IOSR Journal of Research & Method in Education (IOSR-JRME)
e-ISSN: 2320–7388, p- ISSN: 2320-737x Volume 11, Issue 6 Ser. III (Nov. – Dec. 2021), 54-59
www.iosrjournals.org

Influence of Metacognitive Utilization Skill and Gender on Secondary School Students' Performance in Mathematics

Okafor-Agbala, Uzoamaka Chimanya[1] & Prof. Okigbo, Ebele Chinelo[2]

1-2, Department of Science Education
Faculty of Education
Nnamdi Azikiwe University, Awka

Abstract: *The relationship between metacognitive utilization skill and gender on secondary school (SS2) students' academic performance in mathematics in Anambra State, Nigeria was investigated. Four research questions guided the study and four hypotheses were tested at 0.05 alpha level. The study adopted a correlation research design. Proportionate stratified random sampling was employed to draw a sample size of 5,096 from a population of 18,352 SS2 students in 261 state government-owned secondary schools in the state. The instrument used for data collection was mathematics metacognitive utilization skill scale (MMUSS) and profoma for collecting students' result from various schools. The instrument was validated and its reliability was found to be 0.63 using Cronbach Alpha method. Method of data collection was on-the-spot with the aid of five research assistants. Data collected were analyzed using Pearson r, t-test of correlational analysis and simple regression analysis. The findings of the study revealed moderate positive relationship between MUS and achievement in mathematics and also low positive relationship existed among students' MUS scores, gender and their mathematics achievement scores. It was recommended among others that students should be encouraged by their mathematics teachers and school counselors to construct their knowledge through planning, monitoring, regulating and evaluating their knowledge and they should take responsibility for their learning so as to improve their performance in mathematics.*

Keywords: *Metacognitive , utilization, skill, gender, mathematics achievement.*

Date of Submission: 04-12-2021 Date of Acceptance: 18-12-2021

I. Introduction

Lot of studies has been carried out on ways of improving the level of mathematics achievement in Nigeria secondary schools (Esiana 2012; Odili, 2006; Okigbo & Okeke 2011). Most of these studies are on student - based, teacher-based and society-based factors without addressing how the students themselves think about solving mathematics. One of such student-related factor is students' meta-cognitive and self-regulatory skill. Meta-cognition has great potential in increasing the meaningfulness of students' classroom learning. The concept of meta-cognition is related to the knowledge of "when" and "how" to use particular strategies/skills for learning or problem solving (Jaafar & Ayub, 2010). Meta-cognition means "thinking about thinking" or "second-level cognition" It is the ability of self-reflection of the ongoing cognitive process; it is something that is unique to the individual which plays an important role in human consciousness. Meta-cognition shows a person's thinking (Setya Murti, 2011). It is also concerned with knowing how to reflect, how to draw conclusions on the practice. In other words, meta-cognition is also concerned with how the performance has a significant effect on cognitive tasks such as remembering, learning and problem solving (Dowing, 2009).

Metacognition includes knowledge of general cognitive strategies, knowledge of monitoring, evaluation and regulatory strategy. Meanwhile, meta-cognitive strategy/skills refer to methods used to help students understand the way they learn. By using meta-cognitive strategy, students can develop appropriate plans during the teaching and learning process either by memorizing or as eventually routine which they use in studying. Most students learn how to monitor and regulate steps and procedures used to meet the goal of solving problems (Ozsoy, 2010). Mathematics meta-cognition therefore refers to knowledge about "when and how" to use particular skills for learning and problem solving in mathematics (Rezuan, Ahmadi & Abedi, 2006). According to Zimmerman (2001), learners need to engage in a variety of cognitive processes to monitor and control their learning. These basic meta-cognitive processes of monitoring and controlling which learners engage in are; assessing the task at hand, evaluating their knowledge and skills, planning their approach in a way that accounts for current situation, applying various strategies to enact their plan, monitoring their progress along the way and monitoring their progress and adjusting their strategies as needed. These five key meta-cognitive processes also called meta-cognitive skills are critical to one becoming an effective self-directed learner, self-regulated and lifelong learner.

In the context of students' learning of mathematics, the meta-cognitive skills that are required include things like; students' having the ability to understand exactly the mathematical task given, being able to evaluate their abilities realistically in specific mathematics topics so as to engage in appropriate strategies that will lead to good learning outcomes, being able to plan an appropriate approach to the mathematics task at hand, being able to monitor their performance as they apply their chosen strategies that implement their plans and being able to reflect and adjust their approach as needs arise.

Liliana and Lavinia (2011) investigated the potential gender differences regarding the metacognitive skills of 8^{th} (14-17) graders. The result indicated that both girls and boys use their meta-cognitive skills in learning. Zulkiply (2012) examined the relationship between meta-cognition and students' academic performance using Meta-cognitive Awareness Questionnaire (MAI) and students' average examination scores. The result indicated a significant positive relationship between students' academic performance and meta-cognitive awareness. In terms of gender, the study also revealed that there was no significant difference in meta-cognition awareness between male and female. That is gender did not affect meta-cognition awareness. Research findings such as Eze (2007) also suggest that students tend not to utilize meta-cognitive skills more often as they should and this no doubt has negative consequences in their achievements in school subjects in general and mathematics in particular. This could have resulted to students' poor academic achievement in mathematics over the years despite all the research findings on the best ways to improve achievement in the subject through the use of effective teaching methods. This poor mathematics achievement could also be gender based.

Gender which is a psychological construct has been used to describe maleness and femaleness. Oribhabor (2019) defined gender as a psychological and cultural term constantly developed by society to differentiate between the roles, behavior, mental and emotional attributes of males and females. Ezeh (2013) explains that gender describes the personality traits, attributes, behavior, values, relative power, influence, roles and expectations (masculinity and femininity) that society ascribes to the two sexes on a differential basis. The influence of gender on students' achievement in mathematics has remained a controversial and tropical issue amongst educationist and psychologists.

Ajai and Imoko (2015) assessed gender differences in mathematics achievement and retention by using problem-based learning (PBL). The study revealed that male and female students taught algebra using PBL did not significantly differ in achievement and retention scores. Ghazvini and Khajehpour (2011) examined gender differences existing in various cognitive motivational variables (locus of control, academic self-concept and use of learning strategies) and in performance attained in school subjects of literature and mathematics. The study revealed the existence of gender difference in variables under consideration, with girls getting better marks in literature and boys getting better marks in mathematics. Kwame, McCarthy, McCarthy and Gyan (2015) investigated the differences in elective mathematics achievements of final year senior secondary school students and found girls in mixed-sex schools achieved higher than their male counterparts. Omenka and Kurumeh (2013) sought to establish relationship between achievement and gender, using ethno mathematics approach. The findings of the study showed that there is no significant effect of gender on students' achievement in number and numeration when taught using ethno mathematics approach. Based on the above studies, gender have not been stable on mathematics achievement, hence the need for continuous verification. It is against this background that the present study intends to determine the influence of meta-cognitive utilization skill and gender on secondary school students' achievement in mathematics.

II. Purpose Of The Study

The main purpose of the study is to determine students' meta-cognitive utilization skill and gender on their mathematics achievement. Specifically, the study determined;

1. the relationship between students' metacognitive utilization skills (MUS) scores and academic performance scores in mathematics.
2. the relationship between male students' MUS scores and academic performance scores in mathematics.
3. the relationship between female students' MUS scores and academic performance scores in mathematics.
4. the relationship between students' meta-cognitive utilization skills (MUS) scores, gender and performance in mathematics.

III. Research Questions

The following research questions guided the study;

1. What is the relationship between students' metacognitive utilization skills (MUS) scores and academic performance scores in mathematics?

2. What is the relationship between male students' MUS scores and academic performance scores in mathematics?
3. What is the relationship between female students' MUS scores and academic performance scores in mathematics?
4. What is the relationship among students' meta-cognitive utilization skills (MUS) scores, gender and performance scores in mathematics?

HYPOTHESES

The study tested the following null hypotheses at 0.05 level of significance;

1. There is no significant relationship between students' MUS scores and academic performance scores in mathematics.
2. There is no significant relationship between male students' MUS scores and academic performance scores in mathematics.
3. There is no significant relationship between female students' MUS scores and academic performance scores in mathematics.
4. There is no interaction effect between students' MUS scores, gender and performance scores in mathematics.

IV. Method

The study adopted a correlation research design. It was carried out on Senior Secondary two (SS2) students in Anambra State, Nigeria. A sample size of 5,590 drawn from a population of 18,352 SS2 students' in the 261 state government-owned secondary schools in Anambra State, Nigeria. Proportionate stratified random sampling was involved in the study. The instruments used for data collection were Mathematics Metacognitive Utilization Skill Scale (MMUSS) developed by the researcher and profoma for collecting performance scores of students in mathematics. The instrument consists of 18 items with five (5) clusters namely; assessing tasks at hand, evaluating ones strength and weakness, planning appropriate approach, monitoring progress and able to reflect and adjust. For the mathematics performance scores, teachers who taught the students provided their first and second terms scores of which the average was obtained to get the performance score. Validation was done and reliability was also carried, the scores obtained were computed using Cronbach alpha and the instrument yielded internal consistency of 0.66. The instrument was distributed, filled by the students and collected on-the-spot with help of class teachers and five research assistants during normal class activities. Data collected were analyzed using Pearson r, t-test of correlational analysis and simple regression analysis. 5,590 copies of MMUSS were distributed and at the point of collation of data, 494 of the filled instrument were not properly filled so they were discarded. The total sampled summed up to 5,096 (91.2%). The criteria for interpreting the correlation coefficient according to Nworgu (2015) are as follows:

0.1 – 0.30	Weak relationship
0.30 – 0.70	Moderate relationship
0.70 – 1.0	Strong relationship

For hypothesis testing, t-test of correlational analysis was used to test the significant relationship. In interpreting the null hypotheses, the decision rule is that when p-value is less than or equal to 0.05 ($p \leq 0.05$) the null hypothesis was rejected. On the other hand, when p-value is greater than the alpha level 0.05 ($p > 0.05$), the null hypotheses was accepted.

V. Results

Table 1: Pearson r on Students' Meta-cognitive Utilization Skills Scores and Performance Scores in Mathematics

Source of variance	N	MUS (r)	Mathematics (r)	Remark
MUS	5096	1.00	0.68	moderate positive relationship
Mathematics	5096	0.68	1.00	

Data in Table 1, show that a moderate positive relationship (r=0.68) exists between students' meta-cognitive utilization skills (MUS) scores and their performance scores in mathematics.

Table 2: Pearson r on Male Students' Meta-cognitive Utilization Skills Scores and Performance Scores in Mathematics

Source of variance	N	MUS (r)	Mathematics (r)	Remark
Male MUS	2241	1.00	0.71	Strong positive relationship
Mathematics	2241	0.71	1.00	

In Table 2, it was observed that a strong positive relationship (r= 0.71) exists between male students' meta-cognitive utilization skills (MUS) scores and their performance scores in mathematics.

Table 3: Pearson r on Female Students' Meta-cognitive Utilization Skills (MUS) Scores and Performance Scores in Mathematics

Source of variance	N	MUS (r)	Mathematics (r)	Remark
Female MUS	2855	1.00	0.55	Moderate positive relationship
Mathematics	2855	0.55	1.00	

In Table 3, it was observed that a moderate positive relationship (r= 0.55) exists between female students' meta-cognitive utilization skills (MUS) scores and their performance scores in mathematics.

Table 4: Summary of regression analysis on students' MUS scores, gender and performance scores in mathematics

R	R square	Adjusted R square	Remark
0.21	0.044	0.036	Low positive relationship

Table 4 showed that a low positive relationship of 0.21 existed among students' MUS scores, gender and performance scores. More so, the adjusted r^2 explains that 4.4% of the total variability of students' performance scores can be explained by their MUS scores and gender.

Testing Null Hypotheses

Table 5: t-Test of Significant Relationship between Students' Meta-Cognitive Utilization Skills (MUS) Scores and Performance Scores in Mathematics

Correlation coefficient (r)	N	Df	t-cal.	p-value	α	Decision
.68	5096	5094	0.718	0.474	0.05	Not Sig

Table 5 indicates that at 0.05 level of significance and 5094 df, the calculated t 0.718 with p-value 0.474 which is greater than 0.05, the null hypothesis is accepted. This implies that there is no significant relationship between students' mathematics meta-cognitive scores and their performance scores in mathematics.

Table 6: t-Test of Significant Relationship between Male Students' MUS Scores and their Performance Scores in Mathematics

Correlation coefficient (r)	N	Df	t-cal.	p-value	α	Decision
.71	2241	2239	0.908	.366	0.05	Not sig

Table 6 indicates that at 0.05 level of significance and 2239 df, the calculated t 0.908 with p-value 0.366 which is greater than 0.05, the null hypothesis is not rejected. Therefore, it means that there is no significant relationship between male students' mathematics MUS scores and their performance scores in mathematics.

Table 7: t-Test of Significant Relationship between Female Students' MUS Scores and their Performance Scores in Mathematics

Correlation coefficient (r)	N	Df	t-cal.	p-value	α	Decision
.71	2855	2853	7.89	.000	0.05	Sig

Data on Table 7 indicate that at 0.05 level of significance and 2853 df, the calculated t 7.89 with p-value 0.00 which is less than 0.05, the null hypothesis is rejected. Therefore, it means that there is significant relationship between female students' mathematics MUS scores and their performance scores in mathematics.

Table 8: Summary of regression analysis on students' MUS scores, gender and mathematics performance scores

N	R	R^2	R^2 adjusted	df	Cal. T	p-value	α	Remark
5096	0.21	0.044	0.036	5094	7.038	0.000	0.05	Sign

Data on Table 8 indicate that at 0.05 level of significance and 5094 df, the calculated t 7.038 with p-value 0.000 which is less than 0.05 (t= 7.038, df, 5094, p< 0.05), the null hypothesis is rejected. Therefore, there is an interaction effect of students' MUS scores and gender on their performance scores in mathematics.

VI. Discussion

The finding of the study revealed that there is a strong positive relationship between students' meta-cognitive utilization skills and their achievement in mathematics. This strong positive relationship was not confirmed by the test of hypothesis 1 examined in Table 5 of the study. Hence, there is therefore no significant relationship between students' mathematics meta-cognitive utilization skills and their achievement in mathematics.

The finding of this study is in line with that of Zulkiply (2012) and Rani and Govil (2013) whose study reported positive relationship between students' meta-cognition and their academic achievement prompting them to recommend the awareness of meta-cognitive skills. Although, the finding of Smith (2013) concluded that meta-cognitive awareness do not predict students' academic achievement.

The finding of this study from Table 2 also revealed a strong positive relationship existed between male students' meta-cognitive utilization skills and their achievement in mathematics while Table 6 indicates that there is no significant relationship between male students' mathematics meta-cognitive utilization skill scores and their achievement scores in mathematics while Table 3 and 7 indicates that there is significant relationship between female students' mathematics meta-cognitive skill scores and their achievement in mathematics.

Leister (2016) found significant difference in favor of female participants which agrees with the finding of the study which is in favor female while Zulkiply (2012) found significant positive relationship between students' academic performance and meta-cognitive awareness but revealed that gender did not affect meta-cognition awareness, also, Rani and Govil (2013) found that gender has no significant impact on the meta-cognition of undergraduate students.

Zulkiply (2012), Jack (2013), Omenka and Kurumeh (2013), Nejad and Khani (2014) and Evans (2015) all disagrees with the finding of the study that there is no interaction effect of gender, meta-cognitive skills and students' academic achievement. Hence, metacognitive utilization skills have its influence on the academic achievement of mathematics students. This implies that when students' utilize their meta-cognitive skills there might be consistent improvement in the achievement of mathematics.

VII. Conclusion

In conclusion, metacognitive utilization skills was observed to have positive relationship with students' mathematics performance, there was a positive relationship among MUS, gender and mathematics performance with male students observed to have higher positive relationship than the female.

The researchers is of the view that the reason why there is a strong relationship between students' meta-cognitive utilization skills and achievement could be that meta-cognitive skills are usually conceptualized as an interrelated set of competencies for learning and thinking and also include many of the skills required for active learning such as critical thinking, reflective judgment, problem solving and decision-making which hence enhance one's achievement.

VIII. Recommendations

It is recommended that;

1. Teachers should ensure that students are actively involved in the learning activity by ensuring active participation and their lessons organized in such a way that students can bring their own related experiences to bear on the lesson and ask questions, examine their own answers in order to be actively involved in the learning processes.
2. Mathematics teachers and school counselors should encourage their students' to construct their knowledge through planning, monitoring, regulating and evaluating their knowledge and they should take responsibility for their learning.

References

[1]. Ajai, J.T. & Imoko, A. (2015). Gender differences in mathematics achievement and retention scores: A case of problem-based learning method. International Journal of Research in Education and Science (IJRES), 1(1), 45-50.

[2]. Downing, K. J. (2009). Self-efficacy and meta-cognitive development. The International Journal of Learning, 16(4). Retrieved from http://www.learning-journal.com.on January 6,2018.

[3]. Esiana, A.C. (2012). Students' social classroom learning environment and attitude in mathematics as correlates of their achievement in mathematics. Unpublished Master's thesis, Nnamdi Azikiwe University, Awka, Anambra State.

[4]. Eze, U. N. (2007). Assessment of tertiary students metacognitive skills for internet based learning. Information communication technology in the service of education, 265-276.

[5]. Ezeh, D. N. (2013). Science without women a paradox. The 75th inaugural lecture (may 30th), University of Nigeria, Nsukka.

[6]. Ghazvini, S.D. & Khajehpour, M. (2011). Gender differences in factors affecting academic performance of high school students. Proceia-social and Behavioral Sciences, 15, 1040-1045.

[7]. Jaafar, W.M.W. & Ayub, A.F.M. (2010). Mathematics self-efficacy and meta-cognition among university students. Procedia Social and Behavioral Sciences, 8, 519-524. Retrieved from http //www. dx.doi.org.on December 14,2018.

[8]. Kwame, B., McCarthy, P. McCarthy, P. & Gyan, E. (2015). Gender differences in elective mathematics achievements of senior secondary school students (SSS3) in central and western regions of Ghana. International Invention Journal of Education and General Studies, 1(2), 18-24.

[9]. Liliana, C & Lavinia, H (2011). Gender differences in metacognitive skills. A study of the 8th grade pupils in Romania. Procedia-Social and Behavioral Sciences 29,396-401.

[10]. Okigbo, E.C & Okeke, S.O.C (2011). Effects of games and analogies on students' interest in mathematics. Journal of Science Teachers Association of Nigeria, 46(1), 101-112.

[11]. Omenka, J. E & Kurumeh, M. S (2013). Gender and location as correlates of achievement in number and numeration using Ethno mathematics approach in the junior secondary schools in Benue State. Greener Journal of Educational Research, 3(4), 184-190. Retrieved from http:www. gjournals.org.on January 10,2019.

[12]. Oribhabor, C. B.(2019). The influence of gender on mathematics achievement of secondary school students in Bayelsa State. African Journal of Studies in Education, 14(2), 196-206.

[13]. Ozsoy, G. (2010). An investigation of the relationship between meta-cognition and mathematics achievement. Asia Pacific Education Review, 12(2), 227-235.

[14]. Rezvan, S., Ahmadi, S. A. & Abedi, M. R. (2006). The effects of metacognitive training on the academic achievement and happiness on Estiahan University conditional students. Counseling Psychology Quarterly, 19(4), 415-428.

[15]. Setya Murti, H.A. (2011). Meta-cognition and theory of mind (Tom). Journal of Psychology Review, 1 (2).

[16]. Zimmerman, B.J. (2000). Self-efficacy: An essential motive to learn. Contemporary Education Psychology, 25, 82-91.

[17]. Zulkiply, N. (2012). Meta-cognition and its relationship with students' academic performance. Learning and Individual Differences, 17, 344-365.

Okafor-Agbala, et. al. "Influence Of Metacognitive Utilization Skill And Gender On Secondary School Students' Performance In Mathematics." *IOSR Journal of Research & Method in Education (IOSR-JRME)*, 11(06), (2021): pp. 54-59.