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Original Article

Gender Dynamics in Mathematics' Learning Attitudinal Inclinations

Andrew Kibet Kipkosgei[1*]

[1] University of Kabianga, P. O. Box 2030 - 20200, Kericho, Kenya.
[*] Author for Correspondence Email: akipkosgei@kabianga.ac.ke

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ABSTRACT

This paper is examining effects of secondary biases [such as parental perceptions about whether male or female teachers can teach mathematics better and whether female or male students can learn mathematics easily] on learner's attitudes. The findings of this study were based on data obtained from a study of 1200 randomly sampled (female and male secondary school) students in Elgeyo Marakwet County. The county was selected as a representative sample of the other 47 counties in Kenya. This study found that, as a result of parental education or exposure, attitudinal tendencies were evolving. The findings reported in this paper therefore implies that there is a shift from a generalist claim that all parents tend to believe that female learners are not equally endowed like boys in the process of learning mathematics. This study further reveals a transit from the findings of the previous studies where some parents used to believe that mathematics was relatively insignificant to female learners based on their career paths. This paper interrogates if this factor [i.e. parental view] is still impacting on the female students' attitude to mathematics in the early stages of learning or even their inclination towards studying mathematics courses later or not. Impact of female teachers on female learners and vice versa is also addressed in the paper.

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INTRODUCTION

The link between gender and learning mathematics is in relation to the way roles are stereotyped by society. Whereas, in the past, a lot of studies (e.g. Fennema, 1981; Karanja, 1996; Ogoma, 1997; Kariuki, 2004) have been reporting about the perception that good performance in mathematics is linked to male rather than female learners, this paper sought to find out if that is still the case even with the prevailing changes such as the neglect of the boy

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child and the introduction of competence based curriculum (CBC).

In Syyeda's (2016) perspective, attitude is a multidimensional aspect in the sense that it is affective, cognitive and behavioural. Attitude is effective because it is founded on emotions or feelings, whereby the learner may enjoy or lack pleasure in learning mathematics. Learners may feel that learning mathematics is unexciting in a way that affects their knack to learn the subject. From this view, attitude is a cognitive reality as it can be driven by the learner's perception about the usefulness of the mathematics to him or her. Attitude is also behavioural as it can be reflected in the learner's measures towards learning mathematics. This is in line with Yang's finding that behaviours exhibited by mathematics teachers' and even the school administration affect students' learning in a way that will be reflected in the results (Yang, 2013).

This study emphasised that attempts to study and describe attitudes must go beyond the investigation of learners' perspective by considering the teacher's attitude towards mathematics too. Some teachers may be teaching for the sake of it without the seal or competence in a manner that will twirl the learners' attitudes towards the negative. Many learners in this study were able to point out that their liking or disliking of mathematics had something also to do with their certain mathematics teacher(s).

A classroom structure may not favour gender equity if it is designed to advance the independence of boys or girls while rejecting collaborative mathematical thinking. Such a setting will tend to promote dominance of one gender against the other in the learning process. If such dominance in a mathematics class is favouring boys, they may excel over girls. The existence of a segregated kind of environment makes girls feel excluded in the learning activities and therefore affects the process of acquiring knowledge. This means that mutually inclusive criteria can enhance the development of positive attitudes in mixed sex mathematical classes.

Whereas many studies have suggested that girls tend to have negative attitudes towards learning of mathematics (Herman, 1963; Edward, 1973), this study has proved that it is not always true that every girl has a negative attitude towards it. Our study found some girls with very positive attitudes towards mathematics and who are even more competent in undertaking mathematical operations than boys and vice versa. This has motivated this paper to suggest that attitudinal studies should be done across ages or grades so as to shed light on how, why and where attitudes may be changing in the process of growth and learning amongst male and female learners separately. The findings of such a study may reveal levels at which interventions against negative attitudes may be introduced.

Scope of the Research and Research Objectives

An empirical study was done in order to verify if the above claims affect CBC learners' attitudes towards learning mathematics in Keiyo County and how such affects their performance in the subject.

REVIEW OF RELATED LITERATURE

In every civilization where gender practices are separated, there will be a delineation of responsibilities, attire, games, approaches and even behaviours that are meant for female and males respectively. Societies more often than not use obvious or implied masculine or feminine nomenclature (Bonvillian, 1995; Kariuki, 2004). Classification of gender-based roles in society as seen in our study tend to affect the society's view on which discipline subjects should be done by boys or girls as they prepare to handle the expected roles.

Teachers' behaviour is critical in determining leaner's attitudes and as a result their performance in mathematics. For instance, the learners can learn better if mathematics teachers endeavour to make their lessons enjoyable. This shows that creative teaching strategies which employ calculated humour will enable learners to enjoy learning and most probably impact on their performances (Ngussa & Mbuti, 2017).

Pask (1976) is one of the early studies to compare male and female learners' attitudes towards learning of mathematics. He points out that learners move through five stages; silence, received knowing, subjective knowing, procedural knowing, and constructed knowing. The findings relating these five stages were not categorical in linking attitudes

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with gender. The CBC education curriculum which has just been adopted in Kenya is critical in informing the learner of his or her gender at the elementary level. The extent to which this kind of awareness arouses gender-based attitudes to learning at this stage of development is not yet established.

As clearly indicated in Taylor and Mardle (1986), there is enough evidence that there is gender discrimination in the education system whereby 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. Their conclusion however did not ascertain that their findings were universal.

Studies to determine at what age is attitude towards learning of mathematics is acquired by boys and girls such as those of Catsambis (1995) and Sadker & Sadker (1985) are important for education planning. Their study established that parents tend to start building attitudes in children by attaching more value to male child than a female child. Upon getting to school, teachers seem to reinforce the attitudinal foundations. Teachers for that matter seem to lubricate the attitudinal dimensions of the society holding the learner. Just the way most parents do, Sadker and Sadker (1985) have found out that teachers also treat boys and girls differently, with the later considered as the weaker sex.

It is important for a teacher to understand the psychology of classroom discourse organization which is accommodating to male and female learners. Fennema and Sherman (1977) found that in a classroom setting, female learners prefer the use of conversational styles which promote team consensus and encourage building of a precept upon a precept. Girls value the way ideas and actions are connected. Boys on the other hand tend to learn easily via structured argumentation even if actual activities are not interrelated with the ideas. As a result, it appears that most classroom discourses are often unconsciously organized prototypically by teachers as such as to accommodate male learners while disadvantaging female learners even in mathematics classroom. This finding was corroborated by our study on attitudes in CBC program through interviews whereby we established that sometimes teachers negatively impact on learners' attitudes while they are not even conscious of such.

There is no empirical evidence which is linking the failure of girls to participate in girls' and being an inferior gender. It has however been established through research that a negative attitude towards learning of mathematics is one of the reasons why girls hardly participate in mathematics classes and subsequently why they end up failing in the subject (Willis, 1995; Xin, 2004; Leder, 1990). It is evident from studies of these scholars that the link between gender and participation is an affective variable which this study found to be a topic of relevance even in topic with the advent of CBC system of education in Kenya.

The usefulness of a matter is related to attitude or the way someone attaches value to it. For this reason, girls as witnessed in this study and as was also found by Fennema and Sherma (1978) have a very high tendency to have negative attitude towards mathematics if they believe that mathematics will not be useful to them later in their lives. In lieu of this, our study found that where girls thought that there was no direct connection between mathematics as and their future lives of career, it was more likely that they will not like it (much) and even give it enough concentration. On this vein, our study confirmed the view taken by Lynn and Derek (1984) that liking mathematics is very important for a boy or a girl to be successful in it.

Researchers have shown that parents in Kenya impact on the female learners' attitudes towards learning of mathematics. The learners' minds are configured from their homes so that they will portray either positive or negative attitudes. This configuration which is done through day-to-day communication shapes the view and finally the outcome (Ogoma, 1997).

Karanja (1996) asserts that, "If you think the subject is hard, it becomes hard. But if you are positive about it; it becomes simple" (pg 19-20). Jepkoech (2002) suggests that girls' poor performance in mathematics is due to gender discriminative attitudes in peer culture. Such claims motivated this study intending to establish whether there is a relationship between

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peers and students attitude towards learning of mathematics in Competence Based Curriculum (CBC).

CBC is basically a learner-centric system of education. This means that learners' participation is an indicator of learning. Whereas a result of fear or negative attitudes, few female learners participate in learning activities; this will force the teacher to unconsciously concentrate on teaching male learners. This because, the teacher will be responding to students' responses and therefore inactive or passive students may not learn much since they don't present themselves for attention or they are overlooked. A survey of CBC classes showed that there are more girls than boys in all classes in the sampled mixed schools. In spite of the high number of girls against boys, we noted that boys were dominating in mathematics classes since they were asking more questions than girls, they were answering questions more often than girls and they were more frequent and vocal in class consultation across the sampled grades.

Cultural prejudices that are gender biased may impact teacher attitudes towards the ability of girls to learn mathematics. Bosire (1997) shows that a number of male teachers are prejudiced against girls and do not engage them in learning activities such as answering questions or conducting experiments whenever they are combined with boys in the same classes.

Prior experiences affect students' view of mathematics attitudes in such a way that they may lead to poor or good performance (Markovits & Forgasz, 2017; Ashcraft & Kirk, 2001; Passolunghi et al., 2016; Smetackova, 2015 ;). Students who previously performed dismally in mathematics may even dislike and avoid mathematics as he or she progress in education (Joensen & Nielsen, 2009; Woodard, 2004; Rose & Betts, 2004). This implies that experiences are relevant in building and sustaining the right attitudes which are critical in achieving high performance in mathematics. For this reason, measures of reversing negative attitudinal trends can be applied in cases where performance is diving.

METHODOLOGY

Descriptive survey design was used in this research to study the interplay between gender and attitudes in learning mathematics. In this design, the relationship between gender and students' attitudes was analysed and described. The researcher was a mathematics teacher in the Elgeyo Marakwet county for a long time and thus he understood the area well which is why he chose it as a representative sample of the other counties. The target population in this study was 1200 secondary school students in Elgeyo Marakwet County. Purposive technique was used in sampling the gender targets; stratified sampling was used to identify the sub-counties which were studied and finally, random sampling was used in identifying the 600 girls and 600 boys who were studied.

RESULTS AND DISCUSSION

Parental Input on Students' Attitudes towards Learning Mathematics

Our study findings have revealed that most parents (60%) have gender biased attitudes towards which gender can teach mathematics better and which gender can learn it easily. Our interviews revealed that parental perceptions impact what they divulge to their sons and daughters thus affecting their view of mathematics. It turned out however that this trend is evolving in the sense that the most educated or exposed parents do not associate gender with performance in mathematics while the less educated or exposed parents still relate gender with performance in mathematics and even sciences to the extent that they can encourage or fail to encourage their children while driven by gender stereotypes. This finding implies that there is a shift from a generalist claim that all parents tend to believe that female learners are not equally endowed like boys in the process of learning mathematics (Macobly & Jacklin, 1975; Ruffel, Mason & Allen, 1998; Kiania 1995).

Our study further established a transition from the previous perspective as recorded by Dickens and Cornell (1993) where some parents used to believe that mathematics was relatively insignificant to female learners based on the courses or works they were expected to take later in life. Such a parental

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view according to our study is no longer impacting much on the female students' attitude to mathematics in the early stages of learning or even their inclination towards studying mathematics courses later.

In a rare case, our study sought to find how boys and girls fear mathematics teachers or examinations, the results showed that 80% of our male respondents indicated that they performed well in mathematics since they didn't fear their mathematics' teachers and they had had confidence that they will pass mathematics against the 50% in the case of female respondents. Our study for this reason went beyond the surface by establishing that the learners' attitude was sometimes triggered by the fear of a mathematics teacher or lack of self-confidence in relation to mathematics. In the interview, some confessed that many mathematics teachers were known for whipping.

In this study, we found that many (i.e. 65%) male parents use positive reinforcement whenever they are counselling their female children with respect to their performance while using negative reinforcement such as beating towards their male children. On the other hand, the results showed that 60% of female parents use positive reinforcement whenever they are counselling male children in respect to their performance. Whereas this kind of drifting emerges to pose significant effect, the cause of such male parent - female child inclination and vice versa was beyond the scope of this study. This study from this angle has revealed that the influence of female and male parents on children's attitude towards learning mathematics is not the same.

Teachers' Stake in Learners' Attitudes towards Learning Mathematics

This study found that teachers influence learners' attitudes in a number of ways. Our interviews established that teachers have been helping a lot in disrupting existing norms and beliefs about how learning mathematics is a male domain. The findings reveal that most mathematics teachers who teach many girls or only girls and are eager to see them pass tend to battle the negative narratives which seek to dissociate girls from mathematics. As a result, we discovered that many male and female teachers have been engaging in attitudinal campaigns that sought to dismantle negative narratives which were inhibiting positive results amongst male or female learners. This trend which we found in the CBC classes testifies to the fact that teachers contribute to students' attitude towards learning of mathematics as depicted in the 8-4-4 system by Wesonga (1996).

Our interviews of students especially found a number of ways in which teachers participate in the development of negative attitudes amongst students in the CBC. Firstly, the attitude which the teachers themselves hold about mathematics determine their zeal and consequently affects the learners' attitudes; secondly, the method applied by the mathematics teacher such as barely reliance of examples from the text or giving learners a lot of work without marking or revisiting distort the learners' liking for the subject; thirdly, the use of excess repressive punitive measures were found to demoralize learners; fourthly, in cases where learners sought assistance of teachers when they failed to understand mathematical concepts only to be referred to a text book, they quickly lost self-drive (attitude) towards learning mathematics if not the particular topic. Fifthly, we established that if a teacher is incompetent in mathematics or does not understand some topics in mathematics, he or she tends to lack confidence in teaching that, a situation which psychologically impacts on leaner's perception about the teacher and the complexity of the subject.

Peers, Gender and Attitudes towards Mathematics

Findings of this study show that learners in the lower CBC grades have not been influenced by peers to see that mathematics has been a male-dominated field. We established that as the learners progress towards the senior grades, stereotypical opinions about how a particular gender may be better than the other in learning or understanding mathematics begin to be shared amongst peers. Most (70%) of our respondents revealed that it is often the female peers who peddle the claim that mathematics is a masculine field which is highly dominated by men. Upon interviewing mathematics teachers, we confirmed Sherman's (1982) findings that girls whose attitudes have been affected by peers (and/or other parties) tend to be passive in their mathematics

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classes since they have been made to believe that mathematics is meant for boys. In this study, it became clear that the link between peers, gender and attitudes towards mathematics varies from one peer group to another, from one school to another and based on age or level of education. Our interviews further exposed that (trained) peer groups may be used to counter negative gender-based attitudes towards learning mathematics in schools.

This study established that peers have been used in some schools as engines that will power changes in attitudes for progressive academic development. This confirms the claim by Moon and Mayes (1994) that peer groups bring about change in the way students get involved in learning and consequently in the school's achievement. On this vein, this study found that children tend to inculcate new perspective or positive attitudes into their inner being if many or all peer groups in their schools express a similar positive attitude about how boys and or girls may perform mathematics in their schools. A good number of our female respondents (68%) were made to believe that mathematics is a masculine subject which may not be of much relevance to girls in their future careers. This study confirmed that the negative claims such as this on inconsequentiality of mathematics in women's future careers is not founded on facts but opinions or assumptions.

CONCLUSION

This study concludes that attitude is not directly correlated with gender in the sense that not all boys like or dislike mathematics or vice versa. Attitude however, impacts on performance of either gender in learning mathematics. Whereas there were very few female mathematics teachers in the field, we found no significant link between the gender of a mathematics teacher, attitude and performance of learners. There has been a gradual improvement in girls' perspectives towards mathematics and consequently their performance in it. It is notable still that besides male or female attitudes, other environmental factors impact learners' performance in mathematics.

A learner's inability to understand mathematical concepts or techniques is not a gender coefficient. Female learners do not fail to interpret or solve mathematical problems just because they are female. Female learners are not necessarily mentally deficient in comparison to boys since they harbour negative attitudes towards mathematics or are less confident in it. Teachers have to develop measures that are designed to transform the masculine perspective with respect to learning and using mathematics. Society's view of mathematics and female learners as unlike poles that rebel against each other will take time to be changed but it is possible. I begin to articulate the problem that lies in our current view of mathematics and its teaching. Female learners should begin to see that mathematics is a resource that is meant to enrich them and not a burden.

We also conclude that whereas gender differences in attitudes towards learning of mathematics seem to exist, the conclusions must never be made from generalisation. Most girls still appear to have negative attitudes towards learning of mathematics than boys. This may not be true in one learning environment against another as a result of measures put in place to mitigate or because of contextual factors. More studies need to be done even in areas where such had been done to see whether as cultures change in the face of modernization; attitudes towards learning mathematics that are attached gender are also changing.

Cross cultural research findings on the impact of female teachers on male and female learners versus those of their male counterparts should be compared. The results will provide further conclusions on teacher's gender on mathematics teaching and learning in cases where male teachers are teaching male students or female students or vice versa. Findings from mixed schools may be compared separately so as to provide a representative picture. Such studies may be repeated in different grades so as to display attitudinal trends against levels of education.

From an objective reference, studies on performance should also cross-examine data to confirm whether there are other psychological or physiological causes to failure in mathematics which may sometimes be blamed on gender and attitude. It is misleading to conclude in all or even most cases where students are passing to hypothesize that they had a positive attitude, studies must still consider means of

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breaking the borderline between attitudinal basis and non-attitudinal causes to poor performance. Various studies on attitudes have not shown whether learners with negative attitude towards mathematics always perform dismally or there are exceptional cases.

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