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EFFECT OF METACOGNITIVE STRATEGY ON ACHIEVEMENT OF SENIOR SECONDARY SCHOOL STUDENTS IN MATHEMATICS IN ABUJA MUNICIPAL AREA COUNCIL, NIGERIA

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Abstract

This study investigated effect of metacognitive strategy on achievement of senior secondary school students in Mathematics in Abuja Municipal Area Council, Nigeria. The study was necessitated by the need to correct the poor achievement of students in Mathematics and the stereotypical belief that Mathematics is a difficult subject. Two research questions and two hypotheses guided the study. The design was quasi-experimental, specifically the pre-test post-test non-equivalent group design. The population of the study comprised all the 1,543 secondary school students in 21 secondary schools in Abuja Municipal Area Council during the 2019/2020 academic session. Purposive sampling technique was used to sample 56 senior secondary one student in two intact classes from two schools in the area. The instrument for data collection was Mathematics Achievement Test (MAT). The MAT was subjected to trial testing and its reliability coefficient yielded 0.79 using

Kuder-Richardson formula 21. The research questions for the study were answered using Mean and Standard Deviation and the hypotheses were tested at 0.05 significance level using Analysis of Covariance (ANCOVA). It was found among others that there was significant difference in the achievement scores of students taught Mathematics using metacognitive strategy and those taught with conventional method ($p=.000<0.05$); there was significant difference in the achievement scores of male and female students taught Mathematics using metacognitive strategy ($p=.000<0.05$). It was therefore recommended that teachers should use metacognitive strategy to improve the achievement of students in Mathematics and School administrators should organize trainings that are aimed at training teachers on how they can improve students' metacognition in Mathematics using metacognitive strategy.

Key Words: Metacognitive Strategy, Mathematics, Academic Achievement.

Introduction

The desire of any educational system is to produce students who are sufficiently trained to contribute meaningfully to the development of the system and the society at large. Among all academic subjects studied at school, Mathematics has distinctly contributed to man's development. As a subject, Mathematics has become an indispensable tool in the study of humanities, sciences and technology. Without doubt, it remains the most serviceable subject to all disciplines and fields of human work. Mathematics, as it is widely understood, plays a key role in shaping how individuals deal with the various spheres of private, social, and civil life (Anthony & Walshaw, 2009). In fact, no nation can make any meaningful progress in this information and technological age without good foundations in science and Mathematics. This is because every individual needs some measure of Mathematics for his or her day-to-day activities.

Despite the importance of Mathematics, many problems seem to confront Mathematics education in Nigeria. This has resulted to the consistent poor academic achievement in senior school certificate examination (WAEC and NECO) in the subject. A review of the achievement in both internal and external examinations has revealed a disturbing picture as students are observed to perform poorly in most Mathematics examinations.

This has been a source of grave concern for educators, parents, students, school administrators and the general public. For instance, the West African Examination Council results of students in Nigeria reported that students achieve poorly in the subject in the years 2018, 2019 and 2020 with percentage of students with credit pass and above as 23.0%, 31.0% and 38.98% respectively (Kurumeh & Imoko 2018; Moseri, Onwuka & Iweka 2019; Iyi 2020).

One of the factors that has been observed to contribute to the poor academic achievement of students in Mathematics is the way they think about the content they are learning and how they monitor their thinking. There is therefore need to ensure that students are aware of how they think and learn. The process of being aware of thinking and monitoring it is metacognition. Researchers have over the years found that metacognitive strategy has the ability to fully improving the achievement outcomes of students (Gardner cited in Mohammed, 2015). There is therefore need for the mathematics' teacher to enhance the cognition of students through the use of the metacognitive strategy. Metacognition is defined as the activity of monitoring and controlling one's cognition. It is what an individual knows about his/her cognitive processes and how he uses these processes in order to learn and remember (Kagan, 2013). It is a process in which students utilize their

higher level of thinking skill to control various processes of learning such as planning of a specific strategy to approach a particular learning task, then evaluating the level of understanding and progress made to learn that task. Metacognition plays very important role in productive learning. High and low metacognition of students may be a cause of the successful or unsuccessful learning.

Some individuals learn and understand so quickly while others take enormous time to comprehend the same concept. The reason is not always the differences in the Intelligence Quotient (IQ), but how smart the student is in approaching or dealing with the task or how much awareness he has about his own cognition or thinking. For instance, many students learn well while sitting in a library independently while few like dependent learning which means relying on others for understanding. the knowledge the students who understands that he learns better when he constantly asks others questions will help him to learn better. Metacognition is broken down into two subcomponents which are; meta-cognition knowledge and meta-cognition regulation.

Metacognitive knowledge can be described as what we know about our own cognitive processes. Meta-cognitive knowledge refers to one's knowledge or beliefs about the factors that control cognitive (knowledge) processes. Meta-cognitive regulation in

contrast to meta-cognitive knowledge may be thought of as the actual activities in which students engage in order to facilitate learning and memory. Metacognitive abilities help in estimating one's knowledge in relation to their academic achievement of students (Everson & Tobias in Adikwu & Chibabi, 2018).

For the student to develop the needed metacognitive skills, the teacher needs to use worthwhile teaching strategy. This strategy is often referred to as metacognitive strategies. This generally refers to the processes the teacher uses in helping students to be aware of their thought processes. In most schools today, the word metacognitive strategies are very common in teaching students' skills of performing various educational tasks and achieving certain levels of knowledge (AlShammari, 2015). According to Badawy (2012), impacts of metacognition strategies in students are far reaching as it determines how they perceive the learning content. Metacognitive strategy is a made-up if three essential processes of planning, monitoring and evaluation.

The planning aspect of the metacognitive strategy applies to the awareness the learner has about his cognition of learning and how to plan to learn the new content. . Planning entails the ability to understand what one knows, what one does not know and what one is prepared to know. This sub-category of the

metacognitive process may also include an awareness of other's knowledge (Hacker, 2009). Flavell in Jaleel and Pemachadran (2016) adds that metacognitive awareness further includes awareness of thinking (understanding cognitive tasks and the nature of what is required to complete them) and the awareness of thinking strategies (understanding approaches to direct learning). Meta-awareness and planning focus on our knowledge of cognitive factors that affects the ability to learn and achieve, the knowledge of various appropriate strategies to improve learning processes and the awareness of which strategies to select in order to increase our ability to control and manage mental processes (Cornley, 2014). Metacognition planning is actualised in line with stated objectives. The second phase in the metacognitive strategy is monitoring.

Metacognitive monitoring processes help students to become aware of their strengths and weaknesses. A key element is recognising the limit of one's knowledge or ability and then figuring out how to expand that knowledge or abilities. Those who know their strengths and weaknesses are more likely to actively monitor their learning strategies and resources and assess their readiness for particular tasks and performances (Chick, 2013). It must be noted that the success of metacognition monitoring is better enhanced when it is regulated.

In recent times, gender related issues in Mathematics have continued to receive attention, judging by the quantum of studies done to this effect. Babajide and Ogunleye (2010) opines that core subjects like Mathematics is given masculine outlook by educational practitioners. According to Babajide and Ogunleye, academic achievement of students slightly depends on gender as society favour a gender. As a result, Students' acquisition of science process skills is gender specific because boys, due to their more social nature have gained advantage over girls in classroom activities like in the learning of Mathematics (Nwosu, 2007). Bryden (2009) noted that brain lateralization has been used to explain the cognitive differences that lead to differences which are in favour of boys' achievement in Mathematics as opposed to girls.

The academic achievement of students in Mathematics is in dire need of improvement. This is evident in the consistent failure of a reasonable population of students to perform above average in external examinations conducted by the West African Examination Board and the National Examination Council. The present study investigated how metacognitive strategy improve the achievement of students in Mathematics.

Purpose of the Study

The main objective of the study was to determine the effect of meta-cognitive strategy on academic achievement of senior secondary school students in Mathematics in Abuja Municipal Local Government Area. Specifically, the study sought to:

1. Find out the achievement of students taught Mathematics with metacognitive strategy and those taught with the conventional method.
2. Determine the achievement scores of male and female students taught Mathematics with metacognitive strategy.

Research Questions

The following questions were raised to guide the study:

1. What are the mean achievement scores of students taught Mathematics using metacognitive strategy and those taught with the conventional method?
2. What are the mean achievement scores of male and female students taught Mathematics using metacognitive strategy?

Hypotheses

The following hypotheses were formulated and tested at 0.05 level of significance.

1. There is no significant difference between the mean achievement scores of students taught Mathematics using metacognitive strategy and those taught with the conventional method?
2. There is no significant difference in the mean achievement scores of male and female students taught Mathematics using metacognitive strategy

Research Method

The study adopted the quasi-experimental design of non-randomized pre-test posttest control group. The study adopted quasi-experiment design because all the conditions of true experimental control were not met. Thus, intact classes were randomly assigned to experimental and control groups, without disrupting the normal school programmes

The population of the study comprised all the 1543 secondary school students (FCT Educational Secretariat, 2020) from the 21 secondary schools in the Abuja Municipal Area Council (AMAC). The choice of this area council is due to the fact that as a teacher, the researcher has observed that students in the area perform poorly in Mathematics, hence the need to investigate if metacognitive strategy could help them perform better.

The sample for the study was 56 students from two intact classes comprising 27 students in the experimental and 29 in control. The

researcher adopted the purposive sampling technique in choosing the two classes that constituted the sample of the study. Purposive sampling technique was used because it allowed the researcher to select only mixed or coeducational schools for the study so as to collect data on gender. The researcher also used this sampling technique because it was impossible to randomly assign the students to deferent classes.

The instrument used for data collection was Mathematics Achievement Test (MAT). The MAT was a 20-question multiple choice instrument developed from the topics: Number bases, logarithms, indices and standard form. It was divided into sections A and B. Section A elicited data on students' bio-data while section B contained questions on the five topics selected for the study. In scoring, each correct answer attracted one mark. The test is scored over 20. This implies that the instrument is dichotomously scored since some options are considered to be wrong answers. Also, Lessons for the study were planned in two forms. Lesson plan A is for the experimental group while B is for the control group.

The instrument was given to three experts for face and content validation. The experts were two lecturers from the Department of

Educational Foundations and General Studies and one Senior Secondary School one (SS1) Mathematics teacher who was deemed to be sufficiently knowledgeable in the contents of Mathematics at the secondary school level. These experts scrutinized the instruments with respect to: clarity of terms, simplicity of vocabulary and relevance of terms to the study. The experts made corrections in respect to the structuring of some items and the relevance of some items to the objectives of the study. Those suggestions were duly implemented by the researchers and this helped in modifying the items to suit the problem being investigated.

Two teachers who teach Mathematics in the sampled schools served as research assistants. The research assistant in the experimental group was trained on how to teach students using the metacognitive strategy while that of the control was briefed on how to administer the instrument. Data for the study were collected through pre-test and post-tests. and using the MAT. The pre-test was administered to both experimental group and control groups before the treatment to provide the researcher with baseline data about the students. The treatment lasted for five weeks after which post-test was administered. The research assistants helped in collecting data from both experimental and control groups.

Results

Research Question 1: What is the difference between the mean achievement scores of students taught Mathematics with meta-cognition strategy and those taught with the conventional method?

Table 1 Mean Achievement Scores of Students Taught Mathematics with Metacognitive Strategy and those Taught with the Conventional Method

Group	N	Pre-test Mean	SD	Post-test Mean	SD	Mean gain
Metacognitive strategy	29	7.04	2.0	15.70	3.67	8.66
Conventional Method	27	6.31	1.58	6.72	2.99	0.41
Mean diff.		0.73		8.98		8.25

Table 1 Presents the pre-test and post-test mean scores of the metacognitive strategy (treatment) and conventional method (control group). From the result, the pre-test mean scores of the treatment group is 7.04 with a standard deviation of 2.0 while that of the control is 6.31 with a standard deviation of 1.58. The post-test score of the treatment group is 15.70 with a standard deviation of

3.67. On the other hand, the post-test score of the control is 6.71 with the standard deviation of 2.99. This indicates that the mean difference between the treatment and the control group at post-test is 8.25 in favour of the treatment group. In addition, the mean gain of the treatment group is 8.66 which is 2.17 and that of the control group is 0.41.

Research Question 2: What is the difference between the mean achievement scores of male and female students taught Mathematics with metacognitive strategy?

Table 2: Mean Achievement Scores of Male and Female Students Taught Mathematics Using Metacognitive Strategy

Group	N	Pre-test Mean	SD	Post-test Mean	SD	Mean gain
Male	17	7.01	1.94	14.00	2.69	7.00
Female	10	6.58	1.32	15.30	2.40	8.74
Mean diff.		0.44		6.99		1.74

Table 2 Presents the pre-test and post-test scores of male and female students in treatment group. From the result, the pre-test mean scores of male students is 7.01 with a standard deviation of 1.94 while that of the female students is 6.58 with a standard deviation of 1.31. The post-test score of the treatment group is 14.00 with a standard

deviation of 2.69. On the other hand, the post-test score of the female students is 15.30 with the standard deviation of 2.40. This indicates that the mean difference between male and female at post-test is 1.74 in favour of female students. In addition, the mean gain of the male students is 7.00 and that of the female is 8.74.

Hypothesis 1: There is no significant difference between the mean achievement scores of students taught Mathematics using metacognitive strategy and those taught with the conventional method

Table 3: ANCOVA Results of Metacognitive Strategy and Conventional Method

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1128.324 ^a	2	564.162	68.814	.000
Intercept	475.979	1	475.979	58.057	.000
Pretest	.907	1	.907	.111	.741
Group	1079.727	1	1079.727	131.700	.000
Error	434.515	53	8.198		
Total	8405.000	56			
Corrected Total	1562.839	55			

Table 3 indicates that $F(1, 56) = 131.700$, $p = 0.000$. Since the p-value (.000) is less than the alpha value of .05, the null hypothesis which states that there is no significant difference in the mean achievement scores of students taught Mathematics with meta-cognition strategy

and those taught with conventional method is rejected. This implies that there is significant difference in the mean achievement scores of students taught Mathematics with metacognitive strategy and those taught with conventional method in favour of experimental group.

Hypothesis 2: There is no significant difference in the mean achievement scores of male and female students taught Mathematics with metacognitive strategy

Table 4: ANCOVA Result of Male and Female Students Taught Mathematics Using Metacognitive

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	11.893 ^a	2	5.946	.855	.438
Intercept	265.217	1	265.217	38.150	.000
Pretest	1.252	1	1.252	.180	.675
Group	11.624	1	11.624	1.672	.208
Error	166.848	24	6.952		
Total	5841.000	27			
Corrected Total	178.741	26			

Table 4 indicates that $F(1, 27) = 1.67$, $p = 0.065$. Since the p-value is greater than the alpha value of .05, the test is not significant and the null hypothesis which states that there is no significant difference in the mean achievement scores of male and female students taught Mathematics with meta-cognition strategy is not

rejected. This implies that there no significant difference in the mean achievement scores of male and female students taught Mathematics with meta-cognition strategy. The difference in the mean of the two groups must have arisen from sampling errors or any other variations in the study.

Discussion of Findings

The first finding shows that there is significant difference in the academic

achievement of students taught Mathematics with metacognitive strategy and those taught with conventional method. This finding

could be due to the fact that students taught with metacognitive strategy are engaged in higher order thinking in the mathematics class. The metacognitive strategy provides the needed skill for them to control the way they think and how best they learn. The strategy does not only enable them to think, but also help them to monitor how they think in order to solve problems in Mathematics. This finding is in consonance with Gaylo and Dale (2017) who found that there was significant difference in the performance of students exposed to metacognitive strategy and those in the control. The researchers also concluded that metacognitive strategy does not only significantly influence the performance of students but also improves their engagement in Mathematics. The finding is also in tandem with Ozsoy and Ataman (2012) who found that meta-cognitive strategy improves the ability of students to solve Mathematics problems. The researchers further established that the strategy helps students to develop effective thinking structures and help in improving their achievement in Mathematics. The second finding of this investigation is that there is significant difference between the mean achievement scores of male and female students taught Mathematics with metacognitive strategy. This finding points to the fact that meta-cognition strategy has somewhat equal effects on both genders. The finding establishes the fact that the strategy

helps both genders to learn effectively with little disparity in its effects. This finding is in line with the findings of similar researchers in this field. The finding is particularly in tandem with Siswati and Crebima (2017) who found that there was no significant difference between the academic performance of male and female students. The finding is also in harmony with Yi-Tian, Yu-Fang and Jiang-Li (2018) who also found that meta-cognition strategy has similar effect on male and female students.

Conclusion

The findings from the study shows that metacognition strategy has significant effect on the academic achievement of students in Mathematics. The finding also shows that the strategy significantly improves the academic achievement of both male and female students, hence closing the gap in gender achievement in Mathematics.

Recommendations

1. Mathematics teachers should use metacognitive strategy to improve the understanding of students in Mathematics since the strategy improves student's achievement in the subject.
2. School administrators should organize trainings that are aimed at

helping Mathematics teachers improve students' metacognition.

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