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Problem-Solving Strategies as Predictors of Mathematics Achievement Among Form Three Students in Machakos County, Kenya

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ABSTRACT

Mathematics achievement has been a persistent problem among secondary school students in Machakos County in Kenya, with students obtaining poor grades in the KCSE mathematics exams for the past five years. These results limit students' access to STEM education and careers and compromise their problem-solving skills in their daily lives. The study sought to examine the relationships between problem-solving strategies andmathematics achievement of Form Three students in Machakos Sub-County, Kenya. This study was anchored on the Theory of Problem-Solving Behavior by Tallman, which describes how people use systematic strategies in problem-solving and resolving challenges. A correlational research design was used. The target population of the study was 4,903 students of Form Three from 44 public secondary schools in Machakos Sub-County. A sample of 338 students was drawn using Yamane's formula, purposive, stratified and simple random sampling. The Problem Solving Strategies Scale (Rudd) and students' mathematics achievement forms were used to gather information. Descriptive and inferential statistics were used to describe and test quantitative data for significance. The results showed a positive correlation between mathematics problem-solving strategies and mathematics achievement, r (327) =.60, p<.05. Use of formulas, pattern recognition, drawing pictures, eliminating possibilities and reading, rereading and summarizing positively predicted mathematics achievement, whereas guessing and checking negatively predicted achievement in the subject. The study suggests the need to incorporate problem-solving strategies, mathematics support and teacher training to enhance mathematics achievement and learners' critical thinking and STEM engagement.

INTRODUCTION

Mathematics is essential in many aspects of life since most of the decisions that individuals make require mathematical knowledge. It is imperative to note that adequate numeracy competencieshelps individuals to build personal and social confidence in the course of carrying out their daily endeavors (Schleicher, 2023). Conversely, lack of numeracy skills leads to loss of confidence and self-esteem among individuals. Studies conducted in the past have shown that there is a positive correlation between the level of mathematics skills, high school completion rates, future career decisions, and future career success (Stern, 2023). Moreover, mathematical skills, knowledge and quality mathematics achievement allow students to resolve complicated problems in life (Kidman *et al.*, 2020). Mathematics is known as one of the major areas of STEM subjects that are instrumental in social and economic development (Fitzmaurice *et al.*, 2021). It is thus crucial that countries around the world should strive to enhance performance in mathematics, particularly in low and middle-income countries (LMICs). Owing to the significance of mathematics, several countries have persisted in augmenting investment in the education sector in order to enhance academic success in the subject. Nevertheless, poor performance in mathematics remains anissue of concern all over the world.

In Kenya, most of the students have been registering below average grades in mathematics KCSE. Researchers have been undertaking studies in different counties to determine the factors behind poor performance in mathematics. According to Githaiga (2020), the poor performance is associated with poor teaching methods and negative attitude towards mathematics. In Kiambu County, poor numeracy skills among primary school pupils is linked to poor performance in the subject (Maina, 2020). The poor numeracy skills were reported to contribute to low performance in KCSE. Kamau (2020) revealed that the aspects related to this low numeracy skills are insufficient learning resources and physical facilities.

According to the Kenya National Examinations Council (KNEC) statistics, majority of the students have been registering below average grades in mathematics in national examinations. Machakos Sub-County is one of the Counties that have been registering poor performance in mathematics. For aperiod of five years, the Sub-County consistently registered poor performance in mathematics in KCSE. The Sub-County's KCSE mathematics mean scores for the years 2019, 2020, 2021,2022 and 2023 were (2.49D-), (2.29D-), (2.22D-), (1.69D-) and (1.97D-) respectively. This shows that majority of the students have been scoring grade D and below. Studies that have been carried out also confirm that poor academic performance in mathematics in Machakos Sub-County has been an issue of concern. According to Mulungye (2023), the average mathematics failure rate in 2010-2017

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was 72.68% at KCSE in Machakos Sub-County. Quality of instruction was pointed out as the major cause of this low success. On the same note, poor performance was evident in Mwala Sub-County in Machakos County (Mutisya, 2019). The poor achievement was attributed to poor instruction strategies and techniques.

Poor performance in mathematics has also been linked to factors such as poor study habits, low interest, and inadequate instructional resources (Landicho, 2021). On the same note, other factors such as teaching strategies, attitude of teachers and students also affect performance in mathematics in secondary schools. Parental influence, learning environment, gender, and past mathematics performance of students have also been found to affect mathematics performance(Ayebele *et al.*, 2020). Mabena *et al.* (2021) found that mathematics performance among students in South Africa depends on a number of factors. These include discipline, attitude of the learners, language barrier, poor pedagogical content knowledge and skills of the teachers and professional training of the teachers.

In Kenya, entry marks, absenteeism of students, poor teachers, poor teaching methods and poor assessment techniques are some of the major factors associated with poor performance in mathematics in secondary schools (Kamau *et al.*, 2020). From the reviewed literature, there is limited research on the role of mathematics anxiety and problem-solving strategies in mathematics achievement, especially in Machakos Sub County, Kenya. Nevertheless, research findings like the one by Barroso *et al.* (2021) have revealed that the statistical evidence on the variations between the performance of students and mathematics anxiety is significant, students with high mathematics anxiety scores receive low mathematics grades. This gap was addressed in the current study by focusing on mathematics problem-solving strategies as predictors of mathematics achievement in Machakos Sub County.

Mathematics problem-solving strategies have been given different definitions by different education scholars. According to Klang *et al.* (2021), mathematics problem-solving strategies refers to the techniques that students use to solve mathematicalproblems. These strategies are characterized by the plans of action applied to arrive at a solution in problem solving. Some of the mathematics problem-solving strategies that students use include, use of a formula, which entails using a step-by–step approach to solving a mathematical problem (Marais, 2022). Guess and check the answer is also used by the students who continue to make guesses until they find the right answer (Kaminski, 2023). Others apply pattern method, which involves seeking relevant analysis that constitute pattern.

Mathematics problem-solving strategies has been an area of academic interest and researchers have revealed a positive relationship with mathematics achievement. The ability to solve problems is of essential significance to mathematics since it offers a foundation to study concepts, and derive suitable mathematical reasoning and deductions to address mathematical problems (Prema, 2021). In the same manner, students who study mathematics using problem solving-strategy performs much better compared to students who studied mathematics using conventional method (Mehar, 2019). Strategies aimed at solving problems gradually enhance the performance of students in mathematics (Fredy*et al.*, 2021). Kaburu *et al.* (2022) examined the connection between mathematics performance and problem-solving strategies in a study of form three students in Nakuru County. The research indicated that mathematics performance and problem-solving strategies had a positive significant relationship. Research on the influence of the application of problem-solving-strategies on in mathematics achievement has received little attention inMachakos county, a gap this study aimed to fill.

Statement of the Problem

Low performance in mathematics in Machakos County has been an issue of concern. Over the last five years, the mathematics mean scores were as follows; 2019(2.49D-), 2020(2.29D-), 2021(2.22D), 2022(1.69D-) and 2023(1.97D-). In Kenyan secondary schools, mathematics is a compulsory subject. It is a key subject in STEM and all the other sciences. Therefore, continuous low performance in the subject can hinder social and economic growth and realization of vision 2030. The affected students might fail to secure opportunities to take courses in mathematics field and technology in institutions of higher learning. The affected students also might lack properproblem solving skills thus failing to realize their full potential in life.

Considering the increased investment in the education sector with the aim to improve the quality of academic achievement, it is expected that majority of the students should score above average grades in mathematics. But this has not happened in Machakos County. There was need thereforefor this study to address the issue of underperformance to provide empirical evidence that may be used to mitigate it. This could assist in ensuring that the students in the sub-county gain sufficient skills and knowledge to solve life problems, and to improve their chances of pursuing STEM courses which are important in the Kenyan economy.

Purpose of the Study

The research examined problem-solving strategies as predictors of academic achievement in mathematics among form three students in Machakos Sub-County, with the goal of providing research evidence that may be used to enhance mathematics achievement among secondary school students.

LITERATURE REVIEW

Numerous studies on the relationship between problem-solving strategies and the performance of Toraman *et al.* (2020) students in mathematics have been conducted in various learning environments. The essence of problem-solving is generally accepted as a major part of mathematics learning because it facilitates

conceptual knowledge, critical thinking and application of knowledge to new problem situations. explored the connection between mathematics performance, metacognitive awareness, and reflective thinking in solving mathematical problems among seventh-grade students in Ankara, Turkey. The research used correlational research design with a sampleof 412 students in two schools. Structured questionnaires were used to obtain the data on metacognitive awareness, reflective thinking, and mathematics achievement scores.The correlation and regression results showed that there is a significant positive correlation between reflective thinking in solving problems and mathematics performance of students. Moreover, metacognitive awareness was also observed to have a significant predictive value on reflective thinking and mathematics performance. These results indicate that learners who are better conscious of their cognitive processes, and those who are in a thinking reflective group, have a higher performance in mathematics. However, issues associated with the Turkish educational setting are limiting and they may not be generalized to other parts of the world like Kenya. The variation in curriculum implementation, teacher training and instructions practices can affect the efficacy of metacognitive and reflective strategies. This brings a contextual gap, which should be further explored in various learning settings.

Hazmi (2023) conducted a related study and found that problem-solving approaches affected the attitude and achievement in mathematics among Saudi Arabia students. The research design applied was pretest- posttest control group research in a mixed-method study with a sample of 60 middle school students.The findings proved that students taught through problem-solving instructional strategies performed better compared to those taught through traditional lecture-based teaching. The students who were introduced to problem solving strategies had more positive disposition towards mathematics. Such results reveal the twofold advantage of problem-solving teaching in improving both cognitive and affective involvement.

Although these results were positive, the small sample size and the narrow geographical scope of the analysis limit external validity of the results. Therefore, it is not clear how these findings are applicable to other larger and more diverse populations like secondary school students in Kenya. This highlights the necessity of research that has wider samples and alternative methodological designs to confirm these results in other settings.

Tambunan (2019) investigated the impact of problem-solving strategies on the performance in mathematics among students in Indonesia. The research design used was quasi experimental with pretest posttest control groups. The participants in the study were 138 students in the experimental group and 139 students in the control group.The study employed the use of essay-based tests to assess the creativity of the students, communication skills, problem-solving capacity, and mathematical reasoning abilities of the students. The results indicated that students who were taught the problem-solving techniques performed better in terms of creativity, communication and mathematical reasoning than those taught using the traditional scientific methods.

Despite the fact that the quasi-experimental design enabled the comparison of groups, it can be affected by the selection bias because it did not randomly assign participants. This constraint can have an impact on the internal validity of the research. On the contrary, correlational studies are capable of giving information on naturally occurring relationships between variables even though they cannot create a cause and effect relationship. The current study followed the correlational design to supplement the available experimental evidence and also to contribute to the overall knowledge of problem-solving and mathematics achievement.

Lapite *et al.* (2022) explored how attributional style affects mathematics performance in students in the state of Lagos, Nigeria. The research used a sequential explanatory mixed-method design with a population of 300 students of two senior secondary schools. The data collection tools were mathematics performance scores, Attributional Style Questionnaire (ASQ), and focus group interviews.Quantitative analysis results showed that there was no significant correlation between mathematics performance and attributional style.Qualitative data also offered information regarding the perception of students on success and failure in mathematics. The findings of this research are contrary to the findings of other researchers who have found positive correlations between academic performance and psychological constructs.This relationship may be moderated by factors like instructional practices, cultural differences and educational environments. This inconsistency underscores the need to conduct additional studies to streamline the contribution of attributional styles towards learning mathematics especially in the Kenyan context.

The effectiveness of problem-solving instructional strategies is also supported by the research that was carried out in Kenya. Kigamba *et al.* (2020) examined how problem-solving methods affect the mathematics performance of students in Murang'a County. The Solomon Four Group Model was utilized in the study which adopted a quasi-experimental design and a large sample population of 544 pupils and 16 teachers who were selected through 16 schools.Mathematics achievement tests were used in the study as the measure of performance outcomes, and the pretest and posttest were conducted before and after the intervention. These results showed that students who received problem-solving instructional strategies performed better than those who were taught the conventional methods. These findings support the idea that problem-solving strategies would improve knowledge and practice of mathematical concepts among students.Although the study has strong points, such as a relatively large sample size and a strong experimental design, the quasi-experimental nature could still not avoid the impact of possible confounding factors.

Also, the emphasis on primary school students restricts its use to secondary school settings, especially to Form Three students, who might have different cognitive and developmental features.

MATERIALS AND METHODS

The study used a correlational research design to investigate how the variables relate to one another. According to Johnson and Christensen (2019), correlational design enable researchers to investigate the association between two or more variables, including the nature of these associations and their strength. They also enable researchers to test their research hypotheses. The researcher collected data from the participants during their usual days at school; no experiments or changes to the setting were done. The method was appropriate for the purpose of investigating the association between math anxiety, math strategies, and math achievement.

The study targeted a population of 4903 form three students from 44 public schools in Machakos Sub-County in 2025. Form three students were chosen as respondents in the study for having been in school for a relatively longer time thus expected to have developed relatively stable mathematics anxiety and mathematics problem solving strategies. The target schools were categorized into girls boarding, boys boarding, mixed boarding, and mixed day.

Purposive, stratified and simple random sampling methods were used. Purposive sampling was used to select three public secondary schools from Machakos Sub-County. Stratified sampling was applied in four types of schools: girls' boarding, boys' boarding, mixed (girls and boys) day and mixed boarding. Simple random sampling was applied to select the sample of students. The sample size was calculated using Yamane's formula. The sample size was 338.

The researcher used Rudd (2010) Problem Solving Strategies Scale (reliability = 0.82) to measure students' mathematics problem-solving strategies. The questionnaire contained 18 items that assessed six strategies: formula use, guessing and checking, pattern recognition, drawing symbols, elimination and reading/ re-reading. The items were rated on a 5-point Likert scale (1-5). The total range of scores was 18-90, with ≤54 considered as low and 55-90 high in problem solving. Students' mathematics achievement was assessed via a students' achievement form.

The questionnaires were coded in order to make sure that they were properly filled to qualify to be analyzed. The questionnaires were indexed and entered into the computer software for simple access and reference after the data collection process. To avoid permanent loss of data, the raw data and the output data were stored and backups made on various storage means. The data was analyzed by both quantitative and qualitative methods. The SPSS was used to analyze the quantitative data of the questionnaires. In order to analyze the data, the researcher used both descriptive and inferential statistics.

RESULTS AND DISCUSSION

Background Information of the Respondents

Table 1 presents the results of a descriptive statistical analysis that explored gender-based differences in mathematics problem solving strategies.

As Table 1 shows, the females recorded a higher mean of 46.63 (SD = 4.76). Their minimum was 27.00 and their maximum was 60.00, giving a range of 33.00. On the other hand, the males recorded a mean of 42.99 (SD = 7.23). Similarly, their minimum was 27.00 and their maximum was 60.00, giving a range of 33.00. This shows that the female students had stronger mathematics problem-solving strategiescompared to male students. This implies there were gender-based differences in mathematics problem-solving strategies.

Table 1: Descriptive Statistics of Mathematics Problem-Solving Strategies By Gender

Gender	N	Min	Max	R	M	SD	Kur	Sk
Male	160	27.00	60.00	33.00	42.99	7.23	.13	.04
Female	167	27.00	60.00	33.00	46.63	4.76	2.18	.24
Total	327	27.00	60.00	33.00	44.85	6.35	.86	-.24

Table 2 presents the results of a descriptive statistical analysis that explored differences in mathematics problem solving strategies by subscales.

As shown on Table 2, the subscale of reading rereading and summarizing obtained a higher mean score of 16.69 (SD=2.70). Its lowest and highest scores were 10 and

Table 2: Descriptive Statistics of Mathematics Problem-Solving Strategies by the Sub Scales

	N	R	Min	Max	M	SD	Sk	Kur
Using formula	327	4.00	2.00	6.00	4.28	1.36	-.21	-1.04
Guessing Checking	327	9.00	2.00	11.00	6.52	1.25	-.43	1.30
Looking for pattern	327	7.00	2.00	9.00	4.19	1..45	-.08	-.93
Drawing Picture	327	14.00	4.00	18.00	8.57	2.45	.15	.19
Eliminating possibilities	327	7.00	3.00	10.00	8.54	1.56	-1.18	.91
Reading rereading Summarizing	327	12.00	10.00	22.00	16.69	2.70	-.28	-.79

22 respectively, giving a range of 12. Drawing picture followed with a mean score of 8.57(SD=2.45). Its lowest and highest scores were 4 and 18 respectively, giving a range of 14. Looking for pattern recorded the lowest mean score of 4.19 (SD=1.45). Its lowest and highest scores were 2 and 9 respectively, giving a range of 7. The results imply there were differences in mathematics problem solving strategies based on subscales.

Hypothesis Testing

The study sought to establish the correlation between mathematics problem-solving strategies and mathematics achievement, the following null hypothesis was advanced.

H02: There is no significant relationship between mathematics problem-solving strategies and mathematics and mathematics achievement.

To perform the analysis, the relationship between the six domains of problem-solving (using formula, guessing and checking, looking for pattern, drawing picture, eliminating possibilities and reading, rereading and summarizing) and mathematics achievement were determined using Pearson r as shown in Table 3

From Table 3, problem-solving score was positively and significantly correlated with mathematics achievement, r (327) = .60, p< .05. This led to rejection of the null hypothesis. The results imply that the higher the problem-solving, the higher the mathematics achievement. When the sub scales of problem-solving were examined, using

Table 3: Correlation between Subscales of Problem-Solving and Mathematics Achievement

		Maths Achievement
Problem solving	Pearson Correlation	.60**
	Sig. (2-tailed)	.00
	N	327
Using formula	Pearson Correlation	.59**
	Sig. (2-tailed)	.00
	N	327
Guessing Checking	Pearson Correlation	-.29**
	Sig. (2-tailed)	.00
	N	327
Looking for pattern	Pearson Correlation	.33**
	Sig. (2-tailed)	.00
	N	33
Drawing Picture	Pearson Correlation	.65**
	Sig. (2-tailed)	.00
	N	327
Eliminating possibilities	Pearson Correlation	.35**
	Sig. (2-tailed)	.00
	N	327
Reading rereading summarizing	Pearson Correlation	.73**
	Sig. (2-tailed)	.00
	N	327

formula was positively and significantly correlated with mathematics achievement, r (327) = .59, p<.05. The results suggest that the higher the using formula, the higher the mathematics achievement. Guessing and checking was negatively and significantly correlated with mathematics achievement, r (327) = -.29, p<.05. The results suggest that the higher the guessing and checking, the lower the mathematics achievement. Looking for pattern was positively and significantly correlated with mathematics achievement, r (327) = .33, p<.05. The results suggest that the higher the looking for a pattern, the higher the mathematics achievement. Drawing picture was positively and significantly correlated with mathematics achievement, r (327) = .65, p<.05. The results suggest that the higher the drawing picture, the higher the mathematics achievement. Eliminating possibilities was positively and significantly correlated with mathematics achievement, r (327) = .35, p<.05. The results suggest that the higher the eliminating possibilities, the higher the mathematics achievement. Finally, reading, rereading and summarizing was positively and significantly correlated with mathematics achievement, r (327) = .73, p<.05. The results suggest that the higher the reading, rereading and summarizing, the higher the mathematics achievement. Based on the findings that a significant relationship existed between problem solving and maths achievement, the predictive values of problem solving and its subscales, using formula, guessing and checking, looking for pattern,

drawing picture, eliminating possibilities, and reading, reading and summarizing were computed. The results are presented in Table 4.

Model fit: R = .50, R^2 = .25, Adjusted R^2 = .24, F(2, 324) = 53.31, p<.05.

From Table 4, the results reveal that problem solving positively and significantly predicted mathematics achievement (β = -0.32, t (327) = = 4.20, p <.05). This implies that a unit increase in problem-solving increases mathematics achievement by 0.32. Secondly, using formula sub scale positively and significantly predicted mathematics achievement (β = 1.71 t (327) = 3.59, p< .05). This implies that a unit increase in using formula increases mathematics achievement by 1.71. Thirdly, guessing and checking sub scale positively and non-significantly predicted mathematics achievement (β = .17 t (327) = 0.34 p<.05). This implies that a unit increase in guessing and checking increases mathematics achievement by .17. Further, results show that looking for pattern sub scale negatively and non-significantly predicted mathematics achievement (β = -0.07 t (327) = -0.16, p<.05). This implies that a unit increase in looking for pattern reduces mathematics achievement by 0.07. Drawing picture sub scale positively and non-significantly predicted mathematics achievement (β = 0.82 t (327) = 3.15, p = .2). This implies that a unit increase in using formula increases mathematics achievement by 0.82. Eliminating possibilities sub scale negatively and significantly predicted mathematics achievement (β = -2.89 t (327) = -6.75, p< . .05). This implies that a unit increase in eliminating possibilities reduces mathematics achievement by -2.89. Lastly, reading, rereading & summarizing sub scale positively and significantly predicted mathematics achievement (β = 2.46 t (327) = 10.60, p<.05). This implies that a unit increase in reading, rereading & summarizing increases mathematics achievement by 2.46.

Table 4: Multiple Regression Predicting Mathematics Achievement from Problem – Solving Strategies

Predictor	B	SE B	B	t	p
(Constant)	4.18	5.73	–	0.73	.47
Problem Solving	0.32	0.08	0.19	4.20	<.05
Using Formula	1.71	0.48	0.22	3.59	<.05
Guessing & Checking	0.17	0.49	0.02	0.34	.74
Looking for Pattern	-0.07	0.43	-0.01	-0.16	.88
Drawing Picture	0.82	0.26	0.19	3.15	.2
Eliminating Possibilities	-2.89	0.43	-0.43	-6.75	<.05
Reading, Rereading & Summarizing	2.46	0.23	0.63	10.60	<.05

The resulting prediction equation for mathematics achievement from problem solving is presented as follows:

$\hat{Y}$ = 4.18 +0.32 X1+1.71 X2+0.17 X3-0.07 X4+0.82 X5-2.89 X6+2.46 X7 + ε̇

Where $\hat{Y}$ = Predicted mathematics achievement; X1 = Problem Solving, X2 = Using Formula, X3 = Guessing and Checking, X4 = Looking for Pattern, X5= Drawing Picture, X6= Eliminating Possibilities, X7= Reading, Rereading and Summarizing, and ε̇ = standard error.

RESULTS AND DISCUSSION

The aim of the research was to establish the correlation between use of problem solving strategies in mathematics and mathematics performance. The results showed that there is a positive and statistically significant relationship where in case the ability to use problem-solving strategies is high, the level of achievement in mathematics is also high. This implies that learners who efficiently use organized problemsolving strategies have bigger chances of excelling in mathematics because of better reasoning and analysis ability.

The correlation of the sub-scales of problem-solving strategies and mathematics achievement showed that the use of formulas was positively and significantly related to mathematics achievement. This means that students who use formulaic methods often score better in mathematics because formulaic methods promote systematic and procedural problem solving.When the subscale of guessing and checking was examined, there was negative and significant relationship between guessing and checking and mathematics achievement. This implies that too much dependence on trial-and-error techniques can slow down performance in mathematics. High guessers may have no conceptual knowledge and logical thinking that might enable them to solve problems consistently.

Pattern seeking was positively and significantly related to mathematics achievement. The results suggest that learners who are able to identify and utilize patterns are more likely to perform better in mathematics. Pattern recognition promotes abstraction and allows learners to apply similar problems to similar solutions.A positive and significant correlation was observed between the achievement in mathematics and the ability to draw pictures. The findings indicate that the greater was the strategy of using drawing, the greater was the achievement in mathematics. Visual representations also help learners learn abstract mathematical concepts by rendering them into concrete forms.

The exclusion of possibilities had a positive and significant relationship with mathematics achievement. The findings indicate that students who effectively employ elimination strategies are more likely to record improved performance

in mathematics because the strategy helps to reduce the number of correct solutions by using logical arguments. On the same note, mathematics achievement was positively and significantly related to reading, rereading, and summarizing. The findings indicate that students who critically analyze and interpret problem statements and then solve them are more likely to perform better. This brings out the role of understanding in mathematical problem solving.

The theory of Problem-Solving Behavior by Tallman *et al.* (1993) supports the findings of this study. According to the theory, the main objective of problem-solving is to achieve a given goal by resolving a situation through overcoming barriers. The theory includes awareness of the problem, decision-making, action, and evaluation stages (Daroini *et al.*, 2020). These phases indicate the manner in which learners approach mathematical problems in an organised manner.

This process helps a mathematics learner to work on and utilize formulas as a logical step-by-step method of resolving mathematical problems (Marais, 2022). Guessing and checking is also an additional method that the learner can use when trying to confirm answers (Kaminski, 2023). Moreover, learners are able to detect patterns that enable them to fill out sequences and solve problems effectively. Drawing examples or symbols also help the learners in picturing the problems and enhancing comprehension. Further, the process of rule-out enables learners to rationalize on correct answers. It improves comprehension of the issue by reading, rereading, and summarizing the contents before trying to solve the problem (Warger, 2019).

The results of this study are in line with other scholars in related fields. For instance, Toraman *et al.* (2020) investigated the connection between the mathematics performance, metacognitive awareness, and reflective thinking in problem solving. The findings revealed that there is a strong positive correlation between reflective thinking and mathematics performance of students, which implies that high-order thinking strategies lead to improved performance.

Equally, Hazmi (2023) examined how the strategies used in teaching mathematics based on problem solving impact on students attitudes and performance. The results showed that students who were taught by problem solving strategies would achieve better results and show more positive attitudes towards mathematics than those who were taught by traditional methods.Tambunan (2019) studied the impact of problem-solving methods on the performance of students in mathematics in Indonesia. The research identified that problem-solving techniques enhanced the creativity of students, their communication skills, reasoning capability, and their mathematical performance in comparison with traditional teaching techniques.

Kigamba *et al.* (2020) examined the effects of problem-solving methods and the performance of students in mathematics in Kenya. The results showed that learners who were taught via problem solving methods performed better than their counterparts who were taught via the traditional methods. The findings are consistent with the findings of the current study.The evidence shown in the reviewed studies and the present study taken together indicate that integration of problem-solving strategies into mathematics lessons can improve the performance of the learners. Teachers need to embrace teaching methods which focus on active learning, application of strategies and conceptualization to enhance mathematics achievement.

CONCLUSION

The objective of this study was to establish the relationship between mathematics problem-solving strategies and mathematics achievement. The study found that the mathematics achievement is positively and significantly correlated with problem-solving strategies. Further breakdown of the subscales of problem solving strategies indicated that the application of formulas, seeking of patterns, drawing pictures, eliminating possibilities, and reading, rereading and summarizing are all positively and significantly correlated with mathematics achievement.

Conversely, the guess and checking strategy was found to be negatively and significantly related to mathematics performance. Thus, the research concludes that the strategies of exploration might not be of much use, but reliance on guessing and checking is connected with the low level of mathematics performance.

Recommendations

The following recommendations are made:

i. Structured instructional support programs should be designed and implemented by teachers to increase the problem-solving abilities of students.

ii. Educators must strongly discourage the tendency to rely on the guessing and checking strategy and instead instruct the students on logical and step-by-step problem solving techniques.

iii. The mathematics curriculum needs to be reviewed and revised by curriculum developers in order to include an explicit teaching of problem-solving strategies.

iv. Guidance and counseling teachers should help students to build confidence in mathematics by overcoming math-related anxiety and learning challenges. This can be done by mentorship schemes, peer support schemes and specific counseling interventions that will result in the change of the attitude of the students towards mathematics.

vi. Teacher professional development programs based on effective problem-solving pedagogy should be supported by education stakeholders and policymakers.

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