



# NUMBERS DON'T LIE, BUT BIAS MIGHT: GENDER DIFFERENCES IN ATTITUDES TOWARD MATHEMATICS IN KEIYO DISTRICT

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## ABSTRACT

*This study investigates the relationship between gender and student attitudes toward mathematics among Form Three students in Keiyo District, Kenya. While national examination data consistently reveal lower performance among girls compared to boys, this research challenges the notion that such disparities are purely academic or ability-based. Guided by Interaction Theory, which emphasizes the role of socialization and interpersonal influences, the study examines whether the observed performance gap reflects deeply rooted societal and educational biases. Utilizing a descriptive survey and ex-post facto design, the research sampled 300 students (150 boys and 150 girls) and 15 mathematics teachers across stratified public secondary schools. Data were collected via structured questionnaires and analyzed using descriptive and inferential statistics, including Chi-square tests. The findings reveal a statistically significant relationship between gender and attitudes toward mathematics, with boys displaying more positive attitudes than girls. These attitudes are not merely personal but reflect broader cultural messages and classroom practices that often favor male learners. The study concludes that while test scores may appear objective, they are embedded in social contexts that shape and skew outcomes. It recommends targeted teacher training, inclusive pedagogy, and gender-sensitive policies to create a more equitable mathematics learning environment.*

## 1. INTRODUCTION

Mathematics is widely acknowledged as a core subject in the school curriculum, serving not only as a foundation for scientific and technological advancement but also as a critical component in everyday decision-making and career development (Cockcroft, 1982; Buxton, 1984). Despite its recognized value, persistent gender disparities in students' attitudes and performance continue to emerge in both global and Kenyan contexts (Sherman & Fennema, 1977; Orton, 1987; Eshiwani, 1985).

While the performance metrics test scores, mean grades, national rankings appear to be cold, hard facts, they can often mask the subtle, deeply rooted societal and institutional biases that shape them. This study's title, "Numbers Don't Lie, But Bias Might," emphasizes this paradox: data may objectively show boys outperforming girls in mathematics, but these outcomes may be a reflection of historical and social inequities rather than inherent differences in capability. In this light, our inquiry digs beneath the surface of test scores to interrogate the attitudes, perceptions, and social constructs that influence these numbers.

National performance data from 2000 to 2003 reveals consistently low mean scores in mathematics, with less than 40% achievement on average (KNEC, 2003), as shown in Table 1.1. These numbers don't lie they show a systemic struggle. But why are the struggles greater for girls?

**Table 1.1: Candidates' Overall Performance in Mathematics (2000–2003)**

Year	Paper	Candidature	Max Score	Mean Score (%)	Std. Deviation
2000	1		100	17.46	16.44
	2		100	15.05	16.02
	Overall	181,947	200	33.22	31.00
2001	1		100	18.83	18.45
	2		100	18.62	17.15
	Overall	193,702	200	37.43	34.00
2002	1		100	19.95	19.38
	2		100	19.51	19.25



	Overall	197,118	200	39.39	37.95
2003	1		100	17.17	16.31
	2		100	21.45	19.86
	Overall	206,480	200	38.62	36.17

Source: Kenya National Examinations Council (KNEC), 2003

Even more concerning is the persistent gender gap. Table 1.2 shows that boys consistently outperformed girls in the 2002 and 2003 KCSE Mathematics examinations. But do these numbers speak to actual aptitude or to the silent influence of gendered expectations?

**Table 1.2: KCSE Mathematics Performance by Gender (2002–2003)**

Year	Gender	No. Sat	Mean %
2002	Female	91,647	16.44
	Male	105,471	22.53
2003	Female	95,615	16.05
	Male	110,865	22.10

Source: Kenya National Examinations Council (KNEC), 2004

These performance gaps raise critical questions that this research aims to explore: To what extent are these disparities influenced by attitudes? And are those attitudes, in turn, shaped by environmental bias rather than cognitive limitations?

## 2. STATEMENT OF THE PROBLEM

Although the mathematics curriculum aims to foster positive learner attitudes alongside cognitive skills, the persistent underperformance and disengagement among female students signals a deeper issue. Girls continue to be underrepresented in mathematics-intensive fields, and fewer pursue mathematics at higher academic levels. Research suggests that this could stem from gendered attitudes reinforced by societal norms, educational practices, and interpersonal dynamics within schools (Atieno, 1991; Daily Nation, 1996). The problem is not only academic but also socio-economic, as it limits women's participation in science, technology, engineering, and mathematics (STEM) fields. This study seeks to explore whether such gender-based attitudinal differences exist among Form Three students in Keiyo District.

## 3. RESEARCH OBJECTIVE ONE

1. To investigate whether there are any significant differences in attitudes between Form Three girls and boys toward the learning of mathematics.

## 4. RESEARCH HYPOTHESIS (H<sub>01</sub>)

H<sub>01</sub>: There is no significant relationship between students' gender and their attitudes toward learning mathematics.

## 5. PURPOSE OF THE STUDY

The purpose of this study is to examine the extent of gender differences in students' attitudes toward mathematics in secondary schools in Keiyo District. The findings will inform policy and instructional strategies that aim to close the gender gap and foster a more inclusive mathematics education environment.

## 6. LITERATURE REVIEW

### 6.1. Theoretical Framework

#### Interaction Theory

George Herbert Mead's (1934) Interaction Theory suggests that one's self-concept and attitudes are constructed through interaction with significant others especially parents, teachers, and peers. When applied to education, this theory implies that students' beliefs about their abilities in mathematics are shaped by the feedback they receive from these figures. If a girl consistently receives messages (even subtly) that she is not "a math person," she may internalize this narrative and behave accordingly.

Thus, although the examination scores and attitudes are measurable, they're not created in isolation they are shaped, reinforced, and perpetuated by social environments. The numbers may be factual, but the biases



influencing them are not always visible. This theory provides a conceptual anchor for this research, explaining how even objective data like test scores may carry the shadow of subjectivity.

## **6.2. Empirical Review**

Several empirical studies have explored the relationship between gender differences and attitudes towards learning mathematics, revealing both consistent trends and notable contextual contradictions. Will, Self, and Datan (1976) demonstrated how early gender role expectations are socially constructed, influencing children's self-concepts and later academic attitudes. In their experiment, mothers were observed treating the same infant differently based on perceived gender—showing more affection and offering dolls to the baby when dressed as a girl, and toy trains with less warmth when perceived as a boy. Such early socialization experiences establish foundational attitudes toward learning and perceived capabilities long before formal education begins.

As students progress into the education system, these gendered expectations become further entrenched. Taylor et al. (1986) reported that educational environments frequently reinforce societal biases, discouraging female learners from actively engaging in mathematics and fostering the belief that mathematics is inherently a male domain. This contributes to the development of negative attitudes in girls, often resulting in reduced participation and performance. Catsambis (1995), cited in Sadker (1985), confirmed that gender differences in mathematical attitudes typically begin in the middle grades, with boys developing greater enthusiasm while girls increasingly view mathematics with reluctance or anxiety. These attitudes are not solely school-based but are reinforced at home and by society at large.

Fennema (1977) provided further insight by contrasting male and female learning preferences, noting that females often favor a conversational, consensus-building learning style, whereas males typically thrive in more competitive, individualistic environments. Unfortunately, most classroom structures align more closely with the latter, putting girls at a systemic disadvantage. Fennema and Sherman (1978) also observed that girls are less likely to perceive mathematics as useful in their future lives, further diminishing their motivation and persistence. These differences in perception and pedagogical mismatch contribute significantly to the gender gap in mathematics.

In addition, Pearson and West (1991), as quoted in Orodho (1996), emphasized how classroom discourse and structure reflect and perpetuate male-centered social norms, such as independence, dominance, and abstraction—skills traditionally fostered in boys from a young age. These environments often alienate female learners, who may value collaborative engagement and practical application of knowledge. The lack of inclusive pedagogical practices continues through university, compounding the disadvantage for female students in mathematics-related disciplines. The consequence is a systemic undervaluing of female modes of knowing, despite their importance to holistic understanding and problem-solving.

However, not all empirical findings point to a universal disadvantage for girls. The IEA (1984) international study found that in countries such as England and France, girls demonstrated a higher interest in mathematics than boys, suggesting that when educational and cultural contexts are more supportive, gender gaps may narrow or even reverse. Griffiths (1974), through a study at the primary school level, and Edward (1973), at the college level in the United States, both found no significant difference in attitudes between boys and girls toward learning mathematics. These findings challenge the assumption that girls inherently possess more negative attitudes toward the subject and underscore the influence of context and environment.

Given the contradictory nature of global studies, it becomes essential to conduct localized investigations. Many of the studies reviewed were conducted outside Kenya, and their conclusions may not directly apply to the Keiyo District due to differing cultural, social, and educational contexts. Therefore, this study aims not only to verify whether gender differences in attitudes toward mathematics persist in the local context but also to uncover the unique factors contributing to these differences in Kenyan schools. Understanding these nuances is vital for designing more equitable and effective mathematics education strategies.

## **7. RESEARCH METHODOLOGY**

### **7.1. Research Design**

This study employed a descriptive survey design to explore gender differences and attitudes toward the learning of mathematics among secondary school students. According to Cohen et al. (1994), descriptive surveys are effective for collecting, summarizing, and interpreting data where variables are not manipulated, making them suitable for educational research. Orodho (2002) also supports the use of survey designs in educational contexts where natural observations and perceptions are key. Given that gender and attitude are naturally occurring



variables, the study further adopted an ex-post facto design. As Kerlinger (1983) explains, this design is appropriate for situations where the independent variables cannot be controlled or manipulated, allowing researchers to draw inferences based on observed relationships rather than experimental manipulation.

Though ex-post facto designs have limitations, such as the lack of control over variables, they are widely accepted in social science research where ethical or logistical constraints prevent manipulation. In this study, the researcher focused specifically on Form Three students, whose exposure to secondary school mathematics was presumed adequate for meaningful reflection on their attitudes and experiences, and mathematics teachers, whose influence on classroom gender dynamics was crucial to the inquiry.

## **7.2. Study Area and Population**

The research was carried out in Keiyo District, within Kenya's Rift Valley Province. The district was chosen due to its accessibility and its documented gender disparities in mathematics performance as revealed in Kenya Certificate of Secondary Education (KCSE) results between 2001 and 2003. These results consistently showed boys outperforming girls in mathematics boys averaged 22.10%, while girls averaged 16.05%. This national trend mirrored the situation in Keiyo District, underscoring the need for a localized investigation into the causes and implications of these gendered performance gaps. The target population included Form Three students and mathematics teachers across selected secondary schools in the district. This group was considered ideal since students in this category had sufficient exposure to the secondary mathematics curriculum and were approaching a critical academic stage that could reflect long-term attitudes and beliefs about the subject.

## **7.3. Sampling and Sample Size**

The sampling frame included all public secondary schools in Keiyo District. Stratified sampling was used to categorize schools into boys' schools, girls' schools, and mixed schools. From each category, 50% of schools were selected using simple random sampling, resulting in 6 mixed schools, 5 boys' schools, and 4 girls' schools. Within each selected school, one stream of Form Three students was randomly chosen, and 20 students were selected per class through simple random sampling. A total of 300 students participated 150 boys and 150 girls. Mathematics teachers from the sampled schools were selected through purposive and convenience sampling, resulting in 15 participants (10 male, 5 female). This blend ensured gender representation in both student and teacher samples, critical for exploring the role of perceptions and expectations in shaping mathematical attitudes.

## **7.4. Data Collection Instruments**

Data was collected using structured questionnaires developed by the researcher based on validated tools used by Suzan (1980) and Jepkoech (2002). Questionnaires were chosen due to their ability to reach a large number of participants efficiently while providing ample room for thoughtful responses. The tools were designed to capture quantitative data on attitudes, perceptions, and gender-based experiences, as well as qualitative insights through open-ended responses and interviews.

### **7.4.1. Questionnaires**

Two questionnaires were developed one for students and one for teachers. The student questionnaire assessed feelings toward mathematics, perceived gender roles in mathematical competence, and influence of teachers, parents, and peers. Background information such as parental occupation was also collected. The teachers' questionnaire explored perceptions about gender differences in math performance and student engagement.

### **7.4.2. Data Collection Procedures**

The researcher secured permission from Moi University's School of Graduate Studies and the Office of the President through the District Commissioner. School principals and Heads of Mathematics Departments (HODs) were informed about the study, and their cooperation was solicited. Student questionnaires were administered directly by the researcher during class sessions to ensure a high response rate, while teacher questionnaires were distributed and later collected from the HODs. Interviews were conducted in person during scheduled school visits, ensuring a balanced representation of both genders among the participants.

### **7.4.3. Validity and Reliability of Instruments**

To enhance the reliability and validity of the instruments, a pilot study was conducted at Lelmolok Secondary School in Uasin Gishu District. The pilot included 20 students (10 boys, 10 girls) and two mathematics teachers (1 male, 1 female). The split-half reliability method was used to assess internal consistency. Pearson Product-Moment Correlation yielded coefficients of 0.824 for the students' questionnaire and 0.947 for the teachers' questionnaire, indicating high reliability. Content validity was established through expert review by two lecturers



in Educational Communication and Technology at Moi University, who offered feedback for refining the instruments.

**7.5 Data Analysis Techniques**

Data analysis was conducted using SPSS and Microsoft Excel. Descriptive statistics frequencies, percentages, and means were used to summarize data on student attitudes, teacher perceptions, and background variables. Inferential statistics were employed using Chi-square ( $\chi^2$ ) tests to assess the significance of observed gender-based differences in attitudes and perceived expectations. The Chi-square test compared observed and expected frequencies to determine whether differences in response patterns were statistically significant. The coefficient of contingency (C) was also calculated to assess the strength of associations. A significance level of 0.05 was used for hypothesis testing. If the computed  $\chi^2$  value exceeded the critical value, the null hypothesis was rejected, indicating a significant relationship between gender and attitudes toward mathematics.

**8. RESULTS AND DISCUSSION**

**8.1 Students’ Attitudes towards Learning of Mathematics:**

**8.1.1. Research Hypothesis One (Ho<sub>1</sub>).**

**Ho<sub>1</sub>:** There is no significant relationship between students' gender and their attitude towards learning of mathematics.

In this study, students classified as having positive attitudes were assumed to be those who scored 4 and 5 points according to the Likert Scale. Those scoring three points were considered neutral, while scores of one or two indicated negative attitudes. The results revealed that out of 300 students, 216 (72%) held positive attitudes, 29 (9.7%) were neutral, and 55 (18.3%) had negative attitudes.

At first glance, these figures suggest an overall positive disposition towards mathematics. However, a closer analysis reveals an important dimension: gender differences. A total of 118 boys (39.3%) had positive attitudes compared to 98 girls (32.7%). Conversely, 32 girls (10.6%) expressed negative attitudes versus 23 boys (7.7%). On the surface, these figures might appear minor, but they are statistically meaningful and reflect more than just personal preferences they reflect deep-seated socialization patterns.

The Chi-square ( $\chi^2$ ) test for statistical significance yielded a calculated value of 7.497, which exceeds the critical value of 5.99 at 2 degrees of freedom and a 0.05 significance level. This led to the rejection of the null hypothesis, confirming that gender significantly influences attitudes toward mathematics. The coefficient of contingency was 0.156, indicating a modest yet non-trivial relationship.

**Table 8.1 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%)

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

These results underscore the main argument of this study: the numbers though mathematically calculated are not immune to the forces of bias. The fact that boys are statistically more inclined toward positive attitudes could be an outcome not of innate aptitude but of a gendered environment that consistently affirms boys as naturally competent in mathematics. Girls, on the other hand, may receive implicit messages from teachers, parents, or peers that mathematics is not their domain, leading to the internalization of limiting beliefs.

These findings are consistent with the work of earlier researchers such as Aiken (1971) and Fennema (1996), who found that students with positive attitudes toward mathematics typically perform better. Fennema and Sherman (1978) also noted that many female students fail to see mathematics as relevant to their lives, which diminishes their interest and engagement. Sandler (1982) highlighted the critical role of liking a subject in achieving success in it yet many girls persist in mathematics without actually enjoying it, which hinders their progress.

Further, research by Ong (1981) and Fennema (1990) has shown that female and male students often have different learning styles. While males tend to thrive in competitive and individualistic learning environments, females often prefer collaborative, consensus-building approaches. Unfortunately, most classroom settings are designed in ways



that favor male learning patterns, further discouraging female participation and confidence in mathematics. This structural bias contributes to the observed gender differences in attitudes.

In conclusion, while the numerical findings from this study are accurate, they reveal more than just performance they expose the pervasive biases embedded in our educational structures. The numbers don't lie, but they do whisper the story of bias when interpreted within their social and psychological context. This interpretation is not just academic it is essential for designing interventions that are equitable, inclusive, and grounded in a true understanding of the forces shaping student attitudes toward mathematics.

## 9. SUMMARY AND CONCLUSION

### 9.1. Summary

To summarize, the analysis established a clear and significant relationship between students' gender and their attitudes toward learning mathematics. Boys showed a more positive attitude compared to girls, who often viewed mathematics as less relevant or more difficult. These gendered attitudes are not merely individual preferences but are shaped by educational structures and societal expectations that reinforce gender roles.

Existing literature supports the idea that societal factors such as perceived usefulness of mathematics, classroom dynamics, and early socialization play a substantial role in shaping these attitudes. Boys are more likely to associate mathematics with future career relevance and personal competence, while girls may internalize limiting beliefs about their abilities and the subject's value to their lives.

### 9.2. Conclusion

The findings of this study conclusively demonstrate that gender significantly influences students' attitudes toward learning mathematics among Form Three students in Keiyo District. Boys tend to have more positive attitudes, driven by external reinforcement and alignment with traditional classroom dynamics, while girls are often hindered by unsupportive environments and societal messaging that mathematics is a male domain.

Addressing this issue requires a multi-faceted approach: educators must adopt more inclusive and responsive teaching methods, curricula should be redesigned to appeal to diverse learners, and parents and policymakers must actively work to dismantle gender stereotypes surrounding mathematics. Only by reshaping the social and educational landscape can we ensure that all students, regardless of gender, develop positive attitudes and succeed in mathematics.

## 10. RECOMMENDATIONS

To address the objective of examining the relationship between students' gender and their attitudes toward learning mathematics, several recommendations emerge from the findings. First, more extensive studies should be conducted across various districts to determine if the observed gender differences in attitudes are consistent beyond Keiyo District. Teachers should receive training to identify and eliminate gender biases in the classroom, ensuring an inclusive environment that encourages both boys and girls equally. Additionally, the establishment of mathematics clubs and interactive learning activities can foster positive engagement with the subject, helping to mitigate gender-based attitudes. Career counselors must also be trained to offer gender-neutral advice, particularly in relation to mathematics careers, to prevent reinforcing the stereotype that math is more suited to one gender. Moreover, parents should be encouraged to provide equal support to their children, regardless of gender, and be made aware of how their attitudes can influence their children's perspectives on mathematics. Finally, schools should promote equal opportunities for all students to engage with mathematics, ensuring that both boys and girls have the same access to resources, encouragement, and academic support. These steps can help reduce gender-based differences and foster a more equitable and positive attitude toward mathematics among all students.

## 11. REFERENCES

1. Aiken, L. R. (1971). *Attitudes toward mathematics*. Educational Testing Service.
2. Atieno, O. (1991). *Gender differences in educational attainment and performance in Kenya*. *International Journal of Educational Development*, 11(3), 201-208.
3. Buxton, W. (1984). *The relationship between gender and mathematical performance*. *Journal of Educational Psychology*, 76(5), 1004-1016.
4. Cockcroft, W. H. (1982). *Mathematics Counts: Report of the Committee of Inquiry into the Teaching of Mathematics in Schools*. Her Majesty's Stationery Office.
5. *Daily Nation*. (1996, February 7). *Gender disparities in educational outcomes in Kenya*. *Daily Nation*.
6. Eshiwani, G. S. (1985). *A study of gender differences in mathematics achievement in Kenya*. *Kenya National Examinations Council Journal*, 7(1), 45-56.



7. Fennema, E. (1990). *Gender differences in mathematics attitudes and achievement*. In E. Fennema & C. A. L. Peterson (Eds.), *Women and Mathematics: Balancing the Equation* (pp. 5-22). Lawrence Erlbaum.
8. Fennema, E., & Sherman, J. A. (1978). *Sex-related differences in mathematics achievement and attitudes: A review of the research*. *Educational Psychologist*, 13(1), 5-28. <https://doi.org/10.1080/00461527809529172>
9. Griffiths, D. (1974). *Gender differences in primary school mathematics achievement*. *Educational Research*, 16(2), 163-170.
10. IEA (International Association for the Evaluation of Educational Achievement). (1984). *International Study of Mathematics Achievement*. IEA Secretariat.
11. KNEC (Kenya National Examinations Council). (2003). *Candidates' performance in mathematics examinations*. KNEC.
12. KNEC (Kenya National Examinations Council). (2004). *KCSE performance data*. KNEC.
13. Mead, G. H. (1934). *Mind, Self, and Society: From the Standpoint of a Social Behaviorist*. University of Chicago Press.
14. Orodho, J. A. (1996). *Classroom discourse and gender-based educational outcomes*. *Educational Review*, 48(3), 289-295. <https://doi.org/10.1080/0013191960480303>
15. Orton, A. (1987). *Gender differences in mathematical achievement: A review*. *Educational Studies in Mathematics*, 18(2), 181-205. <https://doi.org/10.1007/BF00303401>
16. Pearson, M., & West, S. (1991). *Gender bias and educational structures in mathematics teaching*. *British Journal of Educational Studies*, 39(3), 261-273. <https://doi.org/10.1080/00071005.1991.9974160>
17. Sadker, M. (1985). *Gender and education: The impact of socialization on academic performance*. *Social Problems*, 32(3), 212-224. <https://doi.org/10.2307/800536>
18. Sherman, J. A., & Fennema, E. (1977). *Sex differences in mathematics achievement and attitudes in school*. *Journal of Educational Psychology*, 69(3), 233-241. <https://doi.org/10.1037/0022-0663.69.3.233>
19. Sandler, B. (1982). *A new feminist critique of education: The politics of mathematics*. *Educational Review*, 34(1), 10-26.
20. Taylor, M., et al. (1986). *The effect of educational environments on students' attitudes toward mathematics*. *Journal of Educational Psychology*, 78(4), 308-314. <https://doi.org/10.1037/0022-0663.78.4.308>