EFFECTS OF SOME METACOGNITIVE INSTRUCTIONAL STRATEGIES ON SECONDARY SCHOOL STUDENTS' ACADEMIC PERFORMANCE IN MATHEMATICS IN RIVERS STATE OF NIGERIA

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ABSTRACT

This study investigated the effects of some metacognitive strategies on secondary school students' performance in mathematics in Rivers State of Nigeria. The metacognitive strategies examined are the attribution retraining instruction (ARI) and Self-Management Training (SMT). Two research questions were posed and two hypotheses were formulated and tested at 0.05 level of significance. The non-randomized control group of pretest, posttest quasi-experimental research design involving one control and two treatment groups was used. The population consists of 87,860 senior secondary school students while the sample was made up of three SS 1 of 138 students each drawn from three schools (one control and two treatment groups). The instruments for data collection used for the study was mathematics performance test (MPT) with reliability coefficient value of 0.90. The instrument was validated by two experts in educational psychology, one specialist in measurement and evaluation and one in mathematics education. The mean was used in answering research questions while analysis of covariance (ANCOVA) was used in testing the hypotheses. Findings revealed that the two selected metacognitive strategies were effective in enhancing the academic achievement of the students in mathematics. Based on the findings, it was recommended that policy makers and curriculum developers should advocate for increased and standardized implementation of the selected metacognitive instructional strategies and build them into the curriculum for senior secondary schools also, the policy makers and the government as a whole should allocate increased funding so as to provide regular and special education teachers, some professional development which emphasizes improving the metacognition of students.

Keywords: Metacognitive Strategies, Academic Performance, secondary school students

INTRODUCTION

Recently, there are notice noticeable evidences of decline in the standard of education and quality of students especially at the secondary school level (Duze, 2011). This is glaringly clear in the result of both internal and external examinations especially in mathematics. The situation has really attracted the interest and concern of teachers, psychologists, researchers, parents and school administrators in Nigeria (Ajayi and Muraina, 2011).

Many factors have been pointed at as being responsible for the poor performance of Nigerian secondary school students. Some of these factors include teaching and learning methods, inadequate instructional facilities, students' lack of interest and motivation. Appeh (2016) observed that poor preparation of the students due to poor teaching and dearth of instructional facilities are considered as the main reasons for students' poor performance at public

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examinations. The inability of students to engage actively in the learning process tends to dispose the students to constant rote learning and examination malpractices leading to poor academic performance. In relation to the above, Biehler and Snowman (2015)argued that lack of students' exposure to metacognitive strategies creates difficulties int eh learning process. This ultimately results in students, resorting to rote and blind memorization of concepts to pass examination.

These students generally lack metacognitive or self-regulation strategies that help successful students understand, analyze, solve and evaluate problems. Teachers should therefore understand and teach cognitive processes and metacognitive strategies used by good problem solvers in order to assist these students to become good problem solvers. These strategies are the Attribution Retraining Strategy (ARS) and Self-Management Strategy (SMS). Metacognitive strategies are simply memorable plans or approaches that students are used to problem-solve. These strategies include the students thinking as well as their physical actions.

Metacognition which is thinking about one's thinking process has to do with the active monitoring and regulation of cognitive processes. It refers to the cognitive control and monitoring of all sorts of cognitive processes like perception, action, memory, reasoning or emotion (Brown, 2014).

Students have constantly performed poorly in mathematics at the senior secondary school level in Nigeria. A report published by the West African Examination Council (2014), indicated that students' poor performance in mathematics has been a recurrent issues.This situation has been a big concern to the parents, teachers, and the government of Nigeria inparticular. Poor academic achievement or performance has been traced as far back as the 1960s (Maduabum, 2014). This issue in effect, has led to serious lack of interest and subsequent change of attitude of on the part of the students to achieve better in academics (Achuanye, 2004).

STATEMENT OF THE PROBLEM

The poor performance of students in mathematics in Nigeria in the recent past has been a source of worry to all stakeholders in education. The subject is avoided by many students inspite of its importance in the technological and scientific advancement of the individual and the society at large. This fear and avoidance of mathematics eventually leads to poor performance in both internal and external examinations subjects.

Students still see reading mathematics as just a subject, rather than opportunities to think and use their thinking to make decisions, attack problems, pose hypotheses, evaluate information and make inferences. Metacognition, the mental process whereby one monitors one's cognitive process in thinking, learning, and remembering, or knowledge about one's own cognitive system or knowing how to learn as to enables the students to have control over their thinking internally, analysis their strength and weakness in learning, and encourages intrinsic motivation in them.

This study seeks to improve on the mathematics performance of senior secondary school students in Rivers State of Nigeria through educating the students on the application of metacognitive instructional strategies in the study of mathematics.

RESEARCH QUESTIONS

1. What difference exists in the mathematics performance test mean scores of students exposed to attribution retraining instructional strategy and the control at posttest and follow-up?

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2. What difference exists in the mathematics performance test mean scores of students taught with self-management teaching strategy and the control at posttest and follow-up?

HYPOTHESES

1. There is no significant difference in the adjusted mathematics performance test mean scores of senior secondary school students exposed to attribution retraining instructional strategies and the control group ($P<0.05$).
2. There is no significant difference in the adjusted mathematics performance test mean scores of senior secondary school students exposed to self-management training strategy and the control group do not differ significantly ($P<0.05$).

METHODOLOGY

The study adopted the quasi-experimental design. Rivers state of Nigeria is the area of the study that is conducted in Port Harcourt city Local Government Area of Rivers State. The population consisted of all 87,860 SS 1 students in the 12 senior secondary schools in Port Harcourt city Local Government Area of Rivers State.

One hundred and thirty eight senior secondary school students were randomly selected from 138 secondary schools in the area in three classes of 43, 45 and 50 students respectively selected from each school in Mathematics Performance Test (MPT) and Mathematics Affective Response Scale (MARS). The Mathematics Performance Test (MPT) was developed by the author. The Mathematics Affective Response Scale (MARS) was used to measure the extent to which the two metacognitive strategies improved the affective response of the students to mathematics after the treatment.

The face validity of the instrument were done by subjecting them to the expert scrutiny of the various schools used in the study. A copy of the MPT was given to one expert in Mathematics Education and Measurement and Evaluation. And these gave a coefficient of 0.90 while data collected were analyzed using analysis of co-variance.

RESULTS

The results of the study are presented below in tables 1 and 2.

Research Question 1: What difference exists in the mathematics performance test mean scores of students exposed to attribution retraining instructional strategy and the control at post test and follow-up?

Hypothesis 1: The adjusted mathematics performance test mean scores of senior secondary school (SSS) students exposed to attribution retraining instructional strategy and the control do not differ significantly ($P<0.05$).

Table 1. Mean and standard deviation of pretest and post test scores of the students in the treatment and performance for attribution retraining

		Pretest		Post test			Follow-up		
Group	N	$\bar{x}$	SD	$\bar{x}$	SD	Mean Gain	$\bar{x}$	SD	Mean Diff.
Treatment	50	40.42	11.92	57.54	13.92	17.12	65.58	9.45	8.04
Control	45	40.29	11.90	37.91	11.47	-2.38	38.31	10.45	0.4

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Table 1 showed that students in the treatment group had a pretest mean score of 40.42 and a posttest mean score of 57.54 giving a mean difference of 17.12.

The follow-up test shows a mean of 65.58 and a difference of 8.04 from the post test mean. Students in the control group had a pretest mean of 40.29 and a post test mean of 37.91 with a mean difference of -2.38. The follow-up score for students in the control group shows a mean of 38.31 and a difference of 0.4 from the post test mean.

Table 2. Analysis of covariance (ANCOVA) of mathematics performance Test Scores of students in the treatment and control groups

Sources of variation	Sum of squares	df	Mean square	F-cal	F-tab	Decision
Pretest (covariates)	9078.61	1	90781.61	66.35	3.96	Reject H_0
Groups	12587.22	92	136.92			
Total	22065.83	93				

The table shows that the calculated t-value (66.35) is greater than the table value (3.96). This implies that there is a significant difference between the adjusted mathematics performance tests mean scores of senior secondary school students in the treatment and control groups at 0.05 level of significance. Therefore, the null hypothesis is rejected. This shows that attribution retraining instruction (ARI) is most effective as a metacognitive teaching strategy as reported by the mean value.

Research Question 2: What difference exists in the mathematics performance test mean scores of students taught with self-management teaching strategy and the control at post test and follow-up?

		Pretest		Post test			Follow-up		
Group	N	$\bar{x}$	SD	$\bar{x}$	SD	Mean Gain	$\bar{x}$	SD	Mean Diff.
Treatment	43	35.44	8.99	46.37	14.89	10.93	55.02	13.34	8.65
Control	45	40.29	11.90	37.91	11.47	-2.38	38.31	10.45	0.4

Table 2 showed that students subjected to self-management training had a pretest mean of 35.44 and a posttest mean score of 46.37. This gives a mean gain difference of 10.93. From follow-up test, students in the treatment group had a mean of 55.02 and a mean gain difference of 8.65 compared with the post test mean.

Students in the control had pretest mean of 40.29 and a post test mean score of 37.91 with a mean difference of -2.38. The follow-up score of students in the control group shows a mean of 38.31 and a difference of 0.4 from the post test.

Table 3. Analysis of covariance (ANCOVA) of mathematics performance test scores of students in the treatment and control groups

Sources of variation	Sum of squares	df	Mean square	F-cal	F-tab	Decision
Pretest (covariates)	2879.81	1	2879.81	22.93	3.96	Rejected H_o
Groups	10674.04	85	125.58			
Total	13553.85	86				

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The table above showed that the calculated F-value (22.93) is greater than the table value of (3.96). The result reveals that there is a significant difference between the adjusted mathematics performance test mean scores of SSS students taught with self-management teaching strategy and the traditional lecture method. The null hypothesis is therefore rejected.

DISCUSSION

From the result of the analysis, there is a significant difference between adjusted mathematics performance test (MPT) mean scores of students in treatment group one (School one) exposed to Attribution Retraining Metacognitive strategy and the control group. The result also shows that there is higher mean and mean gain scores at post test and follow-up respectively in favour of students in the treatment group. This is indicative to the fact that exposing students on attribution retraining as a metacognitive instructional strategy is very effective in improving their performance of Lavasani, Sharifcan, Naghizadeh, Shah (2012), Pairs *et al*., (2011), Mamnion and Alexander (2010), and Shah (2009). In their various works and findings, the scholars were unanimous reporting that exposing students to attribution retraining as a metacognitive strategy positively affected and enhanced the students' performance in mathematics.

The result is not surprising hence; Shaha (2012) asserts that the primary objective of attribution is to replace maladaptive, self-defeating attributions with more adaptive, self-helping attributions made by student in their studies.

Research has shown that students who hold adaptive attribution style have more confidence in their academic progress, and work harder towards reaching their goals (Banks and Woolfson, 2008). On the contrast, effective learning is hindered when individuals attribute success to external, unstable and uncontrollable factors such as luck; and failure to internal stable and uncontrollable factors such as lack of ability. Such a maladaptive attribution style has been linked to students holding pessimistic views about their future success, and withdrawal of effort on tasks they perceive to be difficult. On the other hand, a student who explains poor academic outcomes with external, stable, and uncontrollable attributions such as luck, test difficulty, ability, teacher factor, etc is likely to have lower level of perceived control and poorer performance –resigning to faith and is likely to develop learned helplessness.

Effect of self-management training on performance in mathematics

Result of the analysis, show that there is a significant difference between adjusted mathematics performance test (MPT) mean scores of students in the treatment group two (school two) exposed to self-management training and the control group). There is also a higher mean and mean gain score in favour of the students in the treatment group. This result shows that self-management training as a metacognitive strategy is effective in improving the performance of students in mathematics. The findings are in line with that of Shah (2012). The same study established a significant difference between the mathematics academic performance of students in the experimental and control groups in mathematics performance test (MPT).

One of the goals of education is to produce individuals who are capable of educating themselves. This can only be achieved by training he students to manage themselves by setting their own goals, planning their studies, recording their activities, monitoring themselves, evaluating and reinforcing their progress.

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Duze (2011) asserts that students who are trained on self-regulation (an aspect of self-management) are cognizant of their academic strength and weaknesses and have a repertoire of strategies that they can apply in their studies for good results. They also believe that opportunities to take on challenging tasks, practice their learning, develop a deep understanding of subject matter, and exert effort, will give rise to academic success, hence, they are motivated to study for good result.

RECOMMENDATIONS

The following recommendations were made:

1. The schools' management boards should modify the present supervisory methods of classroom teachers by encouraging teachers to systematically incorporate metacognitive based strategies into the instructional setting.
2. The policy makers and the government as a whole should allocate increased finding so as to provide regular and special education teachers, some professional development which emphasizes improving the Metacognition of students.
3. Policy makers and curriculum developers should consider the results of this study and standardize implementation of the selected metacognitive strategies systematically into both structural and delivery and curricula.

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