CORRELATION BETWEEN METACOGNITIVE FACTORS AND ACADEMIC ACHIEVEMENT IN MATHEMATICS AMONG SECONDARY SCHOOLS STUDENTS IN ORON LOCAL GOVERNMENT AREA OF AKWA IBOM STATE, NIGERIA

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KEYWORDS
Meta cognitive factors, Self-assessment, Self resilience, Mathematics achievement

ABSTRACT
This study adopted correlational design to examine correlation between metacognitive factors and academic achievement in mathematics among secondary school students in Oron Local Government, Akwa Ibom State, Nigeria. Two research questions were posed and two hypotheses formulated to guide the study. Proportionate sampling technique was used to select a sample of 300 SS2 students for the study. Two instruments titled questionnaire Metacognitive Factors (MCF)" and Mathematics Achievement Test (MAT) were developed by the researcher and validated by experts and used for data collection. The average reliability of the instrument was determined and the coefficient using Alpha Cronbach Method and Kuder-Richardson formula (21) was found to be 0.84 and 0.87 for meta cognitive factors and Mathematics achievement respectively. The hypotheses were tested using Pearson Product Moment Correlation for hypotheses for two hypotheses. All hypotheses were tested at -05 level of significance. Findings indicated that both self – assessment and self-resilience were significant relate to academic achievement in mathematics. It was concluded that achievement of students in mathematics depend on their meta cognitive factors in terms of self-assessment and self-resilience. It was recommended amongst others that educators should implement strategies that build students' confidence in their mathematical abilities which should include providing self-

assessment, self-resilience, setting achievable goals, and celebrating small successes.

Introduction

Mathematics is a subject that requires not only procedural knowledge but also the ability to reflect on and regulate one's learning processes. Metacognitive skills enable students to plan, monitor, and evaluate their understanding and problem-solving strategies. Students who employ metacognitive strategies tend to perform better academically as they are more equipped to tackle complex mathematical problems (Ibok, Meremikwu, & Umoh, 2020).. The growing emphasis on personalized learning and self-regulated learning has intensified the investigation into the correlation between metacognitive skills and students' mathematics achievement. Metacognition refers to the awareness and understanding of one's own thought processes. It involves two key components: metacognitive knowledge (what individuals know about their own cognition and learning processes) and metacognitive regulation (the processes used to monitor and control one's learning and thinking strategies). It plays a crucial role in effective learning and problem-solving (Schraw, 2021; Ibok Thomas, & Nyong, 2019). Students who exhibit strong metacognitive skills demonstrate greater success in mathematical problem-solving and overall performance (Zhou et al., 2018; Tsai & Lin, 2021). Kramarski and Michalsky (2019) found that students who actively engage in metacognitive strategies—such as self-questioning and self-monitoring—show improved conceptual understanding and problem-solving abilities in mathematics.. Metacognitive skills involve higher-order thinking processes that enable learners to plan, monitor, and evaluate their understanding and performance in mathematical tasks. Despite the increasing recognition of metacognition's importance, there remains a need for comprehensive studies that elucidate how these skills directly influence students' mathematical outcomes. Recent literature suggests that students who engage in metacognitive processes are more adept at deploying effective problem-solving strategies and achieving higher academic performance in mathematics (Veenman et al., 2020; Akin,& Özdemir, 2020). However, the mechanisms through which metacognitive awareness contributes to learning outcomes in mathematics are not fully understood. For instance, while some studies highlight the role of explicit metacognitive training in improving mathematics performance (Cross & Boggess, 2019; Sari & Çalişkan, 2022), there is also evidence indicating that students may not automatically apply metacognitive strategies without appropriate guidance (Baker et al., 2021).

Many students exhibit limited metacognitive awareness, which hampers their ability to effectively monitor and regulate their learning processes in mathematics. Research indicates that students often fail to employ metacognitive strategies that could enhance their problem-solving abilities, leading to lower academic achievement (Veenman et al., 2020). This lack of awareness may result in ineffective study habits and a failure to recognize when they do not understand mathematical concepts. The effectiveness of instructional methods in promoting metacognitive skills has been questioned. Many traditional teaching approaches do not explicitly teach metacognitive strategies, resulting in students lacking the necessary skills to apply these strategies in mathematics (Kramarski & Michalsky, 2020 ; Ibok, Ogbebe, Alu, Joseph, Udobong, Collins, 2024).). This gap in instruction may contribute to the persistent challenges students face in achieving mathematical proficiency.

As mathematics is characterized by problem-solving and critical thinking, fostering metacognitive awareness is importance for enhancing students' achievement and promoting deeper understanding of mathematical concepts. Recent studies underscore the positive correlation between metacognitive skills and mathematics achievement. Students who demonstrate higher metacognitive awareness tend to exhibit more effective problem-solving strategies and better self-regulation in their learning processes (Zhou et al., 2018; Kramarski & Michalsky, 2019). For instance, research by Odom et al. (2021) indicates that explicit instruction in metacognitive strategies significantly enhances students' performance in mathematics. Such insights suggest that metacognitive training

could be an effective instructional strategy to improve students' mathematical abilities. Moreover, the contextual factors, such as teaching methods and classroom environments, significantly influence students' metacognitive development. Various instructional approaches, including collaborative learning and problem-based learning, have been shown to promote metacognitive skills and positively impact mathematics achievement (Baloglu, 2021; Van der Stel et al., 2020). The integration of metacognitive strategies into mathematics curricula has implications for educators seeking to improve student outcomes, especially in a subject where many learners continue to struggle (Sari & Çalişkan, 2022). In this study, Self-assessment and self-resilience are considered as metacognitive factors because they significantly contribute to effective learning, personal growth, and academic achievement.

Self-assessment is increasingly acknowledged as a pivotal component in educational settings, enabling students to evaluate their own learning processes and outcomes effectively. In the context of mathematics education, self-assessment can enhance students' metacognitive skills, promote self-regulated learning, and ultimately lead to improved academic performance. it involves students reflecting on their understanding, identifying gaps in their knowledge, and monitoring their progress (McMillan & Hearn, 2020). This reflective practice has been shown to foster a sense of ownership over the learning process, which is particularly beneficial in subjects like mathematics that require critical thinking and problem-solving skills. A study by Rojas-Drummond et al. (2020) found that when students engaged in self-assessment during mathematics instruction, their achievement levels significantly increased. The authors argued that self-assessment promotes deeper engagement with the material, facilitating better retention and application of mathematical concepts. Research conducted by Ali et al. (2021) found a positive effects of self-assessment on students' metacognition. Their findings indicated that students who regularly practiced self-assessment showed improvements in their mathematical problem-solving abilities and overall performance. A study conducted by Wang and Kuo (2023) examined the relationship between self-assessment feedback and student achievement in mathematics and found that structured self-assessment practices, combined with teacher feedback, led to significant improvements in students' diagnostic skills and problem-solving performance. Effective self-assessment not only aids in self-awareness but also enhances the quality of learning outcomes. The integration of peer assessment alongside self-assessment was explored by Odom and Phelps (2018). This study found that when students engage in both self-assessment and peer feedback, their mathematical achievement improves due to enhanced motivation and a deeper understanding of evaluative criteria. The combined approach encourages collaboration and critical thinking, providing a more comprehensive understanding of the material. Yang and Tsai (2021) found that self-assessment is a critical aspect of self-regulated learning in mathematics. Their research indicated that students who consistently employed self-assessment techniques demonstrated greater self-efficacy and motivation in mathematics, which correlated with higher academic performance. Despite the positive implications of self-assessment on mathematics achievement, challenges remain. Some studies indicate that students may struggle with accurately assessing their own knowledge or skills, which can lead to ineffective self-evaluation strategies (Nicol & Macfarlane-Dick, 2017). However, for self-assessment to be effective, it must be integrated thoughtfully into the curriculum, supported by clear guidelines and feedback mechanisms.

Another metacognitive factors considered in this study is self resilience. Self-resilience, often defined as an individual's ability to adapt and bounce back from adversity, plays a crucial role in students' academic experiences, particularly in challenging subjects like mathematics. Resilience influences not only students' motivation and engagement but also their capacity to overcome obstacles and persist in the face of difficulties in learning. Self-resilience refers to an individual's ability to adapt to adversity, overcome challenges, and recover from setbacks. It encompasses mental, emotional, and behavioral processes that help individuals cope with stress and maintain their well-being amid difficult circumstances. Resilience can enhance academic performance by promoting a positive attitude and perseverance in learning. Self-resilience is characterized by traits such as perseverance, optimism, and the ability to cope with stress and failure (Masten, 2019). In educational contexts, resilient students are better equipped to handle the challenges they encounter in their academic pursuits. This is particularly relevant in

mathematics, where students frequently face frustration and anxiety due to the nature of the content and the problem-solving processes involved.

A study conducted by Akosah-Troy and Bayaga (2018) found that students with higher levels of self-resilience exhibited better academic performance in mathematics. Their research suggested that resilient students are more likely to employ effective coping strategies when faced with challenging mathematical problems, leading to improved assessment results. Research conducted by Morfidi et al. (2022) explored the relationship between self-resilience and mathematics anxiety among high school students and found that resilient students reported lower levels of mathematics anxiety, which in turn positively impacted their mathematics achievement. Studies conducted by Aldhafiri (2023) found that self-resilience enhances students' engagement in adaptive learning strategies in mathematics. Resilient students were more inclined to seek help, collaborate with peers, and utilize resources effectively, resulting in higher mathematics performance. The ability to employ such strategies indicates that resilience fosters a proactive approach to learning. An intervention study conducted by Kalra and Lee (2021) demonstrated that targeted resilience-building programs significantly improved students' mathematics achievement. Students who participated in activities aimed at enhancing resilience, such as stress management and goal-setting, reported greater confidence in their mathematical abilities and higher performance in assessments. The work of Hwang et al. (2022) examined self-resilience as a mediator between students' motivation and their academic outcomes in mathematics and found that resilience mediated the relationship between intrinsic motivation and mathematics achievement, suggesting that motivated students who also exhibit high resilience are more likely to achieve better results. Fostering resilience in students can lead to improved academic performance, particularly in subjects perceived as difficult, such as mathematics.

Statement of Problem

Mathematics achievement is a critical component of academic success and is often influenced by various cognitive and non-cognitive factors. One such factor that has garnered attention in educational research is metacognition, which refers to the awareness and regulation of one's own thought processes. Mathematics achievement among students has been a persistent challenge in educational systems worldwide, often reflecting not only the complexity of mathematical concepts but also students' cognitive and metacognitive skills. Metacognitive factors play a critical role in how effectively students engage with mathematical tasks and ultimately achieve success in the subject. Many students struggle with mathematics due to lack self-assessment and self resilience, low self-regulation leading to decreased motivation and poor academic achievement. Some of teaching approaches do not clearly teach metacognitive approaches, resulting in students lacking the necessary skills to apply these strategies in mathematics which make Most of them often find mathematics abstract and unengaging, which lead to disinterest and lower performance. Metacognitive skills not only help students understand mathematical concepts but also enable them to approach problems more systematically. Moreover, as mathematics serves as a foundational skill necessary for various fields, understanding its correlation with metacognitive skills could lead to improved instructional strategies and potentially address the persistent achievement gaps observed among different student Despite the clear benefits of metacognitive factors in mathematics achievement, challenges such as a lack of teacher training in metacognitive strategies, student misconceptions about their abilities, and insufficient curricular integration persist. These challenges can hinder the effectiveness of metacognitive interventions in enhancing mathematical understanding and performance. It is against these notable and identified problems that the research intended to examine the correlation the correlation between Metacognitive factors and academic achievement in mathematics among secondary school students in Oron Local Government, Akwa Ibom State, Nigeria.

Purpose of the study

The purpose of this study is to examine the correlation between Metacognitive factors and academic achievement in mathematics among secondary school students in Oron Local Government, Akwa Ibom State, Nigeria. Specifically, the study seeks to examine;

i. the relationship between self-assessment and academic achievement in mathematics among secondary school students

ii. the relationship between self-resilience and academic achievement in mathematics among secondary school students

Research Questions

The following research questions were posed

i. How does self-assessment relate with academic achievement in mathematics among secondary school students?

ii. How does self-resilience relate with academic achievement in mathematics among secondary school students?

Research Hypotheses

The following null hypotheses were formulated to guide the study.

H_{o1}: There is no significant relationship between self-assessment and academic achievement in mathematics among secondary school students in Oron Local Government, Akwa Ibom State, Nigeria

H_{o2}: There is no significant relationship between self-resilience and academic achievement in mathematics among secondary school students in Oron Local Government, Akwa Ibom State, Nigeria

Research Methodology

The study was carry out in Oron Local Government Area of Akwa Ibom State, Nigeria. The research design used for this study was the correlational survey design. The researchers used this design to established the relationship between metacognitive factors (in terms of self assessment and self-resilience) and academic achievement of students in Mathematics . The population for the study consisted of all the 879 (478 females and 401 males) SS2 students in 4 approved public secondary schools in Oron Local Government Area of Akwa Ibom State, Nigeria. Proportionate sampling technique was used for this study in order to give all the schools and students of all the f0ur (4) secondary schools an equal chance of being selected for the study. Proportionate was used to ensure that 34.1 % of the entire students in each the four schools were selected for the study. To select the schools for the study, the researcher using all the four(4) schools in the study areas From the each of the schools, the researchers adopted the hat and draw method of sampling where "Yes" and "No" were written on pieces of papers, folded, shaken together and put in the brasket, then each of the students was asked to choose without replacement. Those who picked the paper balls with "Yes" tags were used for the study. . A sample of 300 (163 females and 137 males) SS2 students were selected representing 34.1% of the entire population of SS2 students in the study area. The instruments used for data collection were the questionnaire titled “Meta cognitive and Mathematics achievement test. The questionnaire was made of 14 items, with 7 items to measure each sub-level in terms of self-assessment and self resilience .. The questionnaire was based on four point scale of strongly agreed, agreed, disagreed and strongly disagreed. Mathematics Achievement Test was made up of 50 items constructed by the researchers with help of two experts in Mathematics education. The items were constructed based on SS 2 Mathematics syllabus with four options A, B, C, D. A correct answer attracts one mark while incorrect answer attracts zero (0)mark. The instrument was face-validated by two experts in Measurement and Evaluation and two Mathematics Educators, all from the University of Calabar. Corrections were pointed out by the experts and adjusted by the researchers and the document was considered valid. The average reliability of the questionnaire using Alpha Cronbach Method give .0.84 while the reliability estimate of the students’ Mathematics achievement test was established through Kuder Richardson formula K-R20 which gives .87. Since the reliability index is above 0.50, the estimates were considered high enough for the study. The Statistical Package for Social Sciences (SPSS) computer programme was used to analyze the data collected. The hypotheses were tested using Person Product Moment Correlation coefficient for two hypotheses . All hypotheses were tested at -05 level of significance.

Presentation of Results

The result of the analysis is presented in Tables 1 and 2. The hypotheses were tested at .05 significant level.

Ho_1: There is no significant relationship between self-assessment and academic achievement in mathematics among secondary school students in Oron Local Government, Akwa Ibom State, Nigeria. The independent variable in this hypothesis is self –assessment while the dependent variable is academic achievement in mathematics. In testing this hypothesis, mean, standard deviation of self-assessment and academic achievement in mathematics were computed, compared and correlate using Pearson Product Moment Correction . The results are presented on Table 1.

Table 1: Person Product Moment Correlation of the relationship between self-assessment and academic achievement in mathematics of secondary school students (N= 300)

Variables	N	Mean	SD	r-value	t-value	p-value
Self-assessment	300	18.723	3.232	.743	19.164	.000
Mathematics achievement	300	32.877	5.231			

*Significant at the .05 level, df =298

The result presented on Table 1 shows the high positive significant relationship between self-assessment and academic achievement in mathematics of secondary school students in Oron Local Government, Akwa Ibom State, Nigeria. (r=.743; t=19.164; p=.000). With this result, the null hypothesis was rejected while the alternative was retained at the 0.05 level of significance. The positive r-value indicated that the more high self-assessment , the better the better academic achievement in mathematics tend to be . On the other hand, low self assessment lead to the poorer academic achievement in mathematics.

Ho_2: There is no significant relationship between self-resilience and academic achievement in mathematics among secondary school students in Oron Local Government, Akwa Ibom State, Nigeria. The independent variable in this hypothesis is self resilience while the dependent variable is academic achievement in mathematics. In testing this hypothesis, mean, standard deviation of self-resilience and academic achievement in mathematics were computed, compared and correlate using Pearson Product Moment Correction . The results are presented on Table 2.

Table 2: Person Product Moment Correlation of the relationship between self-resilience and academic achievement in mathematics of secondary school students (N= 300)

Variables	N	Mean	SD	r-value	t-value	p-value
Self-resilience	300	17.989	3.437			
				.811	22.930	.000
Mathematics achievement	300	32.877	5.231			

*Significant at the .05 level, df =298

The result presented on Table 1 shows the high positive significant relationship between self-resilience and academic achievement in mathematics of secondary school students in Oron Local Government, Akwa Ibom State, Nigeria. (r=.811; t=23.930; p=.000). With this result, the null hypothesis was rejected while the alternative was retained at the 0.05 level of significance. The positive r-value indicated that the more high self-resilience , the better the better academic achievement in mathematics tend to be . On the other hand, low self resilience lead to the poorer academic achievement in mathematics.

Discussion of finding

The result of the first hypothesis revealed that there is a significant relationship between self-assessment and academic achievement in mathematics among secondary school students in Oron Local Government, Akwa Ibom State, Nigeria. In the context of mathematics education, self-assessment can enhance students' metacognitive skills, promote self-regulated learning, and ultimately lead to improved academic performance (McMillan & Hearn, 2020). The finding agreed with a study conducted by Rojas-Drummond et al. (2020) who found that when students engaged in self-assessment during mathematics instruction, their achievement levels significantly increased.. The finding align with a research conducted by Ali et al. (2021) who found a positive effects of self-assessment on students' metacognition.. The finding is in line with a study conducted by Wang and Kuo (2023) who found that structured self-assessment practices, combined with teacher feedback, led to significant improvements in students' diagnostic skills and problem-solving performance. The finding agreed with Odom and Phelps (2018) who stated that when students engage in both self-assessment and peer feedback, their mathematical achievement improves due to enhanced motivation and a deeper understanding of evaluative criteria. The finding agreed with Yang and Tsai (2021) who found that self-assessment is a critical aspect of self-regulated learning in mathematics.

The result of the second hypothesis revealed that there is a significant relationship between self-resilience and academic achievement in mathematics among secondary school students in Oron Local Government, Akwa Ibom State, Nigeria The finding agreed with a study conducted by Akosah-Troy and Bayaga (2018) who found that students with higher levels of self-resilience exhibited better academic performance in mathematics. The finding agreed with . a research conducted by Morfidi et al. (2022) who found that resilient students reported lower levels of mathematics anxiety, which in turn positively impacted their mathematics achievement. In agreement to this finding, Aldhafiri (2023) found that self-resilience enhances students' engagement in adaptive learning strategies in mathematics. Also the finding is in consonance with a studies conducted by Kalra and Lee (2021) who found in their studies that students who participated in activities aimed at enhancing resilience, such as stress management and goal-setting, reported greater confidence in their mathematical abilities and higher performance in assessments. The finding agreed with a work of Hwang et al. (2022) who found that resilience in students can lead to improved academic performance, particularly in subjects perceived as difficult, such as mathematics.

Conclusion

The findings of the study indicated that both self –assessment and self-resilience were significant relate to academic achievement in mathematics Metacognitive skills enable students to be aware of their cognitive processes, enhance their ability to self-regulate, and improve their problem-solving strategies. When students engage in self-assessment, they

reflect on their knowledge and skills. This reflection not only fosters deeper learning but also helps them to identify areas for improvement, ultimately leading to better performance in mathematics. Moreover, self-resilience acts as a vital psychological asset that allows students to cope with the challenges and pressures commonly associated with learning mathematics, such as anxiety and frustration. Resilient students are more likely to view difficulties as opportunities for growth and to employ adaptive coping strategies. Together, these elements create a supportive framework that encourages motivation, persistence, and higher academic achievement in mathematics.

Recommendations

Based on the finding of the study, the following recommendation were made;

i. Educators should implement strategies that build students' confidence in their mathematical abilities which should include providing self-assessment, self-resilience, setting achievable goals, and celebrating small successes.

ii. Educators should explicitly teach metacognitive strategies, such as self-assessment and reflection techniques, as part of the mathematics curriculum. This could involve structured reflection on problem-solving processes and encouraging students to monitor their own understanding during lessons.

iii. Schools should integrate regular self-assessment opportunities into mathematics classes. This includes using rubrics and checklists for students to evaluate their own work, thereby promoting self-awareness and accountability in their learning process.

iv. Academic institutions can implement programs focused on building resilience among students. These programs can include stress management workshops, growth mindset training, and activities that promote positive coping strategies in the face of mathematical challenges.

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