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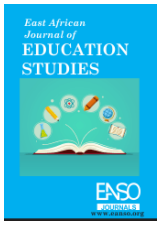

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Original Article

Relationship between Student Attitude and Achievement in Mathematics among Secondary School Students in Ganze District Kilifi County Kenya

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Affective Factors, Student Attitude, Mathematics Achievement, Attribution, Gender.

ABSTRACT

This article is based on a bigger study that sought to establish the relationship between affective factors with students` achievement in mathematics. The article shares findings from the study objective to establish the relationship between student attitude and achievement in mathematics. The descriptive Survey research design on a sample size of 250 students used a mathematics attitude questionnaire and mathematics achievement test to collect quantitative data. The computational formula of Pearson`s product-moment correlation coefficient (rxy) determined the null hypothesis, "there is no statistically significant relationship between student attitude and achievement in mathematics." The study found that there was a statistically significant positive correlation coefficient of $rxy = 0.37$ between student attitude and achievement in mathematics. This implies that student attitude is directly proportional to achievement in mathematics. However, analysis based on gender differences contradicts the stereotype that females always of negative attitude towards mathematics than males. Females in mixed-day secondary schools indicated a higher positive attitude than males. Whereas males in mixed-boarding secondary schools indicated a higher positive attitude than females, unlike in single-sex boarding secondary schools where both genders indicated similar attitude types towards mathematics. The study recommends mathematics teachers have to inculcate a positive attitude in the classroom environment for better achievement since student attitude is directly proportional to achievement in mathematics.

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INTRODUCTION

The reported gender differences in student attitudes toward mathematics influenced some researchers to study some affective variables as mediators of gender differences in mathematics achievement (Casey, 2001). However, little consensus existed among researchers regarding the influence of affective variables on mathematics achievement. According to Fennema and Sherman (1977), the mathematics attitude scale encompasses attitude, anxiety, and confidence which are linked to effects (affective) that generally include attitudes, emotions, beliefs, and perhaps values. The bigger study operationalised affective factors as emotional behaviours or actions driven by feelings that include attitude, anxiety, and confidence (Fennema et al., 2006). Even among those studies that found a significant relationship, there was still controversy regarding the educational implications of the results. For example, some researchers concluded that although statistically significant, the mean effect size for the relationship between student attitude towards mathematics and achievement in mathematics was not strong enough to have useful implications for educational practice (Ma & Kishor, 1997).

The inadequacy report of Fisher and Rickards (1998) noted that student attitudes towards achievement in mathematics were based only on the classroom behaviours of their teacher. On the other hand, some researchers (Narton & Rennire, 1998) have cautioned against dismissing the effects of student attitude on longer-term learning outcomes, despite the finding that most of the gender differences in mathematics were small. One of the explanations for the inconsistent findings regarding the relationship between student attitude and achievement in mathematics was that such a relationship existed only in particular mathematics content areas and for specific affective variables (Ma, 1999). However, despite such consistent findings of student attitude in mathematics, studies of classroom environments have shown that student attitude in mathematics improved greatly (Boaler, 2000). Therefore, on such bases, this research article looked beyond gender and academic abilities to establish the relationship between student attitude and achievement in mathematics aimed at managing the problem posed by females' underrepresentation in advanced mathematics careers.

Statement of the Problem

A meta-analysis of gender comparisons of mathematics attitudes and affect, published by the University of Wisconsin-Madison (Hyde et al., 2006), revealed that the diminishing of male domain stereotyped attitudes of -0.90 effect size proves mathematics is no longer a male domain subject. This indicates we cannot relate to gender differences and academic abilities in explaining the substantial underrepresentation of females in advanced mathematics classrooms and mathematics-related careers. Research about the attitude influence on student achievement failed to explain the females` underrepresentation but focused on classroom environments to infer that teacher-classroom behaviour is a factor associated

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with student attitude per se. The studies found that student attitudes towards mathematics tend to be more positive in classrooms where students perceived greater leadership and helping or friendly behaviours in their teachers and more negative in classrooms where students perceived their teachers as admonishing and enforcing strict behaviours. Therefore, the need to establish the relationship between student attitude and achievement in mathematics aimed at addressing the problem posed by females' underrepresentation in advanced mathematics careers.

Research Objective

To establish the relationship between student attitude and achievement in mathematics.

Research Hypothesis

The null hypothesis of this research article was, "There is no statistically significant relationship between student attitude and achievement in mathematics".

Research Question

How is student attitude an affective factor influencing achievement in mathematics?

THEORETICAL AND CONCEPTUAL FRAMEWORKS

This study considered the Attribution theory developed by Weiner (1974). Weiner defined attribution as a cause of behaviour such as success and failure. Weiner proposed a two-dimensional model with four major causes of success and failure (ability, effort, task difficulty, and luck). The two dimensions are the locus of control and stability. Locus of control relates to whether the cause of success or failure is perceived to result from some factor within or outside of the individual; stability is concerned with whether the cause can change for an individual from one time to another. Since ability is the same from one time to another and is due to a factor within a person, it is categorised as stable and internal. An effort is internal and unstable because the individual has control over effort and may vary the effort expended in different situations. Task difficulty is stable because a given task does not change in difficulty from one situation to another. Task difficulty is also external since a person has no control over it. Luck changes from time to time and is independent of the individual; therefore, it is classified as unstable and external.

The Attribution theory is much relevant to this study because student attitude is rooted in a person's perception of his/her success and failure. When a person perceives the cause of success and failure as stable (ability or task difficulty), the change in expectations will be greater than when unstable factors (effort or luck) are seen as the cause. For example, when success is attributed to the ability or ease of the task, the increase in expectancy for future success in that situation will be larger than if the success had been attributed to good luck. Similarly, when failure is seen as caused by low ability, the drop in expectancy for future performance is greater than when failure is attributed to a lack of effort or bad luck. On average, females and males seem to differ in their patterns of attribution of success and failure. In academic achievement situations, girls are more likely to see success as caused by effort and less likely to see success as caused by ability than boys. In failure situations, girls are more likely than boys to attribute their failure to a lack of ability than a lack of effort. However, these gender differences in attributions are not large and will be more pronounced when the task is gender-stereotyped.

Therefore, since attribution theory is a three-stage process: (1) behaviour is observed, (2) behaviour is determined to be deliberate, and (3) behaviour is attributed to internal or external causes (Weiner, 1974); then it can be relatively inferred and conceptualised that student attitude being the independent variable is behavioural too. The achievement in mathematics being the dependent variable can be attributed to (1) effort, (2) ability,

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(3) level of task difficulty, or (4) luck, as well as intervening by other learning factors such as entry behaviour, resources, teaching techniques, and subject assessment.

RESEARCH METHODOLOGY

The main purpose of this research article was to establish the relationship between student attitude and achievement in Mathematics. The study was motivated by the underrepresentation of females in advanced mathematics levels and related careers. This study employed a descriptive survey research design. The target population comprised both male and female students from secondary schools in Ganze District, Kilifi County, Kenya. The district had 4 zones with a total of 1620 male students and 1080 female students within the 20 schools, among which 12 were mixed-day secondary schools, 4 boarding schools, and 4 single-sex schools. Proportional stratified random sampling was done to ensure at least 50% of the schools were sampled from every zone. The students were selected through a stratified sampling technique with lower strata representing students' poor in mathematics based on class lists of students` achievements kept by the academic master or mistress in school administrative units. Senior classes (Form 4 and 3) were selected for study since they had been in the school much longer and were more knowledgeable about the school environment than junior classes (Form 1 and 2). The research sample size consisted of 250 students (150 males and 100 females).

The research instruments included Mathematics Attitude Questionnaire (MAQ) and Mathematics Achievement Test (MAT). The mathematics Attitude Questionnaire (MAQ) was adapted from the Fennema and Sherman Mathematics Attitude Scale (1977). This is an instrument developed to measure student attitude towards mathematics that consists of a group of nine instruments: Attitude towards Success in Mathematics Scale, Mathematics as a Male Domain Scale, Mother or Father Scales, Teacher Scale, Confidence in Learning Mathematics Scale, Efficacy and Motivation Scales in mathematics, Mathematics Anxiety Scale, and Mathematics Usefulness Scale. The Mathematics Attitude Questionnaire (MAQ) for students consisted of ten statements responded to by students using ticks either strongly agree (SA), agree (A), disagree (D), or strongly disagree (SD). The Mathematics Achievement Test (MAT) for students was in the form of a common Continuous Assessment Test (CAT) that consisted of seven problems totalling twenty marks expected they solved within half an hour.

At the piloting stage, the content validity of the research instruments was established through test-retest by addressing the match between the questionnaire statements and what was intended to assess. It involved administering the improved questions to the same student respondents for the validity of the research instruments. The reliability of the research instruments was established using the split-half method. The split-half method was done by coding the questionnaire items using odd or even numbering before calculating using:

$$rxx = \frac{[2r½½]}{[1 + r½ ½]}$$

Where; r_{xx} = whole test reliability, $r_{½ ½}$ = half-test reliability.

Through the split-half, in the test-retest method, the reliability of all the instruments clicked at $p<0.001$ (Mugenda & Mugenda, 2003).

The instrumentation was done by administering the questionnaire and mathematics test to the sampled students. The students were supposed to fill in the mathematics attitude questionnaire by ticking appropriately after identifying their respective classes, gender, and type of schools. The student's achievement in the mathematics test was obtained directly from the sampled students in the form of a common Continuous Assessment Test (CAT) administered, marked, and scored by the researcher

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mainly for the study purpose without being documented within school administration units.

The data were analysed by using the computational formula of the Pearson Product Moment Correlation coefficient (r_{xy}). The mode of analysis mainly involved Correlational Analysis of Pearson Product moment correlation coefficient (r_{xy}) indicating the statistically significant correlation value for either accepting or rejecting the null hypothesis, "there is no statistically significant relationship between student attitude and achievement in mathematics". The correlation coefficient, r_{xy}, varies between −1.00 and +1.00. A value of −1.00 indicates a perfect negative relationship, 0.00 means no relationship, and +1.00 means a perfect positive relationship. So, values in between were judged low to high negative or positive relationships depending on their size. Correlation Analysis was computed with the objective of establishing the relationship between the independent (student attitude) and dependent (achievement in mathematics) variables. For non-numerical data, the indicator variables were coded as 0 or 1. The indicator variable was coded 0 for any case that did not match the variable name and 1 for any case that did match the variable name from the baseline chosen. The neutral situation of student attitude formed the baseline. This resulted in a positive attitude for cases coded 1 that did match the attitude questionnaire item and a negative attitude for cases coded 0 that did not match the attitude questionnaire item.

PRESENTATION OF FINDINGS AND DISCUSSION

The study sought to establish the relationship between student attitude and achievement in mathematics. The results of student attitude types analysed in cumulative percentages per their mathematics test mean scores are presented in *Table 1*.

Table 1: Attitude and Mathematics Achievement

Type of Schools	Gender	Positive attitude (%)	Mean Score	Negative attitude (%)	Mean score
Mixed Day Secondary Schools	Male (n=100)	84.62 (n=85)	55.45	15.38 (n=15)	15
	Female (n=70)	90.91 (n=64)	36.5	9.09 (n=6)	25
	Average (n=170)	87.77 (n=149)	45.98	12.23 (n=21)	20
Mixed Boarding Secondary Schools	Male (n=20)	83.33 (n=17)	93	16.67 (n=3)	80
	Female (n=13)	75 (n=10)	95	25 (n=3)	85
	Average (n=33)	80.17 (n=27)	94	20.83 (n=6)	82.5
Single Sex Boarding Secondary Schools	Male (n=8)	80 (n=6)	92.5	20 (n=2)	80
	Female (n=9)	80 (n=7)	70	20 9 (n=2)	58.33
	Average (n=17)	80 (n=13	81.25	20 (n=4)	69.17

Table 1 reveals the dynamic status of student attitude and achievement in mathematics. Student attitude is directly proportional to achievement in mathematics. As evidenced in mixed-day secondary schools, students with a positive attitude of 87.77% towards mathematics recorded a mean score of 45.98 in mathematics achievement higher than a negative attitude of 12.23% at 20. For students in mixed boarding with a positive attitude of 80.17% recorded a mean score of 94, higher than of negative attitude of 20.83% at 82.5. Single-sex boarding students with a positive attitude of 80% recorded a mean score of 81.25 higher than those with a negative attitude of 20% at 69.17. However, analysis based on gender differences contradicts the stereotype that females always have a negative

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attitude toward mathematics than boys, which is not the case in this study. In mixed-day secondary schools, females indicated a higher positive attitude than males, but in mixed boarding, males indicated a higher positive attitude than females, unlike in single-sex boarding, where both genders indicated similar attitude types towards mathematics.

The relationship between student attitude and achievement in mathematics was established using the computational formula of the Pearson Product Moment Correlation coefficient (r_{xy}) as shown in *Table 2* below:

$$rxy = \frac{N\sum XY - (\sum X)(\sum Y)}{\sqrt{[N\sum X2 - (\sum X)2]\,[N\sum Y2 - (\sum Y)2]}}$$

Where: X is the average of attitude types (%), Y is the average of respective mean scores, N is the number of corresponding data (6), ∑ is the summation symbol, √ and is a square root symbol.

Table 2: rxy for Attitudes and Mathematics Achievement

X	Y	X^2	Y^2	XY
87.77	48.98	7704	2399	4299
80.17	94	6427	8836	7536
80	81.25	6400	6602	6500
12.23	20	149.6	400	244.6
20.83	82.5	433.9	6806	1718
20	69.17	400	4784	1383
301	395.9	21514.5	29827	21680.6

$$rxy = \frac{(6 \times 21680.6) - (301 \times 395.9)}{\sqrt{[(6 \times 21514.5) - (301)2]\,[(6 \times 29827) - (3959)2}}$$

$$rxy = \frac{130083.6 - 119165.9}{\sqrt{[129087 - 90601]\,[(178962 - 156737]}}$$

$$rxy = \frac{10918}{\sqrt{38486 \times 22225}}$$

$$rxy = \frac{10918}{\sqrt{855351350}}$$

$$rxy = \frac{10918}{29246} = 0.37$$

The r_{xy} shown in *Table 2* above indicates a statistically significant correlation of 0.37 between student attitude and achievement in mathematics. This concurs with Ma and Kishor (1997) but contradicts Papanastasiou (2010) that there is no relationship between student attitude and achievement in mathematics. This relationship was because of factors such as parental and teachers` negative contributions to mathematics being of general difficulty to learn and perform that influenced mathematics achievement. This is magnified by the perception of peer pressure against achievement in mathematics among the students. Unfortunately, most of the interested students and positive attitudes toward mathematics required very close supervision and warm assistance from their teachers which was too minimal due to poor teaching methods and overloaded teaching workloads caused by understaffing. For the less interested students with a negative attitude toward mathematics develop defensive mechanisms against tackling mathematics. These are evidenced by students` propaganda, such as sayings of parents not providing mathematical equipment, mathematics teachers do not know how to teach, the language used to set the mathematics questions is too difficult, and mathematics is only for gifted children (Khine, 2015). As a result, most students view mathematics can be performed by a capable few.

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This is a negative notion about mathematics that spreads too fast under peer influence.

CONCLUSION

The results from this study suggest that secondary students know that mathematics is important, and they seem willing to learn mathematics and learn it well. However, their attitude affects their achievement in the subject. In addition, school teachers are aware that there are certain aspects of students` learning in mathematics that need to be improved. Only teachers and students are limited to theoretical teaching and focused on passing examinations. In this sense, mathematics students do not demonstrate in a more practical way, by which students cannot spontaneously associate mathematics knowledge with the everyday environment. Engagement and exposure will result in students` better perspective of mathematics and their mathematics achievement, which in turn helps students to develop a more positive attitude toward the subject. This promotes learning ability and consequently performs better in mathematics examinations.

A certain amount of attitude is required as an impetus toward positive action; the opposite same could be detrimental to the student's well-being and may greatly contribute to low mathematics results. Therefore, students should get equipped with knowledge of attitude and effective management skills for their benefit while in school and elsewhere. Students should take responsibility to seek affective management help from teacher counsellors, other teachers, or the peer counselling clubs within their schools to ensure that their attitudes do not escalate to levels that negatively impact their academic results. Students should realise that individuals can decide how they process the problems they encounter. Since problems left unprocessed unconsciously become major sources of negative attitudes.

It is, therefore, imperative that the students should desist from apportioning blame and instead proactively seek to find positive solutions to their problems for better adjustment. Students should be encouraged to use all available opportunities to raise issues that cause them to be of negative attitudes; so that teacher counsellors to facilitate positive resolutions to the problems. Teachers sought to understand the nature of students' attitude-causing factors so that they could address the same as part of the affective management skill acquisition process. The developmental process and especially during the teenage poses many attitude-causing challenges to students. Teacher counsellors should therefore invest a lot of time in imparting knowledge on development to help reduce the pressure that might arise from the growth process experience. Teacher counsellors, therefore should help students to learn to take positive responsibility to seek counselling help when need be. Principals play a very vital role in the life of students as they have a monopoly on designing school programs. From this study, the attitude type has indicated students` negative attitudes; as a result, their academic results are lacking. Hence the relationship between student attitude and achievement in mathematics is beyond gender differences and academic abilities.

The Implication of the Findings for Practice

The findings form a base for addressing the trending low mathematics achievement success based on student attitude beyond gender differences and academic abilities. Encourage the creation of an equal competitive academic environment among mixed students. Improve content delivery during teaching to enhance the learning of mathematics. It enhances the students` grouping criterion for effective mathematics teaching and learning. The development of knowledge was hoped to be contributed much by the student attitude on the attributes of ability, task difficulty, effort, and luck towards high mathematics achievement.

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Recommendation

Based on the foregoing discussion of the findings and conclusion, the research article recommends that Mathematics teachers have to inculcate a positive attitude classroom environment for better achievement since attitude is direct to achievement, and further research be done on the impact of special teaching methods for students with a negative attitude towards mathematics.

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Conflict of Interest

The author declares that there is neither conflict of interest nor affiliation with nor involvement in any organisation or entity with any financial interest such as educational grants or non-financial interests such as personal relationships in the subject matter discussed in this manuscript.

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