

RESEARCH ARTICLE

Metacognitive Strategies as a Correlate of Mathematics Performance Among High School Students in Kiambu County, Kenya

George Gitau Muturi*, Elizabeth Wanjiku Mwaniki, and Josephine Ngina Mutua

Department of Educational Psychology, Kenyatta University, Kenya



Open Access

Citation: Muturi, G G., Mwaniki, E.W., Mutua, J, N. Metacognitive Strategies as a Predictor of Mathematics Performance Among High School Students in Kiambu County, Kenya. *Interdisciplinary Education and Psychology*. 2025; 4(1):5.

Received: August 30, 2025

Accepted: November 04, 2025

Published: November 12, 2025

Copyright: © 2025 Muturi, G G. This is an open access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Corresponding author: George Gitau Muturi, Department of Educational Psychology, Kenyatta University, Kenya; E-mail: georgemuturi40@gmail.com

Abstract

Mathematics is considered the foundation for scientific knowledge needed for the development of any nation globally, and therefore, it is a critical subject in schools. Nonetheless, prevalent subpar mathematics performance persists in many educational institutions. While empirical studies have identified a correlation between metacognitive strategies and mathematics performance among high school students, a notable research gap exists within Githunguri Sub-County, Kiambu County, Kenya, regarding the subject matter. Hence, the present study endeavors to explore the relationship between metacognitive strategies and learners' mathematics achievement. The study was founded on Schraw and Moshman's (1995) metacognitive theory. Further, the study utilized a correlational research design. The data were collected from a well-structured questionnaire of the Metacognitive Awareness Inventory (MAI) using 421 (198 boys and 223 girls) form three students. Pearson Product-Moment correlation was utilized to test the null hypothesis that there is no relationship between metacognitive strategies and mathematics performance. Findings of the study revealed a positive and significant relationship between metacognitive strategies and mathematics achievement ($r(419) = .26, p < .01$). Gender differences in metacognitive strategies were tested utilizing the independent sample t-test, where the findings indicated that there were no gender differences in metacognitive strategies on mathematics performance. The predictive index of metacognitive strategies on mathematics performance was tested using multiple regression analysis. Metacognitive strategies had a positive predictive index of ($\beta = .26, p < .001$). The findings of this study are important and form the foundation upon which policymakers can contribute to the formation of programs and appropriate interventions in the educational system that prioritize metacognitive strategies development for improved mathematics.

Keywords

Metacognitive strategies; Planning; Monitoring, Evaluation; Mathematics Performance; High School Education; Kenyan secondary schools

Introduction

Mathematics is an important driver of scientific and technological innovations compared to other subjects globally (Attard & Holmes, 2020). In addition to influencing educational policy (Ryve & Hemmi, 2019), mathematical skills are relevant in making daily decisions and choices that enhance survival, higher education, and career advancement. Mathematics is globally viewed as one of the critical subjects in the school curriculum as it forms the basis of scientific and technological knowledge, which contributes significantly to the social and economic development of a country (Chand *et al.*, 2021). Good grades in mathematics are viewed as a significant predictor of preference for mathematics-based careers, and therefore, learners' scores in mathematics are a priority to teachers, researchers, psychologists, and policymakers.

The mathematics skills attained or developed in high school are key in the area of science, technology, engineering, and mathematics (STEM). Additionally, for the students to secure a mathematics-based career, they must attain a high score in the subject at the end of the high school curriculum. However, there is a problem with the performance of mathematics. Educational stakeholders and researchers have continued to explore various mathematics performance mediators among high school students to improve mathematics performance. However, the persistent low performance trend within Githunguri Sub-County, Kiambu County, Kenya, has sparked considerable concern among educational stakeholders. For instance, for the past six years (2017-2022), approximately 87.89% of candidates scored grade D or below, with mean scores ranging from 2.04 (D minus) to 3.23 (D plain) in mathematics (Kenya National Examination Council [KNEC], 2022). These figures underscore a worrying pattern of mathematics underperformance among students in Githunguri Sub-County, Kiambu County, therefore suggesting systematic issues that require urgent attention and intervention from policy makers and education authorities, and as a result of the current situation, students are deprived of the opportunities in science-based courses in tertiary institutions, which would resultantly spur development in the country. Previous research on factors influencing mathematics performance has primarily focused on the external factors such as teaching methods (Voskoglou, 2019), parental influences (Panaoura, 2021), students' previous performance (Zakariya *et al.*, 2023), and classroom environment factors (Ndidi & Effiong, 2020). However, it is increasingly recognized that affective factors intrinsic to the learner may also significantly influence mathematics performance. One such factor that has sparked attention among researchers in the developed nations is metacognitive strategies. The studies conducted in Western and Eastern populations cannot be generalized to other populations, such as Kenya, due to cultural and educational diversities. Researchers hypothesized that the relationship between metacognitive strategies and mathematics performance may vary due to geographical location and academic discipline of study. Several studies have attributed the mathematics performance of high school students to various aspects of metacognitive strategies in learning (Centino & Sebial, 2023; Kusaka & Ndiokubwayo, 2022; Obote, 2021). Schraw and Moshman (1995) stated that metacognitive strategies refer to the techniques that help learners develop an awareness of their cognition as they learn. Evaluation is the strategy through which students assess the extent to which mathematics objectives have been achieved and appraise their problem-solving performance (Andriani & Mbato, 2021). Most studies proposed and tested by various researchers on metacognitive strategies demonstrated that students with stronger metacognitive abilities, such as planning, monitoring, and regulating their learning processes, tend to perform better in mathematics tasks and assessments (Dündar, 2019; Izmirli & Izmirli, 2020; Küçükakça *et al.*, 2022). Furthermore, in Indonesia, for instance, Lestari and Jailani (2018) found that students who employ planning, monitoring, and evaluation strategies significantly outperform those students who do not employ any metacognitive strategies. Elsewhere, Similar findings are reflected in a study by Küçükakça *et al.* (2022) on a Turkish sample, where it was established that students with good metacognitive awareness and strategy levels have good mathematics performance. Notably, in Kenya, Ong'uti *et al.* (2019) established that students with better metacognitive planning do better in mathematics. However, Ong'uti's study was conducted in Kisii County, a locality whose cultural context differs from that of Kiambu County, necessitating the current study. This study will attempt to find out if the metacognitive strategies employed by students are related to their mathematics performance so that appropriate interventions can be put in place to enhance such strategies for the benefit of students.

Most of the research reviewed on metacognitive strategies and mathematics performance is carried out in Western countries like the Philippines, Indonesia, Turkey, Pakistan, and Singapore, where schooling and home conditions are different from those of Kenya. Notably, the findings derived from such studies may not be readily generalizable to other populations, such as Kenya, where cultural diversities significantly influence educational dynamics. It is hypothesized that the association between metacognitive strategies and mathematics performance may be contingent upon various factors, including locale, level of study, and academic field of study (Nongtdu & Bhutia, 2017). Consequently, the significance of studies like this lies in their capacity to facilitate comparative examination across diverse educational and cultural contexts.

Theoretical Framework

Schraw and Moshman (1995) derived the metacognitive theory from Flavell's (1978) metacognition theory. They proposed that learning is maximized when students learn to think about their thinking and knowingly employ metacognitive strategies (Schraw & Moshman, 1995). The metacognitive theory highlights the role of metacognitive experiences, including the awareness and monitoring of cognitive processes. This model recognizes when one understands or does not understand a concept. In addition, this theory is aware of one's level of confidence in problem-solving. Based on metacognitive theory, Schraw and Moshman (1995) indicated that metacognition involves three metacognitive strategies: planning, monitoring, and evaluation strategies. Planning strategy is defined as the selection of the appropriate strategies and the allocation of the resources that affect performance. They include making predictions, strategizing, sequencing, allocating time and attention selectively before beginning a task. Monitoring strategy, on the other hand, is defined as the awareness of comprehension and task performance. Awareness of actions that an individual needs to follow to organize cognitive processes and the ability to engage in periodic self-testing while learning. Finally, the evaluation strategy is appraising and regulating processes of one's learning and thinking.

This theory was appropriate to this study due to its multidimensional approach to metacognitive strategies, alongside increasing the understanding of how metacognitive strategies interact to facilitate high mathematics scores among learners. Additionally, the model offers educators a theoretical foundation for understanding challenges of learning and cognition, as well as how the model can be applied to instructional design to create a more effective learning climate. Researchers (Bria & Mbato, 2019; Centino & Sebial, 2023; Kusaka & Ndiokubwayo, 2022; Obote, 2021) utilized the model to investigate the research hypothesis concerning the relationship between metacognitive strategies and mathematics performance. Despite variations in research design, study locale, and participants, the findings of these studies contributed to the understanding of the teachers' role in the learning processes, learners' knowledge and understanding of their strengths and weaknesses to aid in the selection of individualized learning strategies and metacognitive skills necessary for improved mathematics education.

Material and Methods

Design

A correlational research design was employed in this current study. According to Mishra and Alok (2017), a correlational research design is utilized to assess the strength of the relationship between multiple variables without altering them, making it a suitable design for this study.

Research Methodology

Quantitative methods were utilized in this research, whereby questionnaires were used in data collection. Quantitative research involves gathering and examining numbers to characterize phenomena, identify relationships, or test hypotheses. This technique is, however, cheap, fast, and takes less time to collect a lot of data (Mackey & Gass, 2015).

Participants of the Study

The anticipated number of participants was attained using the Yamane (1967) formula. A total of 441 from three students were purposively selected. The study involved 10 public secondary schools, with 2 boarding boys', 3 boarding girls', and 5 mixed schools. Notably, a response rate of 95.46% was realized, with a sample of 421 students used in analysis. The 20 students missing in the final list of respondents used for data analysis failed to fill out the questionnaire fully.

Data Collection Instruments

The researcher adapted self-report questionnaires in data collection. Metacognitive Awareness Inventory (MAI; Tak *et al.* 2022) was adapted. In determining whether multiple items that were intended to measure the general construct resulted in similar scores, the internal consistency method was crucial. The instrument sub-scales were reliable—planning ($\alpha = .78$), monitoring ($\alpha = .74$), and evaluation ($\alpha = .71$). Instruments that have a Cronbach alpha of .7 or higher are reliable to be used in studies (Wallen & Fraenkel, 2013). The instrument is a 30-item tool consisting of four sub-levels: declarative knowledge, procedural knowledge, conditional knowledge, and metacognitive strategies. In the study, only 16 items were adapted to measure the specific metacognitive strategies under study: planning,

monitoring, and evaluation. The items were rated on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). Scoring entailed computation of a global score, with scores above 64 denoting higher metacognitive strategies. The researcher reviewed teachers' mathematics assessment records for the end of term two for the year 2024 to obtain the mathematics performance of the students in form three. The Pearson product-moment correlation coefficient was employed. This test is utilized when assessing the correlation between two variables, assuming that both variables follow a normal distribution. Additionally, a test for independent samples was used to test gender differences in metacognitive strategies. Further, multiple regression was utilized to test the predictive weight of the metacognitive strategies scale on mathematics performance. This test is used in investigating the correlation between a single dependent variable and several independent variables.

Data Collection

The researcher explained the wide purpose of the research; sought consent, and participants were assured confidentiality of the information they provided. The participants were allowed to fill questionnaire during the prep time or supervised study time, and it took 20 minutes. The researcher additionally took measures to ensure that respondents involved in the research were not subjected to any risks. The students were assured of confidentiality, with their participation required to be voluntary. Further, the researcher was permitted under the license number, NACOSTI/P/24/414515, ascertaining data ethically with the necessary permission.

Results

The main goal of this research was to investigate how metacognitive strategies correlate with mathematics achievement among three students in public secondary schools.

Descriptive Statistics

Descriptive statistics serve as a crucial tool for data investigation, laying the foundation for meaningful inferential analyses. Table 1 presents the descriptive statistics of metacognitive strategies.

Table 1. Descriptive Statistics for Students' Metacognitive Strategies

<i>N</i>	Range	<i>Min</i>	<i>Max</i>	<i>M</i>	<i>SD</i>	<i>Sk</i>	<i>Kur</i>
421	57	23	80	54.57	9.06	-0.04	-0.07

Note. *Min* = Minimum; *Max* = Maximum *M* = Mean; *SD* = Standard Deviation; *Sk* = Skewness; *Kur* = Kurtosis

Findings, as shown in Table 1, indicated minimum and maximum scores for the scale were 23 and 80, respectively, with a range of 57. The mean score was 54.57 (*SD*= 9.06), while the coefficient of skewness was -.05. This implies that students rated themselves as having higher metacognitive strategies. This implied that most students applied various metacognitive strategies when solving mathematical problems. The skewness (*Sk* = -0.04) and kurtosis (*Kur* = - 0.07) scores suggest the normality of the distribution. As per the guidelines by Sharma and Ojha (2020), scores between ± 1 and ± 10 for skewness and kurtosis, respectively, are within the thresholds for a normal distribution. Table 2 highlights gender differences in Mathematics performance.

Table 2. Gender Differences in Mathematics Performance

	<i>N</i>	Range	<i>Min</i>	<i>Max</i>	<i>M</i>	<i>SD</i>	<i>Sk</i>	<i>Kur</i>
Male	186	58	4	62	32.13	15.49	0.05	-1.07
Female	235	90	1	99	31.09	22.07	0.87	-0.16

Note. *N*=421 *Min*= Minimum; *Max*= Maximum *M* = Mean; *SD* = Standard Deviation; *Sk* = Skewness; *Kur* = Kurtosis

As depicted in Table 2, the mean for the mathematics performance t-score for boys was (*M* = 32.13, *SD* = 15.49) and for girls was (*M* = 31.09, *SD* = 22.07). Notably, the difference between the boys' and girls' means in mathematics was significant, $t(419) = 0.55$, $p < .001$. Therefore, this meant that boys performed generally better compared to girls. Table 3 presents gender differences in metacognitive strategies.

Table 3. Gender Differences in Metacognitive Strategies

Gender	<i>N</i>	<i>M</i>	<i>SD</i>
Male	186	53.10	8.23
Female	235	55.73	9.52
Total	421	54.57	9.06

Note. *N* = 421; *M* = Mean; *SD* = Standard Deviation

As depicted in Table 3, girls ($M = 55.73$, $SD = 9.52$) had a comparatively higher score on average on the use of metacognitive strategies as compared to boys ($M = 53.10$, $SD = 8.23$). However, the difference between the metacognitive strategies across gender was not significant, $t(419) = -2.98$, $p > .05$. This implied that both girls and boys had relatively similar perceptions of their metacognitive strategies.

Hypothesis Testing

Results on the relationship between metacognitive strategies and mathematics performance are presented in Table 4.

Table 4. Correlation between Metacognitive Strategies and Mathematics Performance

Metacognitive Strategies	<i>r</i>	<i>df</i>
Mathematics Performance	.26**	419

Note. ** = Correlation significant at .01 level (2-tailed)

As highlighted in Table 4, there was a significant weak positive relationship between respondents' metacognitive strategies and mathematics performance, $r(419) = .26$, $p < .01$ —the effect size in this study was small. This meant that there is a meaningful relationship between metacognitive strategies (the ability to plan, monitor, and evaluate one's own cognitive processes when handling problem-solving activities) and mathematics performance (the level of success attained in educational pursuits). Therefore, individuals who demonstrate high levels of metacognitive strategies tend to attain high scores in mathematics. Additionally, analysis was conducted to identify how metacognitive strategies predicted mathematics performance in the predictive model. The study's findings are presented in Table 5.

Table 5. Beta Coefficient for the Prediction of Mathematics Performance from Metacognitive Strategies Scale

Model	Unstandardized Coefficients		Standardized	<i>t</i>	<i>sig</i>
	<i>B</i>	<i>SE</i>	<i>B</i>		
(Constant)	1.37	5.60		0.25	.81
MS	0.55	0.10	0.26	5.46	.001

Note. *SE* = Standard Error; *MS* = Metacognitive Strategies

Data in Table 5 showed that metacognitive strategies significantly predicted mathematics performance ($\beta = .26$, $p < .001$). This indicates that variations in metacognitive strategies do not meaningfully influence the dependent variable in this model.

Discussion

Findings of this research showed that there was a significant relationship between metacognitive strategies and mathematics performance. The study supported Schraw and Moshman's (1995) model in emphasizing the role of metacognitive strategies in enhancing problem-solving abilities. The model suggests that learning is maximized when learners develop awareness of their cognitive processes. The positive significant relationship (positive Pearson correlation coefficient index) of metacognitive strategies, planning, monitoring, and evaluation strategy meant that an increased usage of metacognitive skills will lead to an increased mathematics score. The study extends Schraw and Moshman's (1995) metacognitive theory by empirically demonstrating how cognitive knowledge and self-

regulation interact to influence academic performance. The theory's premise that learners can consciously monitor cognitive processes is substantiated through the observed positive relationship between metacognitive strategies and mathematical achievement.

The observed association between metacognitive strategies and mathematics performance agrees with the findings of the prior study conducted by Centino and Sebial (2023) in the Philippines. The study investigated how students' metacognitive strategies influence mathematics performance. These studies have revealed similar findings to the current study, regardless of the study designs and population. While Centino and Sebial carried out their research using a Philippian sample, these studies found that students developing robust metacognitive skills became more adept at recognizing cognitive strengths and weaknesses, enabling targeted learning interventions and systematic mathematical problem-solving strategies. Further, Centino and Sebial's (2023) revealed a predictive weight almost synonymous to the one obtained in the current study, $\beta = .26$, $p < .001$. Notably, the synonymous weak correlation and predictive weight suggest that there could be other factors that affect mathematics more profoundly, especially owing to the subject's need for problem-solving skills and the teacher's efficacy.

Notably, mathematics often requires problem-solving skills that academic resilience alone cannot compensate for. While academic resilience may help with persistence, it necessarily does not directly translate to higher mathematics performance, explaining the two variables' weak relationship.

Notably, current research aligns with Kusaka and Ndiokubwayo's (2022) study, which was conducted using a Rwandan sample. The study explored metacognitive skills and mathematics performance. Though the study used a mixed-method research design provided comparable insights into metacognitive strategies and their influence on mathematics performance. Research implication was that despite the cultural differences among the students, the learners who effectively self-regulate learning processes develop more systematic approaches to mathematical reasoning, breaking complex problems into manageable components and constructing strategic solution pathways.

Additionally, the current research study concurred with Obote's (2021) study carried out among Kenyan high school students. Despite the study utilizing the quasi-experimental research design, the study established the metacognitive strategies' instrumental role in mathematical problem-solving. Obote's research utilized pre-tests and post-tests, demonstrating statistically significant differences in problem-solving abilities between experimental and control groups. The experimental group, exposed to metacognitive teaching strategies, consistently outperformed the control group. Research implications of these studies are that, through encouraging reflective learning processes and strategic thinking, educators can facilitate more profound mathematical understanding, helping students transcend rote memorization and develop adaptable mathematical reasoning skills.

Limitations

This research involved form three students from selected secondary schools within Githunguri Sub-County, Kiambu County. The data was collected utilizing self-report questionnaires, and this may affect the results through biased self-reports. The researcher used a correlational research design, which does not establish a cause-and-effect relationship. It is therefore necessary to conduct similar research with different designs, like longitudinal and experimental research designs, to compare the results. Further, the findings of this study have a high external validity among form three students in Kiambu County. However, the findings may be generalized to other secondary school students or form three students from different counties, though cautiously. Finally, the use of an adapted instrument without piloting posed a potential risk to the reliability of the study. Nevertheless, the researcher attempted to clarify any ambiguities that the students encountered while responding to the questionnaires.

Conclusions

The main objective of the research was to examine the relationship between metacognitive strategies and mathematics performance. Research findings indicated a weak but significant relationship between metacognitive strategies with mathematics performance. This implied that a higher student-reported metacognitive strategies score was more likely to be associated with higher mathematics performance. This meant that the learner's ability to

plan, monitor, and evaluate problem-solving activities may increase the learner's mathematics performance. Notably, as students' metacognitive strategies increased, there was a modest improvement in mathematics achievement. Therefore, it was recommended that teachers and all educational stakeholders strive in order to come up with appropriate interventions and programs to nurture metacognitive skills among the learners. Among the interventions and programs would be explicitly teaching metacognitive strategies to students, where the teacher should model to the learners how to think about thinking. Further, problem-based and inquiry-based learning would be used as interventions to improve the students' metacognitive skills. Particularly, engaging learners in real-world mathematical problems that necessitate reasoning and reflection would hone their metacognitive skills. The metacognitive theory (Schraw & Moshman, 1995) places a strong emphasis on the need for educators to strive to create a flexible classroom environment to enable learners to develop awareness of their cognitive processes in learning. These interventions will help learners develop learning metacognitive skills, which in turn will enhance their academic performance.

Acknowledgement

I am grateful to the Almighty God and to the entire Educational Psychology fraternity for the positive criticisms during the seminars. Gratitude to high school principals, teachers, and students for providing support during the data collection. My heartfelt gratitude goes to my parents, Peter Muturi and Jacinta Wanjiku, for their academic and moral support to make sure I achieve my education. My gratitude also goes to my colleagues and friends who offered academic and moral support throughout this academic journey.

Funding

This study was not funded by any organization or institution.

References

- Andriani, E., & Mbato, C. L. (2021). Male and female Indonesian EFL undergraduate students' metacognitive strategies in academic reading: planning, monitoring, and evaluation strategies. *Journal on English as a Foreign Language*, 11(2), 275-296. <https://doi.org/10.23971/jeft.v11i2.3006>
- Attard, C., & Holmes, K. (2020). "It gives you that sense of hope": An exploration of technology uses to mediate student engagement with mathematics. *Heliyon*, 6(1), e02945. <https://doi.org/10.1016/j.heliyon.2019.e02945>
- Bria, M. G., & Mbato, C. L. (2019). Metacognitive strategies of undergraduate and postgraduate students in reading. *LLT Journal: A Journal on Language and Language Teaching*, 22(2), 182-197. <https://e-journal.usd.ac.id/index.php/LLT/article/view/1779>
- Centino, S. V., & Sebial, S. C. L. (2023). Learning skills, strategies, and students' mathematics performance in distance education: A structural equation modeling analysis. *International Journal of Multidisciplinary Approach and Studies*, 10(1), 72-103. <https://www.researchgate.net/profile/Starr-Clyde-Sebial/publication/368752690>
- Chand, S., Chaudhary, K., Prasad, A., & Chand, V. (2021). Perceived causes of students' poor performance in mathematics: A case study at Ba and Tavua secondary schools. *Frontiers in Applied Mathematics and Statistics*, 7, 614408. <https://doi.org/10.3389/fams.2021.614408>
- Dündar, S. (2019). The relationships among metacognitive awareness, metacognitive strategy use, and mathematics achievement. *International Journal of Instruction*, 12(3), 153-168. <https://doi.org/10.29333/iji.2019.12310a>
- Flavell, J. H. (1978). Metacognitive development. In Scandura, J. M., & Brainerd, C. J. (Eds.). (1978). *Structural/process models of complex human behavior* (pp 213-245). Springer Science & Business Media.
- Izmirli, S., & Izmirli, I. M. (2020). The relationship between metacognitive awareness and mathematical achievement: the mediating role of self-efficacy. *Educational Studies*, 46(4), 525-540. <https://doi.org/10.1080/03055698.2019.1620694>
- Kenya National Examination Council. (2022). *2022 KCSE examination essential statistics*. <https://knec.ac.ke/wp-content/uploads/2023/01/2022-KCSE-EXAMINATION-ESSENTIAL-STATISTICS.pdf>
- Küçükakça, H., Kesici, A., & Lee, J. E. (2022). The effect of using metacognitive strategies in mathematics lesson on students' metacognitive awareness. *Journal of the Korean Society of Mathematical Education*, 25(4), 245-266. <https://doi.org/10.7468/jksmed.2022.25.4.245>

- Kusaka, S., & Ndiokubwayo, K. (2022). Metacognitive strategies in solving mathematical word problems: A case of Rwandan primary school learners. *SN Social Sciences*, 2, 186. <https://doi.org/10.1007/s43545-022-00495-5>
- Lestari, W., & Jailani. (2018). Enhancing an ability mathematical reasoning through metacognitive strategies. In *Journal of Physics: Conference Series* (Vol. 1097, p. 012117). IOP Publishing. <https://doi.org/10.1088/1742-6596/1097/1/012117>
- Mackey, A., & Gass, S. M. (2015). *Second language research: Methodology and design* (2nd ed.). Routledge. <https://doi.org/10.4324/9781315750606>
- Mishra, S. B., & Alok, S. (2017). *Handbook of Research Methodology*. Educreation Publishing.
- Ndidi, M. A., & Effiong, I. E. (2020). Influence of classroom environment on senior secondary school students' academic achievement in mathematics in Calabar Nigeria. *Educational Research and Reviews*, 15(8), 495-503. <https://files.eric.ed.gov/fulltext/EJ1264041.pdf>
- Nongtdu, S., & Bhutia, Y. (2017). Locus of control in relation to academic achievement of college students in Meghalaya. In *4th International Conference on Multidisciplinary Research & Practice* (pp. 159-165). <https://www.academia.edu/download/124529402/ijriss.2023.pdf#page=168>
- Obote, D. (2021). The role of metacognitive teaching strategies on students on problem-solving abilities in public secondary schools in Tharaka south sub-county, Kenya [Master thesis, Tharaka University]. Tharaka University Repository. <http://repository.tharaka.ac.ke/xmlui/handle/1/4308>
- Ong'uti, C. O., Aloka, P. J., & Nyakinda, J. O. (2019). Metacognitive monitoring as predictor of mathematics achievement among students in public secondary schools in Kenya. *International Journal of Psychology and Behavioral Sciences*, 9(1), 1-7. <http://article.sapub.org/10.5923.j.ijpbs.20190901.01.html>
- Panaoura, R. (2021). Parental involvement in children's mathematics learning before and during the period of the COVID-19. *Social Education Research*, 65-74. <https://doi.org/10.37256/ser.212021547>
- Ryve, A., & Hemmi, K. (2019). Educational policy to improve mathematics instruction at scale: Conceptualizing contextual factors. *Educational Studies in Mathematics*, 102, 379-394. <https://doi.org/10.1007/s10649-019-09887-6>
- Schraw, G., & Moshman, D. (1995). Metacognitive theories. *Educational Psychology Review*, 7(4), 351-371. <https://doi.org/10.1007/BF02212307>
- Sharma, C., & Ojha, C. S. P. (2020). Statistical parameters of hydro meteorological variables: standard deviation, SNR, skewness and kurtosis. In *Advances in water resources engineering and management: select proceedings of TRACE 2018* (pp. 59-70). Springer Singapore. https://doi.org/10.1007/978-981-13-8181-2_5
- Tak, C. C., Zulnadi, H., & Eu, L. K. (2022). Measurement model testing: adaption of metacognitive awareness toward mathematic reasoning among undergraduate education students. *Contemporary Mathematics and Science Education*, 3(2), ep22021. <https://doi.org/10.30935/conmaths/12510>
- Voskoglou, M. (2019). Comparing teaching methods of mathematics at university level. *Education Sciences*, 9(3), 204. <https://doi.org/10.3390/educsci9030204>
- Wallen, N. E., & Fraenkel, J. R. (2013). *Educational research: A guide to the process*. Routledge.
- Yamane, T. (1967). *Statistics: An Introductory Analysis* (2nd ed.). Harper and Row.
- Zakariya, Y. F., Nilsen, H. K., Bjørkestøl, K., & Goodchild, S. (2023). Analysis of relationships between prior knowledge, approaches to learning, and mathematics performance among engineering students. *International Journal of Mathematical Education in Science and Technology*, 54(6), 1015-1033. <https://doi.org/10.1080/0020739X.2021.1984596>