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Research Paper

Metacognitive Ability as Determinant of Senior Secondary School Students Academic Performance in Mathematics in Ondo State, Nigeria

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ABSTRACT
This study investigated the metacognitive ability as determinant of academic performance in Mathematicsamong senior secondary school students in Ondo state, Nigeria. The study adopted a descriptive survey design in which a questionnaire and a test wasused to collect data for the purpose of interpreting and describing the metacognitive ability of students' academic performance in Mathematics. The population for this study comprised 12,585 public Senior Secondary School Two (SSS II) Students in Ondo State. The sample of this study was 300 Public Senior Secondary School Two (SSSII) Mathematicsstudents in Ondo State. The multistage sampling procedure was used in selecting the sample.Two research instruments tagged; Performance Test in Mathematics (PTM) and Metacognitive Awareness Inventory (MAI) were used to collect data. Performance Test in Mathematics (PTM) was a test format which was designed by the researchers to assess performance of students in Mathematics. Metacognitive Awareness Inventory (MAI) as an adopted instrument, it contains 30 assessment techniques and tools that can be used to assess students metacognitive abilities. The two instruments were given to experts in Mathematics Education, Psychology and Test Measurement and Evaluation for face content and construct validity. The reliability of MAT and MAI were determined through the use of test-retest method and the instruments were administered on forty (40) Senior Secondary School Two Mathematicsstudents outside the sampled areas and their scores were subjected to Pearson's Product Moment Correlation analysis which yielded0.89 and 0.78 correlation coefficients for MAT and MAI respectively. Data collected from the field were analyzed using both descriptive and inferential statistics such as mean,standard deviation, Analysis of Variance (ANOVA) and Pearson's Product Moment Correlation (PPMC) analysisat 0.05 level of significance.The findings showed that there is no significant influence of students' metacognitive ability on academic performance in Mathematicsand that metacognitive ability of students is gender insensitive. Based on the findings, it is therefore recommended that gender sensitive tools or training should be further discouraged during training of minds towards a certain area of specialization or career talk to students and those Mathematics teachers should choose the best teaching strategy in order to discourage any alteration of any personal variables.

KEYWORDS: *Metacognitive Ability, Gender, Mathematics, Academic Performance.*

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I. INTRODUCTION

Education is exclusively used for the development of human beings in the cognitive, affective and psychomotor domains and also it involves a desirable approach in human behaviour through the process of teaching and learning. Amaele (2011) defines education as what each generation gives to its younger ones which makes them develop attitudes, abilities skills and other behaviours which are the positive values to the society in which they live. Therefore, Mathematics education is crucial in the development of any nation and the teaching and learning of this subject should be given priority in a nation building.

Mathematics is seen as a compulsory subject in primary and secondary school level of education and also for any student to gain admission into any tertiary institution for most of the courses except in art, you must have minimum credit pass in Mathematicsand this shows the importance of this great subject in nation building. Mathematics is being used in day-to-day activities and it is also being applied in every transactions being made by an individual to sustain lives (Ojose, 2011), the society and the nation at large. Mathematics described as an essential discipline that is recognizing as a tool for solving everyday problem faced by individual.

Mathematics is an important subject and the knowledge of it will improve individual cognitive ability, problem-solving strategies and the ability to think. The place of Mathematicsfor the nation to attain the vision 20:2020 holds the potency to every day problem being faced by individuals in the nation. According to Ezeh and Uguanyi (2013), Mathematicsis a subject that develops critical creativity and problem solving mind and skill to be a learner which is also critical for the attainment of vision 20:2020 that will favour better educated minds who are adopt at reasoning, problem solving and learning. They further stated that a sound Mathematicsteacher will teaches explicitly the qualities and harness the values in Mathematicseducation, which is utilized by any nation for the attainmentof developmental growth in educational sector.

According to Adetunde (2016),Mathematics forms the foundation of a solid education and is the corner stone of modern society and the overall national development of any nation. This position indicates that the priority placed on Mathematics education is vital and imperative for any society, community and the nation at large so as to keep her place among the civilized nations of the world in this era of science, and technology advancement. Ale (2009) noted that no nation can make any meaningful achievement and developmental goals without technology which foundations are sciences and Mathematics. Danbatta (2013) corroborate this assertion by adding that the knowledge of Mathematics allows scientist to communicate ideas using universally accepted technology since it is truly the language of science. He noted that the results of mathematical research benefits the economy in the fibre-optic, network carry telephone conversations, computers that carryout various functions, weather forecasting and predictions, the design of fuel efficient automobiles and airplanes, traffic control and medical imaging etc.

The researchers observed that despite the importance of Mathematics by making it a core and compulsory subject for both junior and senior secondary school students (Federal Republic of Nigeria, 2014), couple with several policies, programmes, and innovations that government brought to teaching and learning process in schools, the performance of students has not yielded any significant improvement they seems to have been performing poorly in Mathematics in recent year in both internal and external examinations. Therefore, Mathematics in secondary school should be taught in such a way that students should derived maximum benefit by a way of identifying their area of difficulty in learning the subject and improve on learning the subject for optimal performance.

In the study of Okorie and Ezeh (2016) who stated that Mathematics is the science of things that has a pattern of regularity, logical order, finding and exploring the regularity. Mathematics is the fundamental of science and technology that no area of science, technology and business enterprises escapes its application and it being observed that Mathematics is one of the subjects that is poorly learn, widely hated and abysmally understood in our schools today. According to the Mangle (2018), learning Mathematics should be problem-based learning methods which will turn students from passive listeners to active listeners that isfree, self-learner and problem-solvers.

It will also shift the emphasis of education programmes from teaching to learning which enable the students to learn new knowledge. It involves higher order thinking which is systematic planned,and step will be for the acquisition of set goals and this is called mental modeling will assist students in managing their learning by modeling and solve appropriately. This technique specifically intended to enhance student ability to direct their learning by modeling the use of cognitive process in solving some Mathematics problem.

Metacognition refers to as the process of thinking about thinking (Online Glossary 2014) and was introduced as a concept in field of education by John Flayell who is typically seen as a founding scholar of the field. Metacognition is the knowledge you have of your own cognitive process (your thinking). It is the one's ability to regulate and control one's own thinking processes through various strategies such as organizing, monitoring and adapting. Additionally, it is the ability to reflect upon the task or process an individual undertake and select and utilize the appropriate strategies necessary in a learning interaction, metacognition is a set of skill that enable learners to become aware of how they learn and evaluate and adapt these skills to become

increasingly effective at learning. In a world that demands lifelong learning, providing students with new and improved metacognitive strategies is a gift that can last forever. According to Artelt, Neuenhaus, Linger and Schneider (2012), metacognition has two components; we have metacognitive knowledge or knowledge of cognition and metacognitive skill, or regulation of cognition.Observationsof Artelt, et al, (2012), show that metacognitive ability seems not to have been well explored for the learning and teaching processes in Nigerian secondary schools, it appears that there is a possibility that students' performance in Mathematics can be improved upon if students are exposes to other non-traditional method of learning such as metacognitive learning ability during teaching and learning processes in solving Mathematics questions during class interaction. According to the finding of Vander Stel,Veenman, Deelen and Haenen(2010), learning approach encourages learners to monitor, evaluate and strategize their learning.

It appears that for students to be an effective learner, students should not only use the memory and the language skills they have internalized but they must also develop their own way of learning, students who learn to learn seem to gain control of their learning process and gradually develop the ability to master their mental processes more effectively. A student inner language is what enables such students to develop high–level of cognitive ability associate with metacognition (SetyaMurti, 2011). According to L.D Online Glossary (2014) metacognition enables students to be more active in their learning which means to mobilized all of their resources in order to have successful learning experiences. To do this, they must know how they learn and be aware of the steps that are needed and the means they can be used to acquire knowledge, solve problems, and perform task.

The study of SetyaMurti(2011), revealed that metacognition involves thinking and reflection before, during and after a learning task. He explained that metacognition starts when students think about the strategy, they will use to perform a task, this happens when the students choose the most effective strategies and decide whether the outcome of the strategy meets the standard of setting the goal. Therefore, teachers needs to be trained on the use of metacognitive teaching and learning ability in order to be able to impart such to their respective learners that will improve their performance.

The researchers opined that there are other variables that seems to affects students' performance outside metacognition. Anotherfactors that seems to influence students' performance in Mathematics is gender. In some of the discussions on educational programmes on what can cause the poor performance of students in Mathematics in most of our secondary schools in Nigeria from the researches point of view is gender (Mata, Monteriro&Paixoto, 2012). Mathematics is most viewed by many as masculine domain in which females usually performed less than male in terms interest, beliefs anxiety and concepts of Mathematics problems solving in which they sees their males counterparts doing well in it. Gender difference may exist in area of learning and it appear that females may outperforming males in secondary education across a range of subjects, gender differences may occur in the perception of careers choosing, attitudes towards a particular subject, learning styles and instructional methods.Colom and Lynn (2014), explained that males have larger average brain sizes than females and therefore, would be expected to have higher average Intelligent Quotient (IQ). Traditionally in our society, girls seems to be encouraged to conform with any given situation whereas boys are seen to be active and dominant risk takers which may affect their inquisitive to learn in most difficult subject such as Mathematics than females.Therefore, there is need to investigate into the metacognitive ability as determinant of academic performance in Mathematics among senior secondary school students in Ondo State.

Three research hypotheses were postulated for the purpose of this work:

1. There is no significant relationship between students' metacognitive ability and academic performance in Mathematics.
2. There is no significant difference influence students' gender on academic performance in Mathematics.
3. There is no significant difference in metacognitive ability of male and female students on their performance in Mathematics.

II. Methodology

The study adopted a descriptive survey design in which a questionnaire and a test were used to collect data for the purpose of interpreting and describing the metacognitive ability of students' academic performance in Mathematics. The population for this study comprised 12,585 public Senior Secondary School Two (SSS II) students in Ondo State. The sample of this study was 300 public Senior Secondary School two (SSS II) Mathematicsstudents. The multistage sampling procedure was used in selecting the sample. In stage one,there was random selection of two Local Governments Areas (LGA_S) from each of the three Senatorial Districts in Ondo State. The second stage involved the use of purposive sampling technique to select a senior secondary school from each Local Government Areas(LGA) selected in the State, putting into consideration sex and school with teachers who are University graduate in Mathematics. The third stage involved the use of students in an intact class of two arms randomly selected from each school to be considered. Two research instruments were used for this study titled; Performance Test in Mathematics (PTM) and Metacognitive Awareness Inventory

(MAI). MathematicsPerformance Test (MPT) was a test format which was designed by the researcher to assess performance of students in Mathematics. It consists of two sections; Section A consist of bio-data information of the students such as sex, school. Section B of the instrument however is comprised of 25 multiple from five taught topics of the current scheme of work for Senior Secondary School Two(SSSII) class in Ondo State. Correct answer attracted 2 marks while wrong option attracted no mark. Metacognitive Awareness Inventory (MAI)was designed and developed by Doganayand Dennis (2011),which was adopted from the revalidation of Nelson,Linda (2014), it contains 30 assessment techniques and tools that can be used to assess students' metacognitive abilities. The students would be asked to indicate the degree of emphasis placed on each of the item using a four-point scale, namely: Always = 4, often = 3, sometimes = 2, and never =1.

The two instruments were given to experts in Mathematics Education, Psychology and Test Measurement and Evaluation to be refined so as to for face, content and construct validity. The reliability of MAT and MAI was determined through the use of test-retest method and were administered on forty (40) Senior Secondary School Two (SSS II) Mathematics students outside the sampled areas of the study and was subjected to Pearson's Product Moment Correlation (PPMC) analysis which yielded 0.89 and 0.78 correlation coefficients for MAT and MAIrespectively. The researchers assessed the five topics being taught and conduct an examination through MAT and the scores were allotted to the students' answer scripts and copies of MAI was administered to the sampled students.Data collected were analyzed using both descriptive and inferential statistics such as mean score,standard deviation, Analysis of Variance (ANOVA) and Pearson's Product Moment Correlation (PPMC) analysisat 0.05 level of significance.

III. Results

Hypotheses Testing

Hypothesis 1: There is no significant relationship between students' metacognitive ability and academic performance in Mathematics.

Table 1: Pearson's Correlation of students' metacognitive ability and academic performance in Mathematics among senior secondary school students in Ondo State

Variables	N	Mean	SD	r	P-value
Students' Metacognitive Ability	300	3.68	0.327	−0.129	0.025
Academic Performance in Mathematics	300	4.03	0.547		

$\boldsymbol{p} > 0.05$

Table 1 showed that there is nosignificant relationship between students' metacognitive ability and academic performance in Mathematics($r\ (300) = -0.129. p > 0.05$). Therefore, the null hypothesis is not rejected. This implies that there is nosignificant relationship between students' metacognitive ability and academic performance in Mathematicsamong senior secondary school students.

Hypothesis 2: There is no significantdifference influence students' gender on academic performance in Mathematics.

In testing the hypothesis, scores relating to students' gender on academic performance in Mathematicswere computed and subjected to statistical Analysis of Variance (ANOVA)at 0.05 level of significance. The result is presented in Table 2.

Table 2: ANOVA Analysis ofsignificant influence of students' gender on academic performance in Mathematicsamong senior secondary school students in OndoState

	Sum of Squares	df	Mean Square	F	Sig
Between Groups	0.030	1	0.030	0.169	0.681
Within Groups	53.157	298	0.178		
Total	53.187	299	0.208		

$^{*}\boldsymbol{p} > 0.05$

Table 2 showed that there is no significant difference in the mean scores of students' gender and academic performance in Mathematicsamong senior secondary school students in OndoState ($F = 0.169, p > 0.05$). The null hypothesis is not rejected. This implies that there is no significant influence of gender on academic performance in Mathematics.

Hypothesis 3: There is no significant difference in metacognitive ability of male and female students on their performance in Mathematics.

Table 3: t-test of significant difference in metacognitive ability of male and female students on their performance in Mathematics

Variables	**N**	**Mean**	**SD**	**t**	**df**	**P-value**
Boys	246	3.675	0.330	0.248	1.831	0.804
Girls	54	3.687	0.314			

* **p>0.05**

Table 3 showed that there is no significant difference in metacognitive ability of male and female students, $t\ (298) = 0.248, p > 0.05$). Therefore, the null hypothesis is accepted. This implies that there is no significant relationship in metacognitive ability of male and female students on their performance in Mathematicsamong senior secondary school students in OndoState.

IV. Discussion, Conclusion and Recommendations

The findings of the study indicated that there is no significant difference in students' metacognitive ability and academic performance in Mathematicsamong senior secondary school students.This might be due to the learning approach that teachers adopt nowadays that encourages learners to monitor, evaluate and strategize their learning themselves. This finding is contrary to that of Online Glossary (2014) who submitted that metacognition enables students to be more active in their learning which means to mobilized all of their resources in order to improve their academic performance. The result does not agree with the finding of Setya Murti (2011) who opined that there is significant difference in academic performance and metacognition.

The study showed that there is no significant influence of gender and academic performance in Mathematicsamong senior secondary school students in OndoState. This also might be the use of textbook and instructional materials that is not gender sensitive. This finding is in support of Mata, MonteriroandPaixoto (2012), who ascertain that there is no gender influence of academic performance in Mathematics. The finding also agrees with Okorie and Ezeh (2016), that there is no significant relationship between gender and academic performance.

The findings of the study also showed that there is no significant difference in metacognitive ability of male and female students on their performance in Mathematicsamong senior secondary school students in OndoState. This finding is not in agreement with Vander Stel, Veenman, Deelen and Haenen(2010), who claimed that metacognitive ability is gender sensitive and that it affects the actual process of learning.

Based on the outcomes of this study, it is therefore concluded that students' metacognitive ability does not significantly differentiatein their Mathematicsperformance and that it is not gender sensitive.

Based on the findings of this study, it is therefore recommended that;

1. Teachers should be aware that metacognitive ability of students during teaching and learning process;
2. Gender sensitive tools or training should be further discouraged during training of minds towards a certain area of specialization or career talk to students;and
3. Mathematics teachers should choose the best teaching strategy in order to discourage any alteration of any personal variables.

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