttest instruments were analyzed in line with the research questions and hypotheses. Descriptive statistics such as mean and standard deviation were used in answering the research questions. Analysis of covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance. The area of this study is Mainland Local Educational District Lagos. The 6 Local Education District and their Local Government Areas in Lagos State are:District I: Alimosho, Agege, ifako/Ijaiye, District II: Ikorodu, Shomolu, Koshofe, District III: Epe/ibeju Lekki, Etiosha, Lagos, District IV : Surulere, Mainland,Apapa, District V: Badagry, Ojo Amudofin, Ajero Igbenodu,District VI: Ikeja, mushin, Oshodi-Isolo. The area of this study is Mainland Local Education District. Mainland Local Education District has 23 secondary schools. (Education District IV Sabo Yaba School Administration Department 2013). Mainland Local Education District was chosen because evidence has revealed that the students' achievements in the West Africa School Certificate Examination have been declining (Education District IV Sabo Yaba, School Administration Department Lagos 2013). The population of this study

comprised all the 2014/2015 co-educational senior secondary class two (SSII) students numbering 2,189 (1334 males and 855 females) from 7 co-educational Senior Secondary Schools in Mainland Educational District of Lagos State (Schools Administration Department Education District IV Sabo, Yaba, Lagos (Students' population as at December 2014). The choice of co-educational senior secondary school is to take care of gender variables. The choice of senior secondary class two students was guided by the assumption that they are neither preparing for external examinations as is obtainable in SSIII or adjusting to senior secondary syllabus as the SSI students are doing.

The sample for the study comprised of 207 (89 males and 118 females) senior secondary school two students drawn from six intact classes in three co-educational secondary schools in mainland Local Educational District IV Sabo. The researchers purposively sampled Mainland Local Educational District from the three educational districts in District IV because of high decline in students' mathematics achievement in the West African Certificate Examination using stage sampling technique. The researcher selected three schools from the 7 co-educational secondary schools. The random sampling technique was employed in selecting six intact classes from these three co-educational schools. These three selected schools were randomly assigned to treatment and control respectively through simple balloting.

The researcher developed a 30 item Mathematics Achievement Orientation Questionnaires (MAOQ) through a focus group discussion with 20 students from one senior secondary school outside the study areas and from a reviewed literature. The instrument was designed to address specific feelings towards mathematics learning and problem solving. The questionnaire items are based on a four (4) point scale of Strongly Agree (SA-4), Agree (A-3), Disagree (D-2) and Strongly Disagree (SD-1). The instrument is of two sections. Section A sought for the personal information of the respondents while section B sought for the information relating to students' mathematics achievement orientation.

Cronbach Alpha method was used to measure the internal consistency co-efficient of the mathematics Achievement orientation questionnaire (MAOQ). The reliability for the clusters of the instruments was as follows: mathematics achievement orientation questionnaires 0.84. The instructional programme developed for this study as experimental treatments was Cognitive Restructuring Intervention Programme (CRIP). The face validated version of the instructional programme was subjected to field trials by the researchers. The programme was used in training two groups of sampled students from two senior secondary schools in Shomolu Educational District of Lagos State. Each group of students was trained with the instructional programme by the

trainers who were trained in the use of the different programmes. The trial testing served the purpose of ensuring that the instructional programme was comprehensive and could be easily used. It also helped to ensure that the training programme was well designed to achieve the objectives of using it. The feedback gotten from the trial testing was used in shaping the training programme to its present form.

Cognitive restructuring intervention programme (CRIP) is training programme developed by the researcher through reviewed literature. The intervention is a group procedure directed at cognitive restructuring of students' knowledge, beliefs, values and practices that apparently diminished Need- achievement motivation of students. The intervention basically intended to aid students achieve a paradigm shift in ideology, attitude and social expectations as they affect students' mathematics achievement orientation and capability in their school work. The CRIP contained six modules of activities with six steps. Each module is focused on a specific irrational belief which these students hold about mathematics and their school work in general. The schedule of training was as follows:-

Week/Module Activity

- I am not good at sciences so I don't need to border myself studying mathematics
- I cannot pass mathematics because it is a very difficult subject but I can sort my way out in order to pass when the time comes.
- I always achieve below standard in mathematics subject, so there is no need continuing
- I am tired of my mathematics teachers' uses of derogatory words during mathematics classes and I don't like my mathematics teacher.
- Females do better in art subjects than in science subjects.
- Even if I don't pass mathematics, I can easily find a good Job after all, success is a game of luck.

Each of the module/week activities was treated following the six steps of the cognitive restructuring therapy Intervention Programme thus:

- Step I. Identify the (A) Activating experiences that have been very painful or upsetting/identification of the upsetting situation.
- Steps 2 Identify the (C) Consequences that you believe will exist as a result of A. Recording negative feelings about the upsetting situation.
- Step 3. Identify what (B) Beliefs you have about A that produces C. Recording one's automatic thoughts regarding these feelings.

- Step 4. Dispute (D) beliefs, questioning whether they are really factual and rational. Analyze these thoughts using cognitive distortion check list.
- Step 5. Replace the irrational belief with an E effective Rational Belief. Construct realistic and balanced thoughts.
- Step 6. List those (F) feelings that should be the final outcome. Evaluate this restructuring process.

With the help of experts in Educational Psychology and Guidance and Counselling, the researchers developed a counseling programme on Study Habits: Conventional Counseling on Students' Study Habit (CCSSH). This programme was used to keep the students busy while the experimental group received training programme on cognitive restructuring. The researcher identified and stated the behavioural objectives to be achieved, the activities of the instructor, and the subjects and the evaluation technique to be utilized. This was also designed to last for six weeks of one session per week. In this programme, the trainer tried counselling students on Study Habits using conventional method by asking the students to study hard using different methods. The researcher also developed a conventional lesson plan on mathematics. This lesson was used to keep the students busy while the experimental group receives training. At the end of the training both the experimental and control groups were assessed using mathematics achievement orientation Questionnaire (MAOQ).

Before the commencement of the actual treatments, subjects in both the experimental and control group were pre-tested with mathematics achievement orientation questionnaire. The pretest scores were used as covariates to the students' post-test scores at the end of the treatment. The classes for subjects in both the treatments and control groups were held during their normal time on the school timetable (precisely, during free period). The mathematics achievement orientation Questionnaires rating scale were administered to the subjects in both treatment and control a week after the treatments stopped. To ensure that the extraneous variables which could affect the result of the study were controlled and to ensure that any change in attitude of the subjects were as a result of cognitive restructuring intervention programme the following measures were taken. Hawthorne effect: the factor that the researcher tried to control is the "Hawthorne effect" in which there was a tendency that noticeable difference may occur if the students were aware that they are engaged in an experiment. To avoid this, the researchers posed as a special counseling psychologists posted to the school to help the students alleviate their problems especially those difficulties that lead to their

achievement in mathematics. They explained the importance of cognitive restructuring programme and how one uses it to reframe one's negative thoughts/beliefs which may be seen as frustrating and may lead the student to poor achievement in mathematics.

To reduce the errors that may arise as a result of students' interaction and exchange of ideas, subjects for both the experimental and control groups were selected from different schools. There was a week interval between the end of the training time and the time the post test was administered.

Results

Table 1: Mean and Standard Deviation of students' Pretest-Posttest scores on mathematics achievement orientation

Experimental condition (source of variation)		**Pre-test**	**Post-test**	**Pre-test-post-test mean gain scores**
TM 1Cognitive Restructuring Intervention programme	Mean	1.7792	2.4390	0.66
	N	77	77	
	Std. Deviation	.66141	.39471	0.53
Control	Mean	1.7273	1.8485	0.12
	N	66	66	
	Std. Deviation	.66899	.61375	

Data presented in Table 1 above shows the pretest and post test mean scores of students' mathematics achievement orientation in the treatments and control groups as well as mean gain scores of the groups. The students exposed to cognitive restructuring had a pretest mean scores of 1.78 with a standard deviation of .661 and post test mean score of 2.44 and standard deviation of .395. The pretest-post test mean gain is 0.66. The students in the control group had a pretest mean score of 1.73 and standard deviation of .669 and the post test mean score of 1.85 with a standard deviation of .614. The pretest-post test mean gain score is 0.12. The difference in the mean gain scores for the two groups which favours the treatments groups indicates that students who were exposed to cognitive restructuring manifested enhanced mathematics achievement orientation as against their counterpart in the control group.

This effect of cognitive restructuring on the mean scores of students' mathematics achievement orientation was further tested using the corresponding hypothesis.

Table 2: Summary of the one-way Analysis of Covariance for Mathematics achievement Orientation of the students posttest for Interventions Programme (CRIP) and Control Groups.

Source	Sum of squares	Df	Mean square	F	Sig.	Decision at 0.05 level
Corrected model	14.907[a]	6	2.485	11.751	.000	
Intercept	125.525	1	125.525	593.694	.000	
Pre-achievement	.200	1	.200	.948	.331	
Treatment	14.348	2	7.174	33.931	.000	Sig
Error	42.286	200	.211			
Total	1083.953	207				
Corrected total	57.193	206				

The data presented in Table 2 above shows that treatment as a main factor had a significant effect on the student' mathematics achievement orientation. This is because the f-value of 33.9 in respect of treatment as main factor is shown to be significant at .000 levels and therefore significant at 0.05 levels of probability. *F (1,200) = 33.9, p=000*, The hypothesis of no significant difference in the students' mathematics achievement orientation of those exposed to cognitive restructuring and those that were not was, therefore, rejected. The R- squared of .261, further suggested that 26% of the total variance on the dependent measure was contributed by treatment using cognitive restructuring (CR). This evidence shows that CR was effective in enhancing the students' mathematics achievement orientation as compared to those in control group that were not exposed to it.

Discussion

The result of this study reveals that the use of cognitive restructuring intervention programme has a significant effect on students' mathematics achievement orientation. The group trained in the use of cognitive restructuring skills showed enhanced achievement orientation than the group trained using conventional lesson plan. The treatment group exposed to the use of steps in cognitive restructuring had a significantly higher posttest mean score after treatment as against the pretest mean score than those in control group who were taught using conventional counselling methods.

This result is in agreement with some earlier research findings on the efficacy of cognitive restructuring with respect to students' learning. Studies conducted by Kovalski and horan (1998); Ngwoke and Akaneme (2010); Salman, Esrer, Omotosho, Abdullahi, and Oniyang (2010); Beck (1976); Ellis and Harper (1975,1998); Enukora (2009) and Ekeh and Obi (2012) provide

support for the findings of the present study. The study conducted by Ngwoke and Akaneme (2010) confirmed that training in cognitive restructuring had significant effect on secondary school adolescent students' achievement orientation. The studies conducted by Beck (1967), and Ellis and Harper (1975, 1998) found significant improvement in the subjects' thought processes after being exposed to cognitive restructuring intervention programme. The ability of students to use steps in cognitive restructuring facilitated the thinking process of the students in mathematics problem solving.

Enukora (2009) also reported similar findings that training in cognitive restructuring was effective in raising the hope of hopeless and depressed HIV/AIDS patients. Furthermore, Kovalski and Horan (1998) in their study reported cognitive restructuring as being able to dislodge the adolescent girls' mindset from believing that certain jobs are more appropriate to males than females. The findings of Salman, Esrer, Omotosho, Abdullahi, and Oniyang (2010) revealed significant improvement in the mathematics performance ability of students exposed to cognitive restructuring training. Ekeh and Obi (2012) from the result of their study on the effect of cognitive restructuring on examination anxiety reduction among senior secondary school students reported that skills in the steps of cognitive restructuring was effective in bringing about a significant reduction in examination anxiety among secondary school students exposed to the training. The findings of this study are inconsistent with the explanation of the behaviorist learning theory that irrational beliefs and mindsets are passively acquired. However, when one is made to actively examine the basis of such beliefs one would most likely refute such beliefs.

Conclusion

Based on the findings and discussions of this study the following conclusions are made.

Instructions in cognitive restructuring programme enhanced the mathematics achievement orientation of students. The finding of the study, posttest mean scores in mathematics, achievement orientation between the students exposed to cognitive restructuring programme and those who used the conventional learning method cognitive restructuring treatment were effective in improving the students' mathematics achievement orientation. There was no significant difference among those exposed to the programmes in their mathematics achievement orientation.

Recommendations

Based on the findings of this study, the following recommendations were made.

1. Students should be exposed to cognitive restructuring strategies. To achieve this, the teachers should explain, demonstrate and model the strategies to the students. They should also monitor the students' use of the strategies so as to provide immediate feedback.
2. Cognitive restructuring strategies should be incorporated in teachers' education programmes adequately to prepare the prospective teachers who may teach the students. Also workshops and seminars should be organised by the government and school administrators for mathematics teachers to sensitize them on the importance and use of cognitive restructuring.
3. Curriculum planners should plan the school and class activities to be more student-centered. This will enable the students get more involved in activities so as to explore their potentials for self-discovery rather than depend on teachers' information and conventional learning. Teachers should encourage students to take the lead in class discussions. The students should be given opportunities to ask questions and make attempt to generate answers to their own questions and those of their mates. They should also encourage students to develop confidence in their abilities to handle any learning tasks or problem they encounter.
4. Both male and female students should be exposed equally to training in cognitive restructuring. This will help eliminate gender imbalance in the classroom.
5. Government and non-Governmental Agencies should sponsor further research on the effectiveness of cognitive restructuring in other content areas not covered by this study.

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