

# MATHEMATICS ACHIEVEMENT IN HIGH SCHOOLS, THE ROLE OF MATHEMATICS' SELF-EFFICACY AND MATHEMATICS ACHIEVEMENT OF HIGH SCHOOL STUDENTS IN AUSTRALIA

<sup>\*1</sup>Emmanuel BYIRINGIRO

<sup>1</sup>Phd candidate in Education Department, Mount Kenya University

\*Email of corresponding author: [byiremmy@gmail.com](mailto:byiremmy@gmail.com)

## ABSTRACT

Mathematics self-efficacy is considered an important variable in mathematics education because of its links to mathematics achievement. This paper explored influence of mathematics self-efficacy on mathematics achievement in high schools. This study used correlational research design. Simple random sampling technique was further applied to obtain 308 respondents by using Yamane formula. The collected data was analyzed using descriptive statistics, correlation, and regression analysis through the statistical package for social science (SPSS) version 21. Research data were obtained through questionnaires and documentation. The data collected were analyzed using descriptive statistics and multiple regression. The results of the findings indicated that the mathematics self-efficacy was more correlated with mathematics achievement in High schools ( $r = 0.604$ ;  $p = 0.000$ ). Multiple linear regression analysis showed that mathematics achievement contributed to variation on the performance, hence plays a vital role in mathematics achievement in high school. Additionally, it was further inferred that mathematics self-efficacy has positive effect on student mathematics achievement.

**Keywords:** mathematics self-efficacy, mathematics achievement, high school and Students

## 1.0.INTRODUCTION

Self-efficacy is an important concept in social cognitive theory, which has been widely recognized as one of the most prominent theory about human learning (Ma, 1997). First developed by Albert Bandura (1977), self-efficacy refers to learners' beliefs about their ability to accomplish certain tasks. Many researchers, including Bandura, have demonstrated that self-efficacy affects human motivation, persistence, efforts, action, behavior, and achievement (Zimmerman & Kitsantas, 2014). Researchers have indicated that higher self-efficacy is predictive of higher performance (Bong & Skaalvik, 2003).

In an effort to improve students cognitive and affective outcomes in mathematics and/or school learning, educational psychologists and mathematics educators have continued to search for

variables (personal and environmental) that could be manipulated in favour of academic gains especially in the subject mathematics due to student's disposition, low enrolment and poor performance in the subject (Ormold, 2008). Learning involves both a personally and a socially negotiated construction of meaning (Lunenburg, 2011).

According to Bandura's (1986) social cognitive theory, student's judgements of their capability to perform academic tasks or self efficacy beliefs, predict their capability to accomplish such tasks. Researchers have demonstrated that the value of self-efficacy beliefs for predicting student's performances in mathematics. For example, self-efficacy predicts mathematics problem-solving to a greater degree than to self-beliefs such as mathematics anxiety or self-concept, previous mathematics experience, or self-efficacy for self-regulatory practices (Pajares & Urdan, 2006). It has also been demonstrated that students whose self-efficacy is stronger and more accurate in their mathematics computation and show greater persistence on difficult items than do students with low self-efficacy (Nasser & Birenbaum, 2005).

There are a number of concerns associated with the assessment of students' self-efficacy in mathematics that have influenced the conceptualising of this research study. The first is, much of the previous self-efficacy research has focused on adults in the workplace, university students, and secondary school students (Bandura, 1997). There has been less of a focus on specific subject domains, such as mathematics self-efficacy (Ayodele, 2011). The second is more recent with self-efficacy researchers, such as Moriarty (2014) tended to shift the stem of the self-efficacy question from effort to confidence. This was done, in part, to identify the student's confidence to complete a mathematical task just before doing that task. Confidence was considered an aspect of self-efficacy along with effort and persistence by Bandura (1997) but there is some unease associated with this perception. The first is, self-efficacy is an important determinant of academic performance, but the counter-position is that self-efficacy is merely a reflection of past performance (Talsma et al., 2018). The second is, academic achievement is influenced by effort plus high academic self-concept (Marsh et al., 2016).

Zimmerman (2000) reported that self-efficacy and the sources of self-efficacy were stronger predictors of mathematics achievement than general mental ability. They found that, the relationship between prior mathematics achievement and self-efficacy was stronger for Hispanic students than for Caucasian students. Yara (2010) found that while mathematics ability had a direct effect on mathematics performance, it also had an indirect effect via mathematics self-efficacy judgments. Schunk (1991), in his research indicated that, mastery goal orientation positively increases mathematics self-efficacy. The overall effect these literatures pointed out to somewhat a significant relationship between students' mathematics self-efficacy and students' mathematics achievement. Hodges (2008) found out in his study that students' self-concept influences their academic performance; however, the level of effort exerted by students in

learning to a large extent contributes significantly to students' self-concept in boosting their academic performance.

### **1.1. Problem statement**

Self-efficacy is an important concept in social cognitive theory, which has been widely recognized as one of the most prominent theories about human learning (Ormrod,2008). The theory is believed by many scholars to be the most important theoretical contribution to the study of academic achievement, motivation, and learning. The theory is believed by many scholars to be the most important theoretical contribution to the study of academic achievement, motivation, and learning (Pajares,2011).

A search of mathematics education research indicates that several studies have been conducted on the relationship between attitude toward mathematics and achievement in mathematics (Toland & Usher, 2016). Gutman (2006) examined the reciprocal relationship between attitude toward mathematics and mathematics achievement using the data from the Dominican Republic. The findings suggested that the reciprocal relationship existed between attitude toward mathematics and mathematics achievement. In addition, enjoyment of mathematics directly affected mathematics achievement, and the feeling of difficulty indirectly affected mathematics achievement.

Ma and Xu (2004) investigated the causal ordering between attitude toward mathematics and mathematics achievement using structural equation modeling. The results indicated that all but one path from prior attitude to later achievement was significant, with the standardized path coefficients ranging from .03 to .13. Additionally, the paths from prior mathematics achievement to later attitude toward mathematics were all significant, with the standardized path coefficient ranging from .11 to .23. These studies found that attitude toward mathematics was a significant predictor of mathematics achievement, and furthermore, the causal relationship between them was identified. Although numerous studies have been conducted on the relationship between attitude toward mathematics and mathematics achievement, comparatively there was a deficiency of research in examining the relationship between mathematics self-efficacy and mathematics achievement. Further, no research has been conducted using large-scale samples across the nation. Randhawa, Beamer and Lundberg (1991) investigated the role of mathematics self-efficacy in mathematics achievement using structural equation modeling. This study was carried out in order to assess the effect of mathematics' self-efficacy and mathematics achievement of high school students.

The purpose of our study was to investigate the relationship between mathematics self-efficacy and mathematics achievement in high school in Australia using regression analysis for complex sample survey data.

Specifically, this study sought to achieve the following research hypothesis:

**H<sub>01</sub>:** There is no significance relationship between mathematics self-efficacy and mathematics achievement in high school

## 2.0.METHODOLOGY

The research design adopted was the correlational research design. This design is deemed suitable because the study sought to investigate the relationship between student's mathematics self-efficacy and their mathematics achievements. The study also investigates whether or not difference existed between low or high mathematics self-efficacy students. The target population for this study consisted of all senior High School two students in Nuriootpa High School located in Nuriootpa area in a township within the Barossa Valley region in the state of South Australia. The school has an enrolment of over 1325 students and a workforce of over 140 staff (Nuriootpa High School Annual report, 2022). But this study target students and 5 Mathematics teachers. Thus, the total population of 1330 was targeted and was used to select sample size by using through probability stratified random sampling techniques for the study.

The research instrument used for amassing data in this study were closed-open questionnaire that consists of students' self-efficacy scale (SES) and (SCS) and achievement test.

Fivefold Likert scale type of questionnaire such as Strongly disagree (coded as 1), Disagree (coded as 2), Neutral (coded as 3), Agree (coded as 4) and Strongly agree (coded as 5). The responses of students which fall above 3.0 were considered as high self- efficacy and responses of students which were 3.0 and below were considered as low self-efficacy. The instrument reliability was tested using Cronbach alpha reliability coefficient technique with 0.78 for Students Mathematics Self-efficacy and 0.50 for Students Mathematics Self- concept, was used. In this research, we checked the internal consistency of the instrument.

Statistical Package for Social Science (SPSS) was used to analyse the data obtained from achievement test and questionnaire to obtain a general sense of information and to reflect on its overall meaning. Independent Sample t-test was used to find differences that existed between the achievement scores of students with low mathematics self-efficacy and students with high mathematics self-efficacy using the means and the standard deviations since an independent sample t-test is used to compare mean value(s) of continuous-level (interval or ratio data), taking into consideration all the assumptions associated with the use of the t-test. Also simple linear regression was used to predict students' mathematics achievement from students' mathematics self-efficacy

In addition, the study used the following formula proposed by using Yamane (1973) to determine the sample size because that is too large waste scarce resources and could expose more

participants than necessary to any related risk. Thus, the study used Yamane formula to calculate a sample size because it is the most appropriate for this study.

Using Yamane formulae

$$n = \frac{N}{1 + (N)(e^2)}$$

Where:

n = sample size

N = the population size

e = the acceptable sampling error (5%) at 95% confidence level

Thus;  $n = 1330 / (1 + (1330)(0.05)^2)$

$n = 307.5 = 308$  respondents

In this study the researcher used questionnaires, and documentary review. Closed –ended questions were used where the answers were divided into categories such discrete, distinct and relatively few in number. It is easier for respondents to answer because they had only to choose categories. In that way a chance for irrelevant answers is limited to the minimum, because appropriate answer categories were provided. The main respondents were being teachers that were given the questionnaire as they were enough time to respond to the questions based on research hypothesis. Questionnaires were given to Mathematics teachers and students.

The questionnaire used as the research instrument was subjected to face its validation. This research instrument (questionnaire) adopted was adequately checked and validated by the supervisor his contributions and corrections were included into the final draft of the research instrument used.

The research is purely a quantitative research in nature. After collection of primary and secondary data, the researcher analyzed data by using SPSS 21. Standard multiple linear regression was calculated to find out the effect above listed independent variables and dependent variables. Correlation coefficient was used to analyze the relation between all independent variables with dependent variables. Collected data are presented in tables, which may make the data analysis more comprehensive to its reader. Based on this five rating scale, the collected data are analyzed and interpreted. In qualitative research, data analysis involves reducing, organization the data synthesizing and discovering what is important. So, this study involves a detailed description of case, follow by an analysis of the data for conceptual framework. Data was presented in form of tables and graphs.

The study used the following multiple regression model to establish the statistical significance of the independent variables on the dependent variable.

$$Y = a + \beta_1 X_1 + \epsilon$$

Whereby Y =Mathematics achievement

a= Constant

X<sub>1</sub> = Mathematics self-efficacy

β<sub>1</sub> represent regression coefficients. These were helped in the generalization of the findings on the relationship between Mathematics self-efficacy and Mathematics achievement.

### 3.0 FINDINGS AND DISCUSSION

#### 3.1. Findings

In this study the research sampled 308 respondents from Nuriootpa High School. The data collected from the respondents were analyzed in tabular form with simple percentage for easy understanding. A total of 307 questionnaires of students were distributed and only 290 questionnaires were returned back.

#### 3.1.1 Descriptive Statistics of mathematics self-efficacy on student mathematics achievement

In this research the study attempted to determine the f Influence of teacher-student relationship on student mathematics achievement. The respondents were asked to rate the statements by indicating the extent to which they apply to their organization in 5-point Likert scale.

**Table 1: The distribution of respondents according to Mathematical self-efficacy**

Statements	Mean	Std Dev
I am sure I can learn important math concepts taught by the lecturer in this online learning	3.2	0.72
I am able to communicate or solve difficult Math problems in this online learning.	4.1	0.88
I believe I can understand the most difficult concepts in mathematics taught by lecturers even though they are online	3.5	0.69
I am not able to improve the strategy that has been chosen to solve math problems	3.3	0.76
I am confident that I can master the skills required in this course	4.3	0.85

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I try to communicate with friends online to find the best solution of the math problem at hand	4.5	0.99
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**Source:** Field research, 2023

As shown in Table 1, the results relate to the six statements assessing the effect of mathematics self-efficacy on student mathematics achievement in Nuriootpa High School. The results show that for the first statement, "Student is sure he can learn important math concepts taught by the lecturer in this online learning", the majority of respondents strongly agreed with a mean value of 3.2, and a high positive correlation standard deviation of 0.72. The second statement asked respondents whether the students are able to communicate or solve difficult Math problems in this online learning. The results showed that the majority of respondents strongly agreed with this statement (M=4.1, SD=0.88). For the third statement, "I believe I can understand the most difficult concepts in mathematics taught by lecturers even though they are online", the majority of respondents agreed with this statement, with a mean of 3.5 and a very positive and high standard deviation correlation of 0.69. The fourth statement asked whether they are not able to improve the strategy that has been chosen to solve math problems. Respondents strongly agreed with this statement, with an average mean of 3.3 and a very strong positive standard correlation of 0.76. The next item was whether they are confident that they can master the skills required in this course. The majority of them strongly agreed that statement with a mean of 4.3 and a very high positive standard deviation of 0.85. On the last statement respondents were asked whether they try to communicate with friends online to find the best solution of the math problem at hand, the majority of respondents strongly agreed and agreed that statement with a mean score of 4.5 and positive correlation standard deviation of 0.99. From the results, it implies that the majority of respondents strongly agreed and agreed that all of the above are key elements of mathematics self-efficacy and mathematics achievement in high school.

### 3.1.2. Correlation analysis

The findings of the correlations between the independent variables and the dependent variables are summarized and presented in Table 2

**Table 2: Correlation between mathematics' Self-Efficacy and their Mathematics Achievement (N=150)**

		Mathematics self-efficacy	Mathematics achievement
Mathematics self-efficacy	Pearson Correlation	1	
	Sig. (2-tailed)		
	N	174	

Mathematics achievement	Pearson	.604**	1
	Correlation		
	Sig. (2-tailed)	.000	
	N	290	290

\*\* . Correlation is significant at the 0.01 level (2-tailed).

This Table 2 indicates the correlation analysis between mathematics self-efficacy and mathematics achievement. Further analysis was carried out to identify the relationship between students' mathematical self-efficacy and mathematics performance. For this reason, the Pearson correlation test was conducted to determine the relationship between these two factors. The results showed that there was a positive relationship between mathematics self-efficacy and mathematics performance ( $r = 0.604$ ;  $p < 0.05$ ). The correlation was deemed to be statistically significant since the p-value was less than 5%. The findings therefore showed that there is a positive and statistically significant relationship between Mathematics self-efficacy and Mathematics achievement in high school.

These findings are relevant with Bandura (1997) who claims that self-efficacy beliefs predict academic outcomes. They also support the work of investigators who report significant relations between self-efficacy, other motivation constructs, and academic achievements. The implication that arise is that researchers and school counsellors should be looking to student's beliefs about their mathematics capability, for they are important components of motivation and of academic achievement.

### 3.1.3. Multiple Regression

A multiple regression analysis was performed in this section to identify the predictor and its contribution towards the criterion. It aims to determine the prediction of a single dependent variable from a group of independent variables. The multiple regression analysis was performed with all the assumptions complied with. The results of the multiple regression are presented in Table 3 to Table 5.

**Table 3: Model summary**

Mode	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.514 <sup>a</sup>	.264	.258	.40680

a. Predictors: (Constant), Mathematics self-efficacy

The table 3 below shows the quantity of variance that is explained by the predictor variables. The first statistic, R is the multiple correlation coefficient between all the predictor variables and dependent variable. In is model, the value is .514<sup>a</sup>, which indicates that there is a great deal of variance shared by the independent variables and dependent variables. The next value, R Square, is simply the squared value of R. This is frequently used to describe the goodness of fit or the amount variance explained by a given set of predictor variables.

**Table 4: ANOVA<sup>a</sup>**

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	7.594	1	7.594	45.890	.000 <sup>b</sup>
	Residual	21.183	128	.165		
	Total	28.777	129			

a. Dependent Variable: Mathematics self-efficacy

b. Predictors: (Constant), Mathematics achievement

The table above indicated standard regression which provides the influence of individual predictor variable. That variables is teacher-student relationship. The table shows the output analysis and whether there is a statistically significant difference group mean. As seen, it, the significance value is 0.001 and the mean is 0.165. Therefore, there is a statistically significant difference in the mean length of model.

**Table 5: Coefficients<sup>a</sup>**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	7.783	.461		16.883	.000
	Mathematics self-efficacy	-.757	.112	-.514	-6.774	.000

a. Dependent Variable: Mathematics achievement

Information presented in Table 5 evidenced that  $Y=7.783-0.757 X_1 +\epsilon$  Where y= Mathematics achievement. The regression output above shows that Mathematics self-efficacy variable is statistically equal to 0.000. This shows the regression of independent variable is associated with Mathematics achievement. Multiple analysis regression result above indicates the influence of independent variables based on the regression coefficient. The unstandardized Coefficients is

7.783 when is constant and at the same time the Std. Error is 0.112 when they are associated with coefficients. The significant predictor out of independent variable is positively related to the criterion in the regression, as shown in Table 5.

#### **4.2. Discussion**

The research findings provide an overview of the importance of mathematics self-efficacy on mathematics academic achievement. From the findings, the study found that mathematics self-efficacy affects mathematics achievement when students can learn important math concepts taught by the lecturer in this online learning. when they are able to communicate or solve difficult Math problems in this online learning, when they can understand the most difficult concepts in mathematics taught by lecturers even though they are online, when they are able to improve the strategy that has been chosen to solve math problems, when they are confident that they can master the skills required in this course and when they try to communicate with friends online to find the best solution of the math problem at hand.

Besides, the Pearson correlation analysis showed that teacher-student relationship ( $r=0.604$ ,  $p=0.000$ ) is positively and significantly related to Mathematics achievement in high school. The correlation was deemed to be statistically significant since the p-value was less than 5%. The findings therefore showed that there is a positive and statistically significant relationship between mathematics self-efficacy and Mathematics achievement in high school.

These findings are relevant with Ferla et al. (2009) who have defined math self-efficacy as an assessment of people's self-confidence in their ability for successful task performing or math specific problem. This factor can also effect on educational achievement in math, positively. It has been shown in some studies that both factors, attitude towards math and self-efficacy in math have positive relationship. They have also positive significant effect on educational achievement in mathematics.

#### **5.0 Conclusion and Recommendations**

From the findings, the study concluded mathematics self-efficacy can significantly affect mathematical achievement, and has a positive predictive influence, and its impact on mathematical achievement is greater than mathematics achievement. The evidence is students' mathematics self-efficacy is an important agent that directly and indirectly influences students' mathematics achievement. Thus, mathematics educators need to continue to actively encourage and support the development of positive self-efficacy in all of their students. The total findings of this study indicate that most respondents have high and moderate scores in mathematics self-efficacy. Our findings also show that there is a positive relationship between mathematics self-efficacy and mathematics performance.

Therefore, the researcher can conclude by saying that the research hypotheses including: "H<sub>01</sub>: There is no significance relationship between mathematics self-efficacy and mathematics

achievement in high school”; all were tested; verified and then they are confirmed referring to the statistical (regression analysis) findings and then according to the research, the correlation of 0.604 (60.4%) categorized as positive and very high correlation; this leads to confirm that there is significant influence between mathematics self-efficacy and mathematics achievement

Based on the findings, it can be recommended that since self-efficacy is found to be an essential ingredient in mathematics achievement, it is recommended that teachers are encouraged to engage their students more in regular confidence-building exercises such as mathematical games and so on that look challenging but enable them to do well. Besides, students should be encouraged to explore mathematical patterns that would strengthen their basic numerical skills and also help them to develop a growth mindset.

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