

GENDER DIFFERENCES AND ATTITUDES TOWARDS LEARNING OF MATHEMATICS AMONG SECONDARY SCHOOL STUDENTS IN KEIYO DISTRICT, KENYA.

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ABSTRACT

The purpose of this study was to find out the effect of gender differences and attitudes towards learning of mathematics among secondary school students. It investigated the influence of students' perception of parental, teachers and peer expectations on their attitudes towards learning of mathematics. Descriptive Survey design was used. Data was collected by the use of questionnaires and interview schedules. The collected data was analyzed using both descriptive and inferential statistics. The accessible population were heads of mathematics department and form three students from selected secondary schools in Keiyo district, Kenya. Sample study comprised of 300 students (150 boys and 150 girls) and all heads of mathematics department from the sample schools in Keiyo district, Kenya. Stratified random sampling was used to categorize schools into either boys/girls or mixed schools. Simple random sampling was used to select 15 from 32 secondary schools and 20 students from each selected class. Convenient sampling technique was used to select mathematics' teachers who were interviewed. The findings of this study revealed that significant gender differences and attitudes towards learning of mathematics exist among secondary school students in Keiyo district. The findings showed that both boys and girls have positive attitudes towards learning of mathematics though boys were more positively inclined than girls. Students' perceptions of parental, teachers' and peer expectations were found to significantly influence gender differences and attitudes towards learning of mathematics. From the findings, the study recommended appropriate approaches that teacher - trainers and learners would use when designing mathematical activities that are in the form of fun, relaxed learning and collaborative hands on work and problem solving. Such learning activities would make learning of mathematics a success.

Key words: Mathematics, Gender Difference, Attitudes

INTRODUCTION

Mathematics is a very important subject in the school curriculum. Its importance is not only for the national purpose but also for the individual's life. In view of this importance, it could be more desirable for all students in Kenyan secondary schools to put extra efforts in the learning of mathematics. But this seems not to be the case. Such differences in attitudes towards learning of mathematics tend to favour male students especially in their high school stages. Such differences are well noted in Britain as well as other countries of the world (Orton 1987). Globally, mathematics has been viewed as a subject favouring male students (Sherman and Fenemma, 1977). They further support the idea that the differences between girls and boys in learning of mathematics tend to exist particularly in activities that required complex reasoning; that the differences increased about the onset of adolescence; and that the differences were recognized by many leading mathematics educators. The same experience is realized in Africa according to African Academy of Sciences (AAS) in collaboration with the Association for the Development of Education in Africa (ADEA) on issues of women's performance in mathematics. The same trend as been realized in Kenya.

RATIONALE

From the fore going, it is clear that girls, like boys, need mathematics in their private life, working life, socio-economic and political life of the country of which they are citizens. Cockroft (1982) adds that mathematics is a strategic subject in the development of science and technology. He asserts that this subject is fundamental in the study of physical sciences and engineering of all types. It plays a significant role in character building, boosting self-esteem and providing opportunities for developing curiosity and creativity. It is important then to study the differences between boys and girls in respect to this so that gender equity in education can be arrived at. This study also had an objective of giving recommendation through which the identified gender disparities can be reversed. An analysis of the last six years (2000-2005) of KCSE mathematics results by KNEC (2006) indicates that over 81% of the candidates have been performing poorly in the subject over the years as shown in table 1 below.

Table 1.1 Candidates Overall Performance in Mathematics for the Last six years (2000- 2005).

YEAR	PAPER	CANDIDATURE	MAXIMUM SCORE	MEAN SCORE %	STANDARD DEVIATION
2000	1		100	17.46	16.44
	2		100	15.05	16.02
	Overall	181947	200	33.22	31.00
2001	1		100	18.83	18.45
	2		100	18.62	17.15
	Overall	193702	200	37.43	34.00
2002	1		100	19.95	19.38
	2		100	19.51	19.25
	Overall	197118	200	39.39	37.95
2003	1		100	17.17	16.31
	2		100	21.45	19.86
	Overall	206480	200	38.62	36.17
2004	1		100	19.6	19.2
	2		100	20.2	18.4
	Overall	210000	200	39.8	31.6
2005	1		100	19.4	18.2
	2		100	20.6	19.9
	overall	220000	200	40.0	38.1

Source: KNEC, 2006.

Gender differences can be seen in 2005 KCSE mathematics results which revealed that girls had a mean grade of 16.05% compared to boys with a mean grade of 22.10% thus girls performed poorly compared to boys. The same case was realized in the year 2004 where girls got a mean grade of 16.44% and boys had a mean grade of 22.53 % as illustrated in table 2 below

Table 2. Candidates Performance in 2004-2005 KCSE Mathematics by Gender

SUBJECT NAME & CODE	2004				2005			
	FEMALE		MALE		FEMALE		MALE	
	NO. SAT	MEAN %	NO. SAT	MEAN %	NO. SAT	MEAN %	NO. SAT	MEAN %
MATHEMATICS (121)	91647	16.44	105471	22.53	95615	16.05	110865	22.10

Source: KNEC 2006.

In Keiyo District, KCSE mathematics results for 2004-2006 indicate that over 80% of students have been failing in mathematics (D.E.O's office, Keiyo District) as shown in Table 3.

Table 3. Quality of Grades in KCSE Mathematics in Keiyo District (2004-2006)

Year	2004		2005		2006	
	Number	%	Number	%	Number	%
D+ and Above	140	7.1	216	11.5	138	7.6
D- and below	535	27	491	26	354	19

Source: DEO's Office, Keiyo District, Kenya.

Another set of data obtained from the same DEO's office show that in KC SE mathematics results for 2004 to 2006, over 76% of the students have been failing in mathematics as shown in table 4 below.

Table 4 Mean Scores for KCSE Mathematics in Keiyo District (2004-2006)

Year	2004	2005	2006
Mean Score	2.7850	3.1400	3.1722
High Mark Score	6.730 1	7.6750	7.3200
Low Mark Score	1.1428	1.4118	1.8095

Source: DEO's OFFICE, Keiyo District, Kenya.

There has been an interest in the development of positive student attitudes towards the learning of mathematics. The objective of any mathematics curriculum includes fostering favourable feelings towards learning of mathematics as well as imparting cognitive knowledge.

Therefore, the researcher was prompted into undertaking this study because of the fact that fewer girls excel in mathematics while majority under achieve. Fewer girls than boys continue with the study of mathematics and related courses at higher level of education, and that girls are under represented in areas requiring certain qualifications in mathematics. What seems to emerge from the foregoing is that there may be some social factors that may be influencing the attitudes that boys and girls have towards learning of mathematics. Specifically, the study sought to find out whether there exist gender differences and attitudes towards learning of mathematics among secondary school students in Keiyo District. The study also sought to investigate whether peer, parental and teachers' expectations influenced students' attitudes towards learning of mathematics. And finally, to investigate whether there are any significant differences in attitudes between form three girls and boys towards learning of mathematics.

PURPOSES OF THE STUDY

The main purposes of the study were;

1. To investigate whether there are any significant difference in attitudes between the form tree girls and boys towards learning of mathematics
2. To investigate whether students' perceptions of teachers' expectations influence their attitude towards learning of mathematics.
3. To investigate whether students' perception of parental expectations influence their attitude towards learning of mathematics.
4. To investigate whether students' perception of peers' expectations influence their attitude towards learning of mathematics.
5. To make recommendations on strategies that could foster positive attitudes towards learning of mathematics.

REVIEW OF RELATED LITERATURE

The literature with respect to effect of single sex and co-educational schools on attitudes and performance in mathematics is equivocal. Recent Australian studies, including those of Golis et al (1987) in Fennema (1996), have indicated that single sex school environment have tended to be more closely associated with positive attitudes towards mathematics particularly by girls. They have argued that in single sex classrooms, girls experience an environment in which they are not subject to the same higher level of sexual harassment found in mixed sex classrooms. Further, it has been observed that girls tend to prefer lower levels of social competition and a warmer teaching style and that are more likely to be found only in mono sexual classrooms (i.e. girls only). It has been argued that co-educational schools have more potential for counter sexist practices to be effective (Leder, 1982).

Fear of success was first postulated by Homer (1968) as a variable useful in explaining gender differences in the research on attitude and performance in mathematics. He describes the conflict, resulting fear, and decreased performance that many women experience because of the clash they perceive between attaining success and fulfilling the female roles in our society. However, Homer (1968) extends this notion by postulating that early in life, individuals develop a motive to avoid success. This motive to avoid success may be stronger in females than in males because sex role conditioning for females doesn't emphasize the importance of success in the way that it does for men.

Traditionally, female students have found advanced mathematics achievement elusive. Girls' mathematics achievement in the elementary grades is equal to boys but decrease in middle school. (Callahan and Clements, 1984; Dossey et al, 1988 as cited in Fennema (1996)).

Fennema et al. (1990) in Cockcroft (1982) stated that attitudes were related to achievement in mathematics. The same case is experienced in Kenya as stated by Eshiwani (1975). Fennema et al (1994) in study of gender and mathematics Education Research found that the relationship between attitude and performance is weaker for girls than boys. Generally then, it appears that performance in mathematics is significantly related to attitude. In general, studies of gender differences in mathematics achievement at the elementary school level have reported divergent findings. For instance, some investigators, e.g. Zambo and Foliman (1984) in Orton (1987) have reported a rather rare finding that reveals female superiority in problem solving at the sixth grade level in the United States. Furthermore, though computation is assumed to be a mathematical skill in which girls always out-perform the boys. More specifically, girls were found to perform in the same way as the boys. Lummis and Steveson (1980) as cited in Orton (1987) further noted in their cross cultural study that boys were superior in problem solving as early as the first grade. In a sharp contrast, other investigators (i.e. Fennema and Leder, 1990) who have conducted a meta analysis of 100 studies concluded that there were no significant differences in problem solving in the elementary grades while there was a slight female superiority in computation. Likewise, many studies (Aiken, 1971 and Fennema & Sherman, 1978) have provided evidence that there is no variation of attitudes of elementary school boys and girls.

The findings by Will, Self and Datan (1976) as cited in Sherma et al. (1977), clearly indicate the issue of difference in treatment of boys and girls. In that study, mothers were given the same child to play with. To five of them, the child was made to appear as a male in terms of clothes and given the name 'Adam'. To the other six mothers, the child was made to appear as female in terms of clothes and given the name 'Beth'. It is reported that the mothers gave a doll to 'Beth' and a toy train to 'Adam' and they smiled at and held the baby more closely when they thought they were dealing with 'Beth' than when they thought they had 'Adam'. Similarly in education, according to Taylor et al (1986), there is enough evidence that there is gender discrimination in the education system whereby the female learners are being discriminated against and thus being discouraged from doing such subjects related to mathematics and/or developing a negative attitude towards them. This consequently causes female learners to believe that they cannot make it in mathematics. In Kenya, Jepkoech (2002) seems to agree with this when she asserts that girls' poor performance in mathematics is due to gender discriminative attitude in peer culture. Karanja (1996) confirms that, "If you think the subject is hard, it becomes hard. But if you are positive about it, becomes simple" (pg 19-20). There is need to relate peers, expectations and students attitude towards learning of mathematics.

METHODOLOGY

A total of 300 form three students filled in questionnaires during the period of October November 2006. The accessible population were heads of mathematics department and form three students from selected secondary schools in Keiyo district, Kenya. The study sample comprised of 150 boys and 150 girls and heads of mathematics department. Stratified random sampling was used to categorize schools into either boys / girls or mixed schools. Simple random sampling was used to select 15 schools from 32 secondary schools and 20 students from each selected form three class. Convenient sampling technique was used to select mathematics teachers.

METHODS OF DATA COLLECTION

The study used questionnaires and interviews. The questionnaires for the secondary schools mathematics teachers sought to establish teachers' perception on the relevance of gender in the learning of mathematics. Other questionnaires were responded to by secondary school students, which measured students' feelings towards the learning of mathematics. Other sections sought for the information on students' background, parents' occupation, and perception of peer, parental and teachers' expectations in regard to learning of mathematics. Face to face interviews with 15 teachers and 60 students selected randomly were conducted. These provided further information on teachers' perceptions of students towards learning of mathematics and students attitude towards the subject. During the interview, the researcher asked questions and recorded the responses given by the interviewees.

DISCUSSIONS OF THE FINDINGS AND CONCLUSIONS

The study concentrated on 300 students (150 boys and 150 girls) and 15 teachers from 15 secondary schools in Keiyo district, Kenya. Questionnaires and interview schedules were used for both the students and the teachers. Frequencies and percentages were computed and assessed to highlight the important aspects of the patterns of data observed. Chi-square and contingency coefficient were employed for testing. The hypothesis tested were either rejected or accepted at 0.05 level of significance depending on the outcome. This chapter centres on the discussion of the study findings, conclusions and recommendations. The first hypothesis examined was:

Ho₁: There is no significant relationship between students' gender and their attitudes towards learning of mathematics.

The results obtained showed that majority of the students (boys and girls) had a positive attitude towards learning of mathematics. However, when comparing the attitudes of boys and girls, the results demonstrated that boys were more inclined to positive attitudes than girls. From these findings, it can be inferred that the attitudes of the respondents were dependent on their gender. The calculated Chi-square for testing the hypothesis showed that there is gender difference in attitudes towards learning of mathematics. This finding is in agreement with the findings of other researchers such as Aiken (1971) and Fennema (1996). They all found that students with positive attitudes towards learning of mathematics in any school perform better than students with negative attitudes towards learning of mathematics.

Table 1 Students' Attitudes towards Learning of Mathematics.

GENDER	ATTITUDE			
	POSITIVE	NEUTRAL	NEGATIVE	TOTAL
Boys	118 (39.3%)	9 (3.0%)	23 (7.7%)	150 (50 %)
Girls	98 (32.7%)	20 (6.7%)	32 (10.6%)	150 (50%)
Total	216 (72%)	29 (9.7%)	55 (18.3%)	300 (100%)

$$\chi^2_{\text{calculated}} = 7.497, \chi^2_{\text{critical}} = 5.99, df = 2, C = 0.156, P < 0.05$$

The second hypothesis was:

Ho₂: There is no significant relationship between students' perception of teachers' expectations and their attitudes towards learning of mathematics.

This hypothesis was tested in the two aspects of teachers' expectations both for the whole group and gender wise. These aspects were mathematical expectations by teachers and teachers' willingness to assist students in learning of mathematics. When the overall Chi-square was calculated, it was found that students' perception of teachers' expectations were significantly related to their attitudes. The calculated value was more than the χ^2 critical value at $df=2$ tabulated at 0.05 level of significance. This led to the rejection of the null hypothesis. This finding does not directly support the findings of scholars such as Sandier (1982) and Wendy (1992) as cited in Peterson et al. (1985).

Table 2. Teachers' Expectations and Students' Attitudes towards Learning of Mathematics.

TEACHERS EXPECTATIONS ON PERFORMANCE	STUDENTS' ATTITUDES			
	POSITIVE	NEUTRAL	NEGATIVE	TOTAL
Will pass	150 (50%)	20 (6.7%)	30 (10%)	200 (66.7%)
Will not pass	60 (20%)	10 (3.3%)	30 (10%)	100 (33.3%)
Total	210 (70%)	30 (10%)	60 (20%)	300 (100%)

$$\chi^2_{\text{calculated}} = 9.643, \chi^2_{\text{critical}} = 5.99, df = 2, C = 0.177, P < 0.05$$

The third hypothesis was:

HO₃: There is no significant relationship between students' perception of parental expectations and their attitudes towards learning of mathematics.

The hypothesis was tested for two aspects: parental expectations for the whole group and on gender basis. These aspects were their performance expected by the parents and the importance of mathematics as viewed by the parents. The findings for the whole group showed that the two aspects were significantly related to students' attitudes towards learning of mathematics. On the basis of this finding, the null hypothesis (Ho₃) was rejected.

In conclusion, the parental expectations have a significant influence on students' attitudes towards learning of mathematics. This finding support the findings of Aiken (1976), Kelvin (1976), Prawartt (1983), Zeiduer (1998), Bassey (2002) cited in Akubairo (2004) who found that attitude was significantly affected by parental expectations. However when the Chi-square tests were done to assess if there was any relationship between parental expectations and attitudes of the girls and those of boys, it was revealed that parental view about the importance of mathematics significantly influenced their attitudes. The fourth hypothesis was:

Table 3 Students' Perception of Parental Expectations and their Attitudes towards Learning of Mathematics.

PARENTAL EXPECTATIONS IN MATHEMATICS	STUDENTS' ATTITUDES			
	POSITIVE	NEUTRAL	NEGATIVE	TOTAL
Will Pass	188 (62.7%)	10 (3.3%)	33 (11%)	231 (77%)
Will Not Pass	46 (15.3%)	7 (2.4%)	16 (5.3%)	69 (23%)
Total	234 (78%)	17 (5.7%)	49 (16.3%)	300 (100%)

$$\chi^2_{\text{calculated}} = 7.30, \chi^2_{\text{critical}} = 5.99, df = 2, C = 0.151, P < 0.05$$

Ho₄: There is no significant relationship between students' perception of peers' expectations and their attitudes towards learning of mathematics.

The study findings established that students' perception of peers' expectations are significantly influenced by their attitudes towards learning of mathematics. For this reason, the null hypothesis (HO₄) was rejected. This finding is similar to the findings of researchers such as Burton (1988) and Fennema (1981). According to Burton (1988), peer pressure, students' socio-economic background, lack of adequate learning materials and poor student-teacher interaction are some of the reasons that make students dislike mathematics. However, when the relationship between gender attitudes and perception of peers' expectations was tested for any significant relationships, it was found that the two aspects of peers' expectations, namely: Importance of mathematics and performance expected by the peers' were significantly related to both boys and girls attitudes towards learning of mathematics. This finding in particular tallies with what Caroline (July 12, 1996) expresses that "We (ladies) are weak because the society willed us to be so" (pg. 13). It is also in support of Owiti's (2001) findings.

Table 4 Students' Perception of Peers' View on the Importance of Mathematics and their Attitudes towards Learning of Mathematics.

PEERS' VIEW ON THE IMPORTANCE OF MATHEMATICS	STUDENTS' ATTITUDES			
	POSITIVE	NEUTRAL	NEGATIVE	TOTAL
Important	270 (90%)	5 (1.7%)	7 (2.3%)	282 (94%)
Not important	7 (2.3%)	3 (1.0%)	8 (2.7%)	18 (6.0%)
Total	277 (92.3%)	8 (2.7%)	15 (5%)	300 (100%)

$\chi^2_{\text{calculated}} = 79.5834, \chi^2_{\text{critical}} = 5.99, df = 2, C = 0.4579, P < 0.05$

Conclusion

The relevance or irrelevance of mathematics to the students' future career in the modern technological world affects their attitudes towards learning of mathematics.

The teachers' expectations determine the way in which they interact with the boys and girls and thus influence the boys and girls relationship with Mathematics. Teachers have higher expectations on the boys than on the girls and hence interact more with the boys than with the girls.

The parental expectations have a significant influence on students' attitudes towards learning of mathematics. Parental view about the importance of mathematics significantly influenced their attitudes.

The findings for performance expected by the parents showed that there was no significant relationship between girls' perception of performance expected by their parents and their attitudes towards learning of mathematics.

There was a significant relationship between boys' perception of performance expected by their parents and their attitudes towards learning of mathematics.

There were gender differences in attitudes towards learning of mathematics among secondary school students in Keiyo District. Students' attitudes and gender differences do exist but favours boys who tend to have higher positive attitudes towards learning of mathematics.

Parental, teachers' and peers' expectations as reflected in the perception of various activities and the feedback they give were much lower for girls than for boys.

All the factors investigated had a significant influence on students' attitudes towards learning of mathematics for the whole group. However, parental expectations on performance had no significant relationship to girls' attitudes only while there was a significant relationship to boys' attitudes. Teachers' and peers' expectations were strongly related to girls' attitudes than boys.

Recommendations

On the basis these findings, this study concludes that gender differences and attitudes towards learning of mathematics exists among secondary school students of Keiyo district. Based on this conclusion, the following recommendations were made:

More comprehensive studies should be undertaken to include a larger population in order to ascertain whether the differences transcends to other districts. Mathematics teachers should be encouraged to set up a 'mathematics clubs' in schools. The aims of such a club will include assisting students to develop a positive attitude towards learning of mathematics, learning the history of mathematics so as to appreciate its slow and painful development from the ancient time to the present, among other things. This can also be integrated with the establishment of mathematics laboratories to make the teaching method (instructions) more interesting and real to the learners. Parents/guardians should be encouraged to provide good studying environment for all children. By doing this, they will be helping them to develop positive attitudes. They should also be advised to motivate those who already have positive attitudes towards learning of mathematics to maintain or improve on them.

This study recommends that schools should sensitize parents on the need to change societal perceptions that promotes negative attitude development as relates to what a boy or a girl may do or may not do. Through such campaigns, girls may see that they have equal abilities with the boys in learning of mathematics. If these can be done, parents will no longer discourage either girls or boys that mathematics is meant for only a given sex, gifted persons or sons and daughters of certain bright families only. Parents should participate in the discussion of the students' homework and whenever possible, they should show equal concern over boys and girls performances in mathematics without quarrelling them.

The school has a role to play in transforming the negative attitudes that are related to the students' gender. This is because the school's failure to control the development of negative attitudes will impact on its general performance. One of the ways in which the school can reverse the trends is through the provisions of co-educational-interactive activities and tours whereby students will visit schools where girls perform well in mathematics if they are girls and vice versa. Exposure to personalities such as female mathematicians, scientists and engineers who have excelled in mathematics and who could be role models could also assist in motivating the students to change their perspectives that mathematics is associated with a certain sex only. From this,

students will be able to learn more about careers related to mathematics and breakdown the stereotypes associated with the mathematical competence, i.e. reduce the “nerd” factor.

This study strongly recommends that gender biases in career counseling departments in secondary schools should be checked. This is because by telling girls not to choose mathematically oriented career since it can be cumbersome for girls will create an impression to the girls that mathematics is a gender selective discipline which is favourable to the male students only. Any career counselor who advises female students that mathematics related courses are preserved for men will enhance the development of negative attitudes by the girls towards mathematics. The government through the ministry of education, science and technology should organize in service courses, seminars, workshops and symposiums where mathematics education experts can be invited to furnish teachers with research findings on gender friendly techniques of teaching and learning mathematics. The information on enhancing positive attitudes towards learning of mathematics could also be disseminated to parents through the mass media such as radios and televisions.

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