The Relationship between Gender and Attitudes of Students towards Chemistry in Secondary Schools in Bureti District, Kenya

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Abstract

The aim of this paper is to highlight and discuss the role played by gender in shaping attitudes towards Chemistry subject in secondary schools in Kenya. The paper is based on a study conducted in Bureti District of Kericho County. The main focus of the paper is to gauge the level of performance among girls in Chemistry subject, to compare boys' and girls' performance and show how girls could perform better, to assess the self-confidence level of girls in Chemistry and to give a general overview of the relationship between gender and attitudes towards Chemistry. The research employed a descriptive survey design. The target population comprised Form Four students in ten selected secondary schools in Bureti District of Rift Valley Province Kenya. Stratified random sampling technique was used to select the study sample. Schools were selected from the following categories: Girls schools, Boys schools and Co-educational schools. Simple random sampling was used to select the respondents from Form four classes as well as a teacher in each school. In all, one hundred and eighty-nine students and ten teachers filled the questionnaires. The data collection instruments were questionnaires based on the Likert-scale and document analysis. Data was analyzed descriptively using frequency tables, means and percentages while hypotheses were tested using Analysis of Variance. The results showed a significant relationship between gender and the attitude of students towards Chemistry. Furthermore, it was noted that self-concept of ability is a possible cause of academic achievement. Science teachers' should encourage development of positive self-concept of ability among students. Among other recommendations, the report suggests that guidance and counselling of students in schools should be encouraged, to ensure positive attitudes towards and full participation by girls in, the subject. The study will help to bridge the gap between girls and boys in co-educational schools.

Key Words: Relationship, Gender, Attitudes, Students, Chemistry, Secondary Schools

INTRODUCTION

The past two decades have seen a substantial increase in the opportunities, training, and encouragement given to girls and women to improve their performance in Mathematics and Sciences and to foster greater involvement in related fields. Although statistics reveal that there has been some progress made in the number of women who pursue Math and Science related programmes, the number of women majoring in other math related disciplines such as engineering and computer sciences is still small (National Centre for Education Statistics [NCSE, 2003]).

Globally, women tend to be under-represented in science and technology (Kinyanjui, 1993). This is partly due to choices they make at lower levels in their school education. Limited access to science and technology means that the majority of women will not get a chance to contribute to national development and their participation in the decision making process will be limited.This imbalance between the sexes needs to be addressed for an egalitarian society. The difficulties and problems hindering female participation and good performance in Mathematics and Science subjects should be investigated. This is supported by Njuguna (1998) who recommends further research to be carried out on gender and the type of school (co-educational or single sex) in relation to attitude towards science subjects and academic achievements in these subjects. Thus the study that informed the writing of this paper aimed at exploring gender attitudes held by students about Chemistry in secondary schools.

This research was again based on Sex-role theory. The theory defines the process through which people adopt the attributes of cultural sex-roles. Most psychologists have reached the conclusion that the social environmental factors have much more impact than the underlying biological factors in the development of gender- related stereotypes (Eshiwani, 1989). Sex-role theory can provide a base for investigating stereotypes and attitudes of students' towards Chemistry.

The Kenya Certificate of Secondary Education (KCSE) examination results show that most students have been performing poorly.The performance of female students has been poor in Chemistry (Kenya National Examinations Council [KNEC], 2005).Balanced teaching is essential in determining the academic achievement in Chemistry. Science has developed to a level where we today live in scientific civilization where science is no longer confined to a few individuals or countries that are devoted (Wachanga, 2002). Science is involved in food production and preservation, health care, telecommunication and energy conservation.

One of the challenges that hinder female access to higher education is the quality of the school and the subjects offered, the greatest disadvantage experienced by the Kenyan girls was lack of access to science and mathematics, which proved decisive because access to higher education required both. The poor quality institutions they attended and continue to attend and their constricted curriculum choices put the girls and women at a disadvantage. Eshiwani (1984) notes that in Kenya, most of the girls went into domestic science handicraft and Biology while boys went in for Chemistry because of the quality of the school and the curriculum offered. Watson (1995) presents the disparities in fields of study chosen by men and women. Research in Kenya conducted by Kithyo (1999) also shows that most of these schools are of poor quality and offer limited subject choices to the students thus limiting the girls' access to tertiary and university education.

While some aspects of differences between male and female students in education may have a biological basis, the vast literature in this area indicates that the main differences reported during the school years appear to result mainly from gender-linked experiences, both at home and at school.The challenge for the effective teaching is to ensure that both male and female students are able to receive a broad based education, with the opportunities to follow up specific interests and activities, without students' progress and choices being unjustifiably constrained by gender (Brown,1992). Many studies have

highlighted the ways in which the students and the schools response to gender contribute to these constraints, particularly by fostering the perception that attainment in some subjects is more appropriate to boys or to girls. For example, Macrae (1991) asked 11-12 year old pupils to rate school subjects along various seven-point rating scales, which included the dimension of masculine-feminine. The study also reported that boys tend to view masculine subjects as ―interesting‖ and feminine ones as ―boring‖. In contrast, the girls tend to view masculine subjects as ―difficult‖ and feminine subjects as ―easy‖. Numerous studies have highlighted a number of factors, which seem to influence the development of such perceptions. These include:

(a) Whether the subjects are usually taught by a male or a female teacher
(b) Whether the subjects are related to sex-stereotyped career aspirations or not
(c) Whether or not the sexes differ in their perceptions of the subject‘s interests and their general ability in the subject
(d) Whether or not the students and the teachers‘ behaviour in the classroom reinforces sex-stereotyped perceptions
(e) Whether or not school documentation or organization relating to the curriculum includes in-built assumptions about sex-stereotyped behaviour.

The greater emphasis now evident in schools to promote equal opportunities demonstrates that much more effort has been taken to improve school practices in this respect, and programmes of personal and social education typically deal with gender issues (Myers, 1992). Examples include having visits from women engineers to talk to female students about the possibility of careers in engineering; having posters on the wall in the Mathematics classrooms of great male and female Mathematicians, and encouraging boys to take part in singing and dance activities. Interventions such as these do seem to have had an effect in moving both boys and girls towards holding more positive attitudes to activities regarded as more typical of the opposite sex. What has proved harder to achieve is converting a change of attitude to actual changes of behaviour.

A particularly interesting intervention has been the use of girls-only science lessons in co-educational schools as a means of allowing girls to do science without boys being able to dominate the teachers‘ attention and teacher-student interactions. In addition, there is a tendency to regard doing well at school as a reflection of conformity and conscientiousness, which sits less easily with the development of boys‘ self-image, in parts exaggerated by the presence of girls.

Cockroft (1982), in his review of research has reported that ―There appears to be an identifiable (although small) correlation between attitude and achievement. It is not clear, however, in what way attitude and achievement affect one another. Sayers (1991) observes that females are underrepresented in education, particularly in the area of mathematics and Science. In the comparison between boys and girls attitudes, he found that girls are less confident and more nervous. Njuguna (1998) has found out that there is a positive relationship that exists between attitude towards Science subjects and achievement in these subjects.

Dale (1974) could not find any evidence to favour single-sex schools but he reports a polarization of attitudes between the sexes in mixed school towards the choice of subjects taken. Boys in single-sex schools are more favourably inclined towards stereotypical _female' subjects such as French, and girls in single-sexschools were more likely to opt for Maths and Physics.In Africa, girls specializing in natural sciences tend to come from more affluent socio-economic background and to have better educated parents with less strongly held nation of sex-role stereotypes (Erinosho, 1993). Sex role stereotyping in school text books continues to be significant, and girls are rarely depicted as active participants in science text book illustrations (Kelly, 1986).

The Female education in Mathematics and Sciences in Africa (FEMSA) project has observed that the lower performance and participation of girls in Mathematics and Science is as a result of the attitude of the teachers, students and parents to the idea of women engaging in' male careers' such as engineering. There is a belief among many teachers including some women that girls are intellectually incapable of studying difficult and task oriented subjects such as mathematics and sciences. There is evidence that girls are actively discouraged by teachers, who do not expect good performance from their girls and do not wish to ―struggle‖ with them. Some parents have the beliefs that a girl who succeeds in Science, Mathematics and Technology is somehow abnormal and a poor prospect for marriage.

It is possible that some part of the explanation as to why fewer girls than boys participate in higher levels of Chemistry and in Science-related careers may be due to the students holding stereotypes about appropriateness of Science for males verses females. Particularly amongst cognitive theorists, gender stereotypes are believed to provide the knowledge base against which behaviour is matched and its appropriateness evaluated (Francis, 2000). Further research has shown that students in secondary schools illustrate how their attitudes and values regarding the nature of school and the importance of school learning are fostered and shaped by the expectations of their peers, parents and teachers (which may often be in conflict with each other). Interviews with pupils highlight the way in which pupils need to strike a balance between the social side of the school life and the importance of devoting time and effort to school learning.

Statement of the Problem

Despite the efforts made by researchers to improve secondary school Chemistry curriculum, recent findings indicate that the level of Chemistry achievement, among other subjects, has remained persistently low (Ministry of Education [MOE, 2005]). Researchers have identified many variables affecting student achievement, especially girls. These include student's social-economic status, availability of learning resources, cultural context, family size, vocabulary of scientific terms and computation.

There seem to be limited research on the effect of attitude and gender on student performance in Chemistry. The study therefore endeavoured to fill the gap by investigating the attitude that students have towards Chemistry and its influence on academic achievement. Many students in Kenya choose to drop science subjects when given a choice and even those who take them; performance is below average (Changeiywo, 2000; Aduda, 2003).

Research findings and records from KNEC show that the mean scores in Biology and Physics lie between 27 and 32%, while that Chemistry lies between 25 and 26%. The overall performance is below average, worst of all is Chemistry. This difference in performance may be a result of the attitudes held by students towards Chemistry. Perhaps the poor performance in science subjects is the one that prompted the government through the Ministry of Education Science and Technology (MOEST), with the assistance of the government of Japan through Japan International Cooperation Agency (JICA), to undertake a programme to Strengthen Mathematics and Sciences in Secondary School Education (SMASSE) (Changeiywo, 2000). This programme has been implemented in Bureti District but students' performance in science still remains low (KNEC, 2005).

In response to the challenge posed by the poor performance and low enrolment in science, several studies have been carried out in Kenya to investigate the possible causes (Eshiwani, 1984; Kyalo, 1984; Mondoh, 1986; Wachanga, 2005). The majority of the studies centred on the instructional methods used by the teachers in teaching sciences and Mathematics. However, Haimowitz (1989) notes that the cause of most failures in schools might not be due to inadequate instruction but perhaps by active resistance by learners. Head (1988) reinforces this argument by pointing out that students do not like sciences in most cases and therefore it is imperative that their feelings are considered alongside their thought.

Mwamwenda (1995) also argues that the achievement of students in a subject is determined by their attitudes towards the subject rather than the inability to study. All these arguments point to the important role that attitudes play in determining the achievement of any success. This therefore suggests that favourable attitudes towards sciences should be developed if success is to be attained. To be able to do this, a clear understanding of factors which influence formation of attitudes is essential. This paper therefore examines the relationship between the attitudes held by learners towards Chemistry and gender-related issues.

Limitations of the Study

Although the descriptive survey design employed in the study enabled data collection on many variables, there were increased chances of sampling errors. Despite the fact that the design allowed for a large number of subjects, the number used was small since more subjects could attract increased costs. The few boys' schools in the District and the proportionate sampling technique may not have provided a truly representative sample and since the design was non-experimental, independent variables might not have been fully controlled.

MATERIALS AND METHODS

The study was conducted in Bureti District in South Rift Valley Province. Thirty percent of the Secondary schools in the District are provincial schools while the rest are district secondary schools. The District has a total of 55 secondary schools of which 40 are co-educational, eleven are girl's schools, and four are boys' schools. The main concern of the author was the academic performance of students in the Kenya Certificate of

Secondary Education (KCSE) national examination. Bureti District has continued to pose poor results in chemistry in National examinations.

The study sought to obtain information on students‘ attitudes towards Chemistry through questionnaires. As such, descriptive survey method was chosen because it is suited to the study of individual‘s attitudes. The study population comprised 189 Form Four students in public secondary schools and 10 Chemistry teachers in ten Secondary schools within Bureti District of Rift Valley Province, Kenya. A Chemistry teacher of the selected schools was part of the study because they have a task of preparing and creating a proper teaching and learning environment. Form Four students were selected because they have been in the school long enough to exhibit the necessary affective variables. The experience they have gained could enable them think abstractly.

Since it was practically impossible for the author to access all the schools in the District, only accessible population of secondary schools was used. The use of different types of schools was adopted so as to provide a representative sample of the school population from Bureti District. Stratified random sampling was used to get students from different settings. This was because there are claims that students in these different settings perform differently in academic work. In the study, the sample size comprised 10 Secondary schools, 10 Chemistry teachers and 189 students. The total number of respondents was 199.

Data was broken into broad categories for analytical purposes (parametric and non-parametric). It was then prepared for analysis through coding. Editing and cleaning of the data collected preceded analysis. Data was analyzed using descriptive statistics, which included use of frequency tables, means, standard deviation and percentages, while hypotheses were tested using analysis of variance.

RESULTS AND DISCUSSIONS

Performance of Girls in Bureti District in KCSE

The study aimed at finding information from the teachers on how girls perform in Chemistry.

Table 1. Performance of girls in Chemistry in Bureti District

Performance	Frequency	Percentage
Average	6	60
Poor	4	40
Total	10	100

According to the majority of teachers in the study (60%), the performance of girls in Chemistry was average while 40% revealed that the performance of girls in Chemistry was poor as shown in Table 1. This clearly indicates that the performance of girls in Chemistry is still low in the district. The dismal performance by some girls could be attributed to the negative attitude towards the subject. The attitudes the learners hold, for

instance, may have an impact on academic achievement since predispositions of the learners are likely to have an impact on the learning process.

Comparison of Performance between Girls and boys

The study sought to ascertain if there was a significant difference in achievement of Chemistry between boys and girls.

Table 2. Girls can do as well as boys in Chemistry

Response	Frequency	Percentage
SD	49	26
U	10	5
A	130	69
Total	189	100

From Table 2, 49 students (26%) revealed that girls cannot do as well as boys in Chemistry while 130 students (69%) responded positively that girls can do just as well as boys in the subject. This could mean that 49 students (26%) had a feeling that girls are not as good as some boys in Chemistry. Such revelations indicate why some girls develop negative attitudes towards Chemistry and dismal performance by some girls could be out of the negative attitude towards the subject.Differential treatment between boys and girls both at schools and home could impact negatively on the performance of girls in science. The attitude of some teachers could have discouraged some students, especially girls from Chemistry. Some could be stereotyping by passing comments or statements to the effect that girls were not expected to do well. Research over the last decade has shown that males and females have different classroom experiences because they approach learning differently and because teachers tend to treat them differently.

In other instances in classroom, teachers set standards for discourse. Their reliance on teaching methods that adhere to traditional norms and beliefs about gender differences, and that only male students are capable can create a ―chilly climatel for girls (Sandler, 1982). More studies have also reported the low expectations teachers have of their female students, which often lead to giving more attention to boys and even ignoring girls in classroom (Mungai, 2002). On the other hand, the reduced attention to girls affect the equality of opportunity because it renders girls less visible and worthy of attention, which is likely to affect their sense of self efficacy. Both teachers and students are contributors to a pattern that gives girls fewer opportunities to participate in classroom. Gender sensitivity should therefore be observed in teaching and learning.

Self-Confidence among Girls

Several studies have revealed that female students show more fear or anxiety towards the learning of Chemistry than their male counterparts do. The study therefore intends to confirm from the teachers of Chemistry from BuretiDistrict as shown below.

Table 3. There is a drop in self-confidence among girls

Response	Frequency	Percentage
Disagree	1	10
Undecided	1	10
Agree	6	60
Strongly agree	2	20
Total	10	100

From Table 3, only one of teacher (10%) admitted that there is no drop in self-confidence among girls. One teacher was undecided while majority of the teachers in the study (80%) revealed that there is a drop in self-confidence among girls in chemistry. Most female students in the study seemed to be scared mostly of the broadness of the subject, too much calculations, job opportunity and quality and methodology of chemistry teachers. According to the teachers in the study, a drop in self-confidence among the girls could be attributed to; broadness of the subject, lack of guidance and negative attitude.

Examinations also contribute to anxieties experienced or lack of confidence among the girls. Most of the girls in the study said that they felt nervous in examinations, especially Chemistry papers. One girl put it this way: ―In Chemistry exam I panic. I feel nervous…it does affect my results. I make silly mistakes during practicals….‖ They also revealed that tasks done outside classroom, a lot of students resorted to cheating by coping from friends. Though this appears valid, it says a lot about the modes of assessment that teachers generally employ.

Relationship between Gender and Attitudes of Students towards Chemistry

The research sought to establish the relationship between gender and attitudes of students towards Chemistry. The findings were as shown below.

Table 4. Relationship between gender and attitudes

Gender	Descriptive	Chemistry is my favourite subject	Able to tackle Chemistry problems	Girls can do just as well as boys in Chemistry
Boy	Mean	4.3810	3.5357	3.8214
	N	84	84	84
	Std. Deviation	0.9806	1.2843	1.4821
Girl	Mean	4.1048	3.2952	3.5619
	N	105	105	105
	Std. Deviation	1.1260	1.12475	1.4995
TOTAL	Mean	3.9101	3.7143	3.7460
	N	189	189	189
	Std. Deviation	1.2409	1.5204	1.4436

As noted in Table 4, the means of boys with respect to the attitudes towards Chemistry are relatively higher as compared to that of girls. More girls than boys expressed negative attitudes regarding the difficulty of Chemistry. It is possible that these attitudes of girls

are due to ―social norms‖ or in other words to social stereotypes. Girls' beliefs that Chemistry is difficult reflect stereotypes like ―Boys are born to be scientists or chemists.‖ It was found that the general performance of girls was low regardless of the type of school. The reasons suggested were the effects of parental, social attitudes and perception of jobs. As most of the books, films, television programmes; and newspaper articles highlight male science figures, then gender equity should be a goal of science education. The females in the study seemed to be scared most by the broadness of the syllabus, too much calculation, and more failures than passes, job opportunity and methodology of Chemistry teachers. The major problems of the males are centred on ill-equipped laboratory, lack of exposure to practical and strictness of the teachers. To support this claim is the low means for girls as compared to boys as shown in Table 4.

It would appear that many girls perform badly in Chemistry out of complacency. At primary school, girls and boys appear to perform at par. In fact, in some instances, some girls do better than boys, especially where it appears girls believe that they are good and thus relax in the subject. As Eccles and Blumenfeld (1983) explain, ―Students start school with sex-differentiated goals and attitudes. These attitudes appear to consolidate into sex differentiated beliefs regarding Mathematics and scientific abilities sometime around early adolescence‖(p. 80).

A Pearson correlation was calculated to establish whether a relationship exists between gender and attitudes of students towards Chemistry. A weak correlation was obtained on examining the relationship between gender and the item on _it would make me happy if I excel in Chemistry.' This implies that the feelings and perception that the students have about their ability as Chemistry learners are likely to be influenced by gender. Positive feelings about one's ability are likely to contribute to the favourable attitudes towards Chemistry. Analysis of Variance (ANOVA) was conducted to test if the relationship established is significant or not.

Table 5. Gender and the students' attitudes towards Chemistry

	Sum of Squares	Df	Mean square	F	Sig.
Between groups	23.718	3	7.906	3.400	0.019
Within groups	430.198	185	2.325		
Total	453.915	188			

Table 5 shows that F (3,185) =3.400, P<0.05. Thus there is a significant relationship between gender and the students' attitudes towards Chemistry. Consequently, the null hypothesis was rejected.

CONCLUSIONS AND RECOMMENDATIONS

Taken together, the findings of the study discussed in this paper seem to suggest an existence of both explicitly and implicitly activated stereotypes that affects performance. Though the messages of discouraging gender stereotyping appear to have filtered through

most of the students in the schools, its implications have not yet taken root. Many girls with positive or negative attitudes revealed awareness of the message; in particular that there are no differences between boys and girls academically, and that all subjects are open and should be done by all.

Although, all students, whether male or female, show anxiety towards learning of the subject, the anxiety is higher in females than their male counterparts.Teachers, as most other people, have stereotypical beliefs about gender. Sex-role identity influences the cognitive development of males and females in various domains depending on whether or not they see them as an acceptable domain to study for their sex. Evidence suggests that mathematics and sciences are viewed to be more appropriate for males than females.

One of the Millennium Development Goals (MDG) is to ensure gender parity in access and provision of education in all disciplines. And since sex equity in general is a societal goal, it is crucial to remove the barriers that prevent females from learning mathematics and sciences effectively. The first step therefore is for mathematics and science teachers to be more gender sensitive. If teachers understand and respect female learning style, they will alter classroom discourse to accommodate girls‘ participation and provide a message to both males and females that no single learning behaviour is superior to the other. Equally important are the concrete changes both in the teaching methods and curricular.

A cooperative learning that promotes collegiability between males and females students is one approach. Structuring lessons around the thinking process needed to arrive at answers to questions rather than focusing solely on the answer is another. Scientific problems can be tailored to reflect girls‘ experiences (although they should not be limited to stereotypically female concerns such as cooking, laundry and sewing) and emphasize practical, real life applications Providing opportunities for girls to interact as peers separate from the co-educational classroom can also strengthen their interest and participation in sciences. Gender bias in education and career counselling should be eliminated. Only when female are convinced that they can both learn sciences and use it for professional success will full integration of sciences in classrooms occur.Gender equity in the classroom is essential and peer pressure and expectations should be closely monitored. Boys need to be sensitized about their stereotyped behaviour.

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