

Relationship Between Problem-solving Strategies and Mathematics Achievement among Secondary School Students in Kenya

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Abstract

Continued poor achievement in mathematics among secondary school students in national examination in Kenya and Nakuru County in particular, has caused great concern among education stakeholders. This is because this trend may cause loss of opportunities for students in their choice of career growth and in the society, this may cause inadequate human capital in the areas of science, technology, engineering and mathematics which is crucial for social economic development. Despite this worrying trend, little attention in terms of research has been put in place to explore possible ways of resolving this issue. The aim of this study therefore was to provide possible insights based on psychological domains to explore possible solution by establishing the relationship between problem-solving strategies and mathematics achievement among secondary school students. The study used correlational research design. The target population was all form three students in public secondary schools in Nakuru County in the year 2019. The researcher used both probability and non-probability sampling techniques to obtain the sample size. Purposive sampling technique was used to select secondary schools and form three students in Nakuru County. Simple random sampling was used to select students from each school. Stratified sampling was used to select different categories of schools. The sample size was 585 students (279 boys and 306 girls). Data were collected using problem-solving strategies questionnaire adapted from Rudd's (2010) and academic achievement proforma. Results revealed that there was positive and significant relationship between problem-solving strategies and mathematics achievement in public secondary schools, $r(585) = .22, p < .05$. It was also revealed that 56% of changes in mathematics was accounted by problem-solving strategies. Though there are several alternative problem-solving strategies, use of a formula had positive and significant contribution while guesswork had an inverse significant relationship with mathematics achievement. Consequently, the study recommends that secondary school students should study keenly so as to understand mathematics formula and improve their mathematics achievement.

Keywords: *Mathematics achievement; Problem solving strategies; Secondary School*

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I. Introduction

Globally, mathematics is recognized as an important subject that equips students with strategies and skills that are necessary in higher education training, career aspirations and personal fulfillment in life (Yeping & Schonfield, 2019). According to Ledder (2019), mathematics is crucial in many facets of life. For instance, at school level mathematics skills enables students to achieve success and at the societal level it equips the students with skills required to succeed in life. Attard and Holmes (2020), asserts that mathematics is the foundation of all technologies in the world and as such its importance in socioeconomic development cannot be overemphasized. As pointed out by Attard and Holmes, the role played by mathematics in other fields of study is of great significance as compared to other subjects in the whole education system. As a result of its significance, there is more emphasis for students to score quality grades in mathematics at both primary and secondary levels (Attard & Holmes, 2020). However, despite the important role mathematics plays in the society, it has been characterized by perennial poor achievement as posted annually in the Kenya National Examinations (K.C.S.E

Essential Statistics, 2019). Hence the need to explore factors that may help to alleviate this poor achievement in mathematics in this case, problem solving strategies.

Problem-solving as defined by Rahman (2019) refers to the framework or pattern within which creative thinking and learning takes place. According to Kozikoglu (2019) problem-solving strategies involves application and adaptation of appropriate strategies in the process of building new knowledge to find solutions to problems. As outlined by Astra and Mujayanah (2020) there are four stages through which students can strategize and find solutions to their problems. First, they must purpose to understand the problem. This may require the student to read and reread the question to understand it. Secondly, the students must come up with a good plan, to identify the appropriate formula to use. Thirdly, they must execute the plan, that is, use the formula appropriately. Finally, the student must review the plan. In order to exploit the four stages, the student must explore various strategies of problem-solving. These strategies are; read, reread and summarize the question, look for a pattern, draw a picture or symbol, use a formula, eliminate possibilities, guess and check the answer.

According to Toroman (2020) problem-solving strategies impact positively on the students' success in handling a given mathematical task since the students' will not only learn the basic facts on problem-solving accuracy, but also read and understand the question. Toroman asserts that, the students are less likely to make errors during the problem-solving process, since they are able to translate the written problem by using appropriate symbols, drawings and unit clues properly. This ultimately helps them to improve in their mathematics grades.

A study by Tambunan (2019) documented a significant association between problem-solving strategies and mathematics achievement. It was concluded that through problem-solving strategies students' attitudes and abilities were positively impacted. Suriati and Ahmad (2019) documented significant impact of problem-solving strategies on mathematics achievement in Malaysia. In Turkey, Simsek (2020) documented a positive influence of problem-solving strategies on mathematics achievement. In the USA, Li and Schoenfeld (2019) carried out a study to examine the relationship between problematizing teaching strategies and mathematics achievement. The study indicated that problematizing teaching strategies adopted were associated with student achievement in mathematics. Effective problem-solving strategies were associated with better mathematics achievement. In Nigeria, Olewaraju (2022) investigated the use of mathematics disposition strategies and mathematics achievement. The research found that mathematics disposition strategies were significantly correlated to mathematics achievement. The study concluded that teacher support is required in teaching the students on appropriate problem-solving strategies to enhance mathematics achievement.

In Kenya, Muema (2018) investigated the relationship between teaching methods on problem-solving and mathematical achievement of students. It was found that teaching methods on problem-solving among the students had a positive relationship with mathematics achievement. Problem-solving strategies help the students to solve complex mathematics tasks which will lead to better performance in mathematics. Kigamba (2019) documented inverse effect of problem-solving strategies on mathematics achievement in Kenya. Furthermore, Awofala et al. (2022) recorded a significant effect of problem-solving strategies on mathematics achievement in Nigeria. Moreover, there was no significant difference between male and female students on mathematics achievement. The current research specifically focused on mathematics problem-solving strategies and mathematics achievement of secondary school students in Nakuru County to advance knowledge in this area.

1.2 Statement of the Problem

In the last five years from 2016 to 2020, analysis of Kenya Certificate of Secondary Examination (KCSE) results by the Ministry of Education has revealed that the overall mean grade in mathematics nationally has been D plus. In Nakuru County, the mean grade within the same period was D plus (D+) but in 2016 to 2018, the grade dropped to D plain. This characteristic poor achievement in mathematics is quite worrying bearing in mind that the subject is instrumental in a variety of fields that are important for socio-economic development. Some of these fields are engineering, medicine, business, commerce and all sciences related fields. This continued poor achievement may ultimately translate into students not joining their careers of choice and hence missing opportunities, both at the tertiary institutions and in employment which negatively affects social and economic development in the county and the country at large.

Some of the factors attributed to poor mathematics achievement include under staffing, inadequate instructional materials, retrogressive practices, low motivation, negative attitude of both teachers and students. Other researchers have attributed this achievement to poor school admission policies, reduced community support, limited learning resources, mismanagement of resources, students' indiscipline and widespread teachers and students' absenteeism. However, these factors as outlined are largely environmental in nature. In this regard, there was need to investigate psychological factors which have attracted little attention so far by researchers in Nakuru County. This study therefore, sought to examine the influence of problem-solving strategies on mathematics achievement of secondary school students in Nakuru County, Kenya.

3. Aim of the Study

The aim of this study was to examine the relationship between problem-solving strategies and mathematics achievement among secondary school students in Kenya.

4. Review of Related Literature

In a related study by Rudds (2010) on levels of achievement in mathematics, the researcher investigated the effects of problem-solving strategies on seventh grade students' self-efficacy. The study used experimental research design where a sample of forty-one students was used from two seventh-grade mathematics classes. The sample was split into two groups; one group with twenty-three students acted as a control group and received three days of standard classroom instruction. While the other group had eighteen students who received three days of intervention which included learning problem-solving strategies in addition to their standard instruction. Both groups undertook a self-efficacy survey and pre-test which was done one week prior to the study. The findings revealed that the achievement of seventh-grade students in solving novel problems greatly improved as a result of undertaking problem-solving strategies interventions. From the findings, the group that received the intervention had a significant improvement in their positive perception of their problem - solving attitudes, abilities and strategies but not in their self-efficacy. The current study therefore, sought to find out the relationship between problem-solving strategies and mathematics achievement in a developing country using *ex post facto* research design bearing in mind that the Rudd study was undertaken in a developed country using experimental design. The study was also geared towards clearing out inconsistencies that have been portrayed.

In another related study by Loong (2012) among pre-university international students in mathematics achievement, the findings revealed the influence of use of problem-solving strategies between low, average and high mathematics achievers for Malaysian and international students. The findings revealed that problem-solving strategies had a significant influence on academic achievement. The current study, sought to establish the relationship between problem-solving strategies and mathematics achievement in a different country, in this case, Kenya and using a different research design.

In Pakistan, Perveen (2010) undertook a study on the impact of using problem-solving strategies on mathematics achievement of girls in a single sex secondary school which was sponsored by government. The sample comprised of forty-eight girls who participated in the survey. The sample was divided into two where half of the girls were used as experimental group and the other set as the control group. Despite having the two groups with almost equal mathematic capabilities, after receiving treatment, as directed by heuristics steps, experimental group showed significant higher achievement than the control group. Hence, indicating that problem-solving strategies had an influence on mathematics achievement. This study by Perveen involved only one single-sex public school and therefore results may not be generalizable to other countries hence the need to undertake a comparative study. The current study sought to find out the relationship between the two variables using *ex post facto* design, where both boys and girls were sampled.

Kousar (2010) investigated the effect of problem-solving strategies on mathematics achievement in secondary schools in Pakistan. Experimental research design was adopted and convenient sampling applied to select 96 10th grade students in government girls' school in Pakistan. Students were equally divided into control and experimental group. Independent T test analyzed the data. Study findings revealed that students had equal mathematics score at the beginning though the findings changed with experimental group performing better. These findings may not be generalized into Kenyan perspective since students are exposed to different education programmes.

Another study by Saputro et al. (2019) investigated the impact of problem-solving instruction on academic achievement and science process skills among prospective elementary teachers in Indonesia. Quasi experiment design was adapted and primary data gathered through issuance of questionnaires. Convenient sampling was applied to select 48 respondents. Descriptive statistics, correlation and non-parametric tests were used to analyze the data. The findings revealed that there was a significant difference in academic achievement between experimental and control groups. There were significant correlations between achievement, problem-solving skills and teacher skills. It was recommended that there was need to adopt scientific approaches to develop problem-solving skills that would enhance academic performance, concern this study aimed to address using a population of Kenyan secondary school students.

Fatoke et al. (2013) examined the effects of problem-solving instructional strategy and numerical ability on students' learning outcomes in Nigeria. Experimental research design was adopted and primary collected through issue of questionnaires among 210 respondents selected purposively. Descriptive statistics and analysis of covariance were used to analyze the data. Study findings revealed that problem-solving strategies and students' numerical ability had significant effect on chemistry performance. There was no significant difference between male and female chemistry performance. It was recommended that teachers should consider teacher's numerical capability while teaching to enhance their performance. The study used experimental

research design while the current research used correlational design to establish if similar results can be obtained.

A study by Lai et al. (2018) investigated the effect of mathematics problem-solving training system on first year middle school students in Nigeria. A quasi experiment was adopted in the study and data collected among 153 students who were selected through stratified sampling. Descriptive statistics and independent T test analyzed the data. Those who were subjected to Problem-solving Assessment, Diagnosis and Remedial Instruction (PSADRI) system recorded better academic performance as compared to others. It was recommended that there is need for adoption of alternative problem-solving approaches which should be contingent to student unique characteristics. The current research used correlational research design and a population of secondary school students to address the population gaps.

Relatedly, Ntibi and Hope (2018) investigated the effect of problem-solving strategies on academic performance in physics and chemistry student in Calabar municipality in Nigeria. Quasi experiment was adopted and 202 respondents were selected randomly and administered questionnaires. Descriptive statistics and analysis of variance were adopted for data analysis. Results of the study revealed significant difference between experimental and control groups and those who were taught quick problem strategies recorded the highest performance. It was concluded that use of problem-solving approaches should be adopted to enhance chemistry and physics academic performance. There are difference problem-solving approaches and this study focused on mathematics achievement to fill the knowledge gaps.

Contradictory findings on the relationship between problem-solving strategies and mathematics achievement have been reported. Matemba et al. (2014) investigated the relationship between problem-solving strategies and academic performance in Kakamega Municipality. Correlation research design was adopted and stratified sampling guided the selection of six schools. A sample of 200 students was proportionately selected. Quantitative data was collected through issue of questionnaires and qualitative data collected through use of focus group discussions guide and observation check lists. Quantitative data was analyzed through descriptive statistics, bivariate and multiple regression approach. Qualitative data were thematically analyzed. The findings revealed that there was no significant relationship between problem-solving strategies and academic achievement. Gender had no significant effect on problem-solving strategies. Therefore, there was need for this study to contribute to this debate.

5. Methodology

5.1 Research Design and Target Population

In this study, correlational research design was used. According to Lord (1973), a correlational design is a type of research where the investigation is conducted after the fact. In this design, the researcher conducts an unbiased investigation into what has already occurred. In this form of study, the researcher's aim is to collect data to determine causes, relationships, and their meaning, (Cohen et al., 2011; Punch, 2011). The researcher in this situation is limited to reporting what has already occurred.

In the current study, the researcher aimed to establish the association between problem solving strategies and mathematics achievement. Sekaran and Bougie (2013) claim that this strategy is used to determine whether two or more variables are correlated. According to Orodho (2005), correlational design is used to determine the strength of relationship between variables. The design was utilized to determine the correlation between problem solving strategies and mathematics achievement. The target population was all form three students in public secondary schools in Nakuru County in the year 2019.

5.2 Sampling Techniques and Sample Size

The researcher used both probability and non-probability sampling strategies in this investigation. The researcher used purposive sampling technique to select secondary schools in Nakuru County. According to Sekaran and Bougie (2013) purposive sampling is appropriate in circumstances when one wants to obtain a specified sample with characteristics of the issue under research. The selection of schools and respondents was done using probability sampling techniques, including stratified sampling and simple random sampling. This made it possible to guarantee that each student in the target population had a fair chance of being chosen to participate in the study. The researcher used class lists in order to find the necessary number of participants from each school. The sample from each class was selected using 'yes' and 'no' pieces of papers. The sample size was 585 students (279 boys and 306 girls).

5.3 Research Instruments

a. Problem-solving Strategies Scale

The researcher in consultation with the Supervisor customized problem-solving strategies questionnaire adapted from Rudds (2010) to fit the Kenyan situation. This questionnaire composed of eighteen questions presented on

a 5-point Likert-type scale ranging from 5 to 1 as follows; 5 (strongly agree), 4 (agree), 3 (neutral), 2 (disagree) to 1 (strongly disagree). Scoring involved calculating the sum of the scores and the highest score was 90 and the lowest 18. A score of 54 and below indicated low level of use of problem-solving strategies while a score between 55 and 90 indicated high level of use of problem-solving strategies.

b. Academic Achievement Proforma

Document analysis of the form three students' academic achievement records was carried out to collect data on mathematics achievement scores of the participants. In this research, the midterm and end of term one examination average results in 2019 were used. The results were then transformed into T scores to enable comparison across secondary schools. The scores were grouped into three categories; below average, average, and above average. A score of 40 or less was considered to be below average, a score of 41 to 60 was considered to be average, and a score of 60 or more was considered to be above average.

5.4 Data Collection Procedures, Analysis and Presentation

The researcher first obtained a research permit and authorization letters to do the research. The researcher administered the questionnaires to the students to collect data on problem solving strategies. To deliver the questionnaire to the sampled schools, the researcher used the drop-off approach. This made it possible for the instructors and the qualified research assistant to distribute the questionnaires at the appropriate time. This was done during regular class hours or in accordance with an arrangement made with the relevant school administration. The instructions for data collection were read to the sampled students. The completed questionnaires were then collected by the researcher for data analysis.

The data was then coded, and entered into SPSS for analysis. Data analysis was done using both descriptive and inferential statistics. Descriptive statistics involved the use of means, frequency, percentages, and standard deviation. Pearson's moment correlation coefficient and regression analysis were used in hypothesis testing.

6. Results and Discussions

This section presents descriptive statistics of problem solving strategies and mathematics achievement.

6.1 Descriptive Statistics of Problem Solving Strategies and Mathematics Achievement

The descriptive statistics of problem-solving strategies were also analyzed based on gender to obtain the minimum score, maximum, mean, standard deviation, skewness and kurtosis coefficient.

Table 1
Descriptive Statistics of Problem-Solving Strategies and Gender

Gender	N	Minimum	Maximum	Range	Mean	SD
Male	279	38	86	48	58.43	8.37
Female	306	32	78	46	59.41	8.30
Total	585	32	86	54	58.94	8.34

The female students obtained a slightly higher mean score of 59.41 (*SD* = 8.30) compared to that for the boys who got a mean score of 58.43 (*SD* = 8.37). The female students had a minimum score of 32 and a maximum score of 78 while the male students had a minimum score of 38 and a maximum score of 86. This implies that the female students did slightly better than their counterparts did on the problem-solving strategies scale.

Table 2 shows the gender and mathematics achievement of the students.

Table 2
Description of Mathematics Achievement by Gender

Gender	Freq	Min	Max	Range	Mean	Std. Dev	Skewness	Kurtosis
Male	279	33.21	78.29	45.08	48.55	10.67	.374	-.49
Female	306	33.21	77.75	44.55	51.32	9.16	.191	-.07
Total	585	33.21	78.29	45.08	50.00	10.00	.230	-.35

From Table 4.8, the male students had a minimum score of 33.21 and a maximum of 78.29. Their mean score was 48.55 with a standard deviation of 10.67. Their counterparts had a minimum score of 33.21 and a maximum score of 77.75. The mean score for the girls was 51.32 with a standard deviation of 9.16. This indicated that the female students performed better than male students.

6.2 Hypothesis Testing

The study examined the relationship between problem-solving strategies and mathematics achievement of students. The following hypothesis was tested;

H₀₃ There is no significant relationship between problem-solving strategies and mathematics achievement in Nakuru County.

Product moment correlation coefficient and regression analyses were adopted for data analysis. Correlation analysis output is shown in Table 3.

Table 3
Correlation Analysis on Relationship between Problem-solving Strategies and Mathematics Achievement

	1	2	3	4	5	6	7	8
Mathematics Achievement	1							
Read read and summarize	585 .22** .00	1						
Guess work	585 -.26** .00	585 -.27** .00	1					
Pattern	585 .20** .00	585 .31** .00	585 -.11* .01	1				
Formula	585 .39** .00	585 .48** .00	585 -.32** .00	585 .31** .00	1			
Picture	585 .24** .00	585 .54** .00	585 -.23** .00	585 .36** .00	585 .41** .00	1		
Eliminate possibilities	585 .17** .00	585 .18** .01	585 -.15** .00	585 .09* .04	585 .25** .00	585 .10* .02	1	
Problem-solving strategies	585 .75** .00	585 .50** .00	585 -.34** .00	585 .36** .00	585 .55** .00	585 .52** .00	585 .20* .00	1
	585	585	585	585	585	585	585	585

Results in Table 3 revealed that there was positive and significant relationship between read, read and summarize problem-solving strategies and mathematics achievement in public secondary schools in Nakuru County ($r(585) = .22, p < .05$). Secondly, there was negative and significant relationship between use of guess work and mathematics achievement in public secondary schools in Nakuru County ($r(585) = -0.26, p < .05$). Thirdly, there was positive and significant relationship between use of patterns, formula, picture, elimination of possibilities and mathematics achievement in public secondary schools in Nakuru County ($r(585) = .20, p < .05$), ($r(585) = .39, p < .05$), ($r(585) = .24, p < .05$) and ($r(585) = .17, p < .05$) respectively. Finally, there was a positive and significant relationship between problem-solving strategies and mathematics achievement in public secondary schools in Nakuru County ($r(585) = .75, p < .05$). Thus, the null hypothesis was rejected suggesting that problem-solving strategies influenced mathematics achievement of the students.

Regression model summary is shown in Table 4. Multiple linear regression model examined the relationship between problem-solving strategies and mathematics achievement in Nakuru County as shown in Table 4.

Table 4

Model Summary on Relationship between Problem-solving Strategies and Mathematics Achievement in Nakuru County

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.43	0.19	0.18	16.89
2	0.75	0.56	0.56	12.34

Results in Table 4 revealed that 18.9% of changes in mathematics achievement in Nakuru County can be accounted for by read, read and summarize, guess work, pattern, formula, picture and elimination methods of solving mathematics problems while the remaining percentage can be accounted by other factors not included in the model. An *R* squared of 0.56 revealed that 56% of changes in mathematics was accounted by problem-solving strategies. ANOVA results are presented in Table 5.

Table 5

ANOVA on Relationship Between Problem-solving Strategies and Mathematics Achievement

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	38348.95	6	6391.49	22.42	0.00
	Residual	164807.1	578	285.13		
	Total	203156	584			
2	Regression	114385.9	1	114385.91	751.23	0.00
	Residual	88770.08	583	152.26		
	Total	203156	584			

Results in Table 5 revealed that there was a significant relationship between problem-solving strategies; read, read and summarize, guess work, pattern, formula, picture and elimination of possibilities and mathematics achievement in public secondary schools in Nakuru County $F(6, 578) = 22.42, p < .05$. Secondly, there was significant relationship between mathematics problem-solving strategies and mathematics achievement in secondary schools in Nakuru County $F(1, 583) = 751.23, p < .05$. Table 6 presents regression coefficients showing nature of relationship between problem-solving strategies and mathematics achievement in secondary schools in Nakuru County.

Table 6

Regression Analysis on Relationship between Problem-solving Strategies and Mathematics Achievement

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		β	Std. Error	Beta		
1	(Constant)	41.28	0.69		59.13	.00
	Read, read and summarize	0.35	0.89	0.02	0.39	.69
	Guess work	-2.67	0.75	-0.14	-3.57	.00
	Pattern	1.44	0.76	0.08	1.88	.06
	Formula	5.41	0.86	0.29	6.30	.00
	Picture	1.15	0.87	0.06	1.32	.19
	Eliminate possibilities	1.23	0.73	0.07	1.70	.09
2	(Constant)	35.33	0.56		63.63	.00
	Problem-solving strategies	11.78	0.43	0.75	27.41	.00

Regression coefficients in Table 6 revealed that there was positive relationship between read, read and summarize problem-solving strategies and mathematics achievement in public secondary schools in Nakuru County ($\beta = 0.35, t(584) = 0.39, p > .05$). Secondly, there was a negative and significant relationship between mathematics solving strategies through guess work and mathematics achievement in Nakuru County ($\beta = -2.67, t(584) = -3.57, p < .05$). Thirdly, there was a positive relationship between use of pattern to solve mathematics problems and mathematics achievement in public secondary schools in Nakuru County ($\beta = 1.44, t(584) = 1.88, p > .05$).

3.57, $p < .05$). There was a positive and significant relationship between use of formula to solve mathematics problems and mathematics achievement in public secondary in Nakuru County ($\beta = 5.41$, $t(584) = 6.3$, $p < .05$). There was a positive and significant relationship between problem-solving strategies and mathematics achievement in public secondary schools in Nakuru County ($\beta = 11.78$, $t(584) = 27.41$, $p < .05$).

6.3 Discussion of the Results

The objective of the study sought to examine the relationship between problem solving strategies and mathematics achievement. The findings indicated that there exists a positive and significant relationship between problem solving strategies and mathematics achievement. The findings are in support of those of Hardi (2019) who investigated the effectiveness of problem solving on the students' mathematical capabilities. The researcher reported a significant relationship between problem solving strategies and mathematics achievement. The study further indicated that problem solving strategies were more effective to students' mathematical abilities. This indicates that students who use effective problem solving strategies perform well in mathematics. Thus teachers need to support the students to enhance their problem solving strategies for better performance in mathematics.

Another study by Heris and Utari (2018) found similar results as the current study. The study investigated the role of the problem solving strategies on mathematics achievement. The results of the study indicated that students who use high level of problem solving strategies perform better in mathematics than those who use low level of problem solving strategies. High level problem solving strategies help the students in solving complex mathematics tasks which in the end leads to high scores in mathematics. This implies that students have to be equipped with the necessary problem solving strategies to help them tackle mathematics problems.

In Nigeria, Badru (2018) reported similar findings. The study investigated how problem solving strategies predict mathematics achievement of junior secondary school students. It was established that problem solving techniques significantly predicted the academic success of the students particularly in mathematics. The study also established that students who were equipped with problem solving strategies were more confident in answering mathematics questions. The study findings also indicated that students with effective problem solving strategies had high self-confidence to answer even more complex mathematics tasks and pass their examinations. This therefore indicates the importance of problem solving strategies towards mathematics achievement amongst the students. Thus, to improve mathematics achievement in secondary schools in Nakuru County, teachers need to guide students to improve on their problem solving strategies.

Similar results on the relationship between problem solving strategies and mathematics achievement have been reported in Kenya. For instance, Gakinya (2021) carried out a study in Murang'a county to establish the effect of problem solving approach to teaching mathematics on students' achievement in secondary school. The findings of the current study are in agreement with the findings of Gakinya (2021). The study established that performance of the students taught using problem solving strategies had a change in attitude towards mathematics and this in turn enhanced their mathematics achievement. As a result of problem solving strategies, the students were determined to do more mathematical tasks which made them achieve better grades. This therefore is an indication that problem solving strategies plays an important role in mathematics achievement. Therefore, it's imperative that for better achievement in mathematics in Nakuru County, students need to be supported and guided to enhance their problem solving strategies.

The findings reported by Hardi (2019), Heris and Utari (2018), Badru (2018) and Gakinya (2021) agrees with self-determination theory by Deci and Ryan (2000). The theory asserts that an individual acts based on their thoughts, goals, beliefs and values and the level of academic self-concept, academic control and confidence impacts on learning and level of achievement. The theory also indicates that students have ability to control their achievement at school. The findings of the studies indicate that problem solving strategies enable the students to successfully work on their mathematics tasks and achieve their best in the subject. Mathematics achievement is influenced by self-determination which is characterized by academic effort and persistence. Students who are driven by the desire to perform better tend to put more effort into their task to achieve their best grade in mathematics. They persist on their academic goals even if the task is challenging which result in better achievement in mathematics.

7. Conclusions

The study found that problem-solving strategies had positive significant influence on mathematics achievement in Nakuru County. There is need to discourage students from guessing the answers while solving mathematics problems. This would minimize likelihood of poor mathematics achievement. Students need to be encouraged to use formulas to solve mathematical problems, this is because it had the highest prediction power. Elimination strategies as a method of solving mathematical problems should be discouraged amongst secondary

school students since their mathematics examination questions are not multiple choices as compared to primary schools.

8. Recommendations

Though there are several alternative problem-solving strategies, use of a formula had positive and significant contribution while guesswork had an inverse significant relationship with mathematics achievement. Consequently, the study recommends that secondary school students should study keenly so as to understand mathematics formula and improve their mathematics achievement.

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