Effects of Student Confidence on Achievement in Mathematics among Secondary School Students in Ganze District Kilifi County Kenya

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ABSTRACT

This article is based on a more extensive study that sought to establish the relationship between affective factors and students` achievement in mathematics. The article shares findings from the study objective to assess the effect of student confidence on achievement in mathematics. The descriptive survey research design on a sample size of 250 students used a mathematics confidence questionnaire and mathematics achievement test to collect quantitative data. The computational formula of the Pearson`s product moment correlation coefficient determined the null hypothesis, "there is no statistically significant relationship between student confidence and achievement in mathematics." The study found a statistically significant positive correlation coefficient of between student confidence and achievement in mathematics. This implies that student confidence is directly proportional to achievement in mathematics. However, analysis based on gender differences contradicts the stereotype that males are always more confident than females. Males in mixed-boarding and mixed-day secondary schools indicated more belief than females, unlike in single-sex boarding secondary schools, where both genders showed similar belief towards mathematics. The study recommends mathematics teachers to guide students through solving mathematics problems for them to develop self-confidence for better achievement since student confidence is directly proportional to achievement in mathematics.

Keywords: Student Confidence, Mathematics Achievement, Attribution, Affective Factors, Gender

INTRODUCTION

Research on gender differences in student attitudes toward mathematics influenced some researchers to investigate affective variables mediating gender differences in mathematics achievement (Casey, 2001). However, little consensus existed among researchers regarding the influence of affective variables on mathematics achievement. Fennema and Sherman (1977) describe the mathematics attitude scale as composed of attitude, anxiety, and confidence, which are linked to effects (affective) that usually include attitudes, emotions, beliefs, and possibly values. The more extensive study operationalized affective factors as emotional behaviors or actions driven by feelings that have attitude, anxiety, and confidence (Fennema et al., 2006). A significant reason for studying affective factors in mathematics education is to find ways to help students learn more mathematics (Andrej, 2015). Another reason to study affective variables is that a positive attitude toward mathematics is an essential educational outcome, regardless of achievement level.

However, this article did not advocate on positive attitude per se but how confidence affects the students' achievement in mathematics (Papanastatsiou, 2000). Generally, confidence in mathematics has been

associated with mathematics achievement, with correlation coefficients ranging from 0.3 to 0.4 (Hart, 2010). For example, Hart (2010) found that the mean for highly confident students was more than that of low-confidence students. Hart further found that high-confidence students engage in mathematics a more significant percentage of the time than low confidence students. The gender differences in self-confidence were more marked for application problems than computation problems only, with female students showing significantly lower confidence for application problems. In summary, examining the relationship between confidence and mathematics achievement, one finds a consistent, positive correlation association with some support for causal factors in the development of self-concept. For gender-related differences, several studies report no significant differences in self-concept between females and males. This implies that the effect of confidence on mathematics achievement requires further reasoning beyond gender differences and intellectual skills. Therefore, on such bases, this research article looked beyond gender and academic abilities to assess the effect of student confidence and achievement in mathematics aimed at managing the problem posed by females' underrepresentation in advanced mathematics careers.

Statement of the Problem

According to a meta-analysis of gender comparisons of mathematics confidence and affect published by the University of Wisconsin-Madison (Hyde et al., 2006), mathematics has lost its male domain stereotyped confidence effect size of -0.90. 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 confidence influence on student achievement failed to explain the females` underrepresentation.

Still, it focused on classroom environments to infer that teacher- classroom behavior is a factor associated with student confidence per se. The studies reported that compared with males, female students had debilitating causal attribution patterns, perceived mathematics as a male domain, were reflective, field-dependent, divergent in thinking, and cautious in dealing with mathematics. However, none of these studies demonstrates a clear self-concept relationship between student confidence and achievement in mathematics. Therefore, the need to assess the effect of student confidence and achievement in mathematics aimed at addressing the problem posed by females' underrepresentation in advanced mathematics careers.

Research Objective

To assess the effect of student confidence on achievement in mathematics.

Research Hypothesis

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

Research Question

What are the determinants of confidence as an affective factor in mathematics achievement?

THEORETICAL AND CONCEPTUAL FRAMEWORKS

This study considered the Attribution theory developed by Weiner (1974). Weiner defined attribution as a cause of behavior, such as success and failure. Weiner proposed a two-dimensional model with four significant 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

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the reason 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 categorized as stable and internal. An effort is internal and unstable because the individual controls 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 position 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 their 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 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) behavior is observed, (2) behavior is determined to be deliberate, and (3) behavior is attributed to internal or external causes (Weiner, 1974); then it can be relatively inferred and conceptualized that student anxiety being the independent variable is behavioral too. The achievement in mathematics being the dependent variable can be attributed to (1) effort, (2) ability, (3) level of task difficulty, or (4) luck; as well as intervening by other learning factors such as entry behavior, resources, teaching techniques, and subject assessment.

RESEARCH METHODOLOGY

The main purpose of this research article was to assess the effect of student confidence on 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 of 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 student`s 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 are 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 Confidence Questionnaire (MCQ), and Mathematics Achievement Test (MAT). Mathematics Confidence Questionnaire (MCQ) 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 Confidence Questionnaire (MCQ) for

students consisted of nineteen statements indicated by students through ticking appropriately either strongly agree (SA), agree (A), disagree (D) or strongly disagree (SD). The Mathematics Achievement Test (MAT) for students was in form of a common Continuous Assessment Test (CAT) that consisted of seven problems totaling 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 calculated 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 confidence questionnaire and mathematics test to the sampled students. The students were supposed to indicate their mathematics confidence by ticking appropriately after identifying their respective classes, gender, and type of school. The student's achievement in the mathematics test was obtained directly from the sampled students in form of a common Continuous Assessment Test (CAT) administered, marked, and scored by the researcher mainly for the study purpose without being documented within school administration units.

The data were analyzed 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 confidence 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 no relationship while +1.00 perfect positive relationship. So, values in between were judged low to high negative or positive relationship depending on their size. Correlation Analysis was computed on the objective to establish the relationship between the independent (student confidence) 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 confidence formed the baseline. This resulted in a more confidence for cases coded 1 that did match the confidence questionnaire item and a less confidence for cases coded 0 that did not match the anxiety rating scale item.

PRESENTATION OF FINDINGS AND DISCUSSION

The study sought to assess the effect of student confidence on achievement in mathematics. The results of student anxiety levels analyzed in cumulative percentages per their mathematics test mean scores are presented in *Table 1*.

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Table 1: Confidence and Mathematics Achievement

Type of Schools	Gender	Less Confidence (%)	Mean Score	More Confidence (%)	Mean score
Mixed Day Secondary Schools	Male (n=100)	15.38 (n=15)	45	84.62 (n=85)	50
	Female (n=70)	25 (n=45)	25	75 (n=53)	38.33
	Average (n=170)	20.19 (n=60)	35	79.81 (n=138)	44.17
Mixed Boarding Secondary Schools	Male (n=20)	16.67 (n=3)	80	83.33 (n=17)	93
	Female (n=13)	25 (n=3)	85	75 (n=10)	95
	Average (n=33)	20.83 (n=6)	82.5	79.17 (n=27)	94
Single Sex Boarding Secondary Schools	Male (n=8)	20 (n=2)	80	80 (n=6)	92.5
	Female (n=9)	20 (n=2)	62.5	80 (n=7)	70
	Average (n=17)	20 (n=4)	71.25	80 (n=13)	81.25

Table 1 revealed the dynamic status of student confidence and achievement mathematics. Student confidence is directly proportional to achievement in mathematics. As evidenced in mixed-day secondary schools, students with more confidence of 79.81% towards mathematics recorded a mean score of 44.17 in mathematics achievement higher than those of less confidence of 20.19 % at 35. For students in mixed boarding with more confidence of 79.17% recorded a mean score of 94 higher than those of less confidence of 20.83% at 82.5. Single sex boarding, students with more confidence of 80% recorded a mean score of 81.25 higher than those with less confidence of 20% at 71.25. However, analysis based on gender differences contradicts the stereotype that males are always of more confidence towards mathematics than females. Males in mixed-boarding and mixed-day secondary schools indicated more confidence than females, unlike in single-sex boarding secondary schools where both genders indicated similar confidence towards mathematics. The slight gender disparity on student confidence and mathematics achievement in half of the schools where the study was carried out, expounded due to both the principal and the deputy principal being of the same gender and students lacked people to deal with their gender issues.

The effect of student confidence on achievement in mathematics was determined 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 confidence levels (%),

Y is the average of respective mean scores,

N is the number of corresponding data (6),

∑ is summation symbol,

√ is a square root symbol.

Table 2: r_{xy} for Confidence and Mathematics Achievement

X	Y	X^2	Y^2	XY
70.81	44.17	6370	1951	3525
79.17	94	6268	8836	7442
80	81.25	6400	6602	6500
20.19	35	407.6	1225	706.7
20.83	82.5	433.9	6806	1718
20	71.25	400	5077	1425
300	408.17	20279.5	30497	21316.7

$$rxy = \frac{(6 \times 21316.7) - (300 \times 408.17)}{\sqrt{[(6 \times 20279.5) - (300)2]\,[(6 \times 30497) - (408.17)2}}$$

$$rxy = \frac{127900 - 122451}{\sqrt{[121677 - 90000]\,[(182982 - 166603]}}$$

$$rxy = \frac{5449}{\sqrt{31677 \times 16398}}$$

$$rxy = \frac{5449}{\sqrt{519439446}}$$

$$rxy = \frac{5449}{22791} = 0.23$$

The r_{xy} shown in Table 2 above indicates a statistically significant correlation of 0.38 between student confidence and achievement in mathematics. The study revealed a clear self-concept relationship between student confidence and achievement in mathematics. This concurs with Ma and Kishor (1997) but contradicts Papanastasiou (2010) that no relationship between student confidence and achievement in mathematics. This correlation was due to the development of self-concept of the individual students per the attribution theory that determines student confidence beyond academic or gender disparities. Also, motivational talks resulted in girls` inferiority onto mathematics decline as well as mathematics teachers better their techniques by aligning strategies to sex. The cause effect of confidence on mathematics achievement starts at discussion level as the students constantly consult from their mathematics teachers. Students become determined to tackle all problems fearing that if not able to attempt all questions then they would fail. The volunteering behavior towards attempting mathematics was experienced from both female and male students with inferiority of female gender towards mathematics diminishing rapidly. For example, female students showed high confidence, required very less supervision, had minimal consultations and were determined in calculating all questions under limited time. So the determinants of confidence is how someone`s self-concept will be serious in striving to achieve in mathematics without basing on person`s

gender difference nor academic abilities (Weiner, 1974).

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 confidence levels affect 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 limit 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 help students to develop more confidence toward the subject. This promotes learning ability and consequently performs better in mathematics examinations.

A bearable and manageable confidence level 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 on confidence 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 confidence do not escalate to levels that impact negatively their academic results. Students should realize that individuals can decide on how they process the problems they encounter. Since problems left unprocessed unconsciously become major sources of less confidence.

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 less confidence; so that teacher counsellors to facilitate positive resolutions to the problems. Teachers sought to understand the nature of students' demoralizing factors so that they can address the same as part of the affective management skill acquisition process. The developmental process and especially during the teenage poses many confidence challenges to the 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 the monopoly to design school programs. From this study, the confidence level roots from academic self-concept as the individual`s perception of self with respect to achievement in school. Hence the relationship between student anxiety 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 confidence 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 confidence on the attributes of ability, task difficulty, effort, and luck towards high achievement in mathematics.

RECOMMENDATION

Based on the foregoing discussion of the findings and conclusion, the research article recommends that mathematics teachers have to guide students through solving mathematics problems in order they develop

self-confidence for better achievement since student confidence is directly proportional to achievement in mathematics. Also, further research be done on the impact of special teaching methods for students with less confidence 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 organization 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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