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Looking Beyond Access: A Case Study of Science and Technology Education for Girls in Murang'a District, Kenya

Mweru Mwingi

Introduction

Generally speaking, improvements have been made in education in many sub-Saharan African countries, including Kenya. However, while access to and survival in school have become less of a problem regionally, there are still education inequalities in Kenya, even though it is among the few sub-Saharan African countries renowned for investing heavily in education. Education inequalities are pervasive in Kenya (UNESCO 2004). Many are gender- related and are especially pronounced in the quality of education outcomes, where three features are notable. First, girls' performance in the Kenya Certificate of Secondary Education (KCSE) falls below that of boys with regard to the overall aggregate and science and technical subjects. Second, there is under-representation of females in tertiary education. According to the Economic Survey for 2001 women accounted for only 31.7 percent of students enrolled in the six public universities in 2000/01. In Jomo Kenyatta University of Science and Technology, the only science and technology university in Kenya, only 21 percent were female. The trend was similar in all four national polytechnics (29.2 percent), technical training institutes (39.8 percent) and institutes of technology (43.0 percent). Third, although the quality, relevance and effectiveness of education are mirrored in employment, in 1999/2000 women comprised only 29 percent of waged employees. And except for social services, education services and domestic services, where female representation was slightly over 35 percent, women were less than 20 percent in agriculture and forestry, mining, manufacturing, electrical and

water works, building and construction, transport and communications and finance and business.

There is a deeply entrenched gender problem in primary and secondary education in Kenya (UNESCO 2002, 2004), despite the fact that that the 8-4-4 education system introduced in the late 1980s was designed to be practical and technical-oriented (Republic of Kenya 1988:17; 1984:5-8) and to prepare Kenyan youth of both sexes for the technical and scientific workplace[1]. Secondary education is the gateway to tertiary education and ultimately to technical and scientific employment, and so it is important to examine the situation in girls' schools, which are claimed to greatly strengthen female performance and participation in the classroom. Single-sex girls' schools are expected to expand opportunities for girls, particularly in science and technology education (UNESCO 2004). Literature on single-sex schools states that the absence of competitive classmates of the opposite sex promotes learning environments that are free from the gender stereotypes that hold girls back (Marsh 1991) and facilitates engagement that is free from peer pressure and negative competition from boys. In single-sex schools, girls' intellectual curiosity, assertiveness and high self-esteem are promoted. Moreover, the presence of female teachers as role models makes girls see that women can hold power and be strong and confident individuals and leaders who can enter any occupational field. Since the 1980s, numerous studies attest to the academic and psycho-social benefits of an all-female education (Riordan 1985,1990; Whyte et al. 1985; Lee and Marks 1990; Wong et al. 2002). However, with the re-emergence of the co-ed/single-sex debate, there is evidently a need for more critical engagement with girls' schooling and, in particular, the issues surrounding female access, participation and output in science and technology education.

Female Participation in Science and Technology Education

Studies in a number of sub-Saharan African countries show that girls in single-sex schools achieve better grades in Mathematics, science and technology subjects and are more likely to pursue university education and take science and technology courses in higher education than girls in mixed-sex schools (Erinosho 1997; Odaga and Heneveld 1995; Eshiwani 1983a, 1983b). While these benefits are well-known, there are still contradictions in girls' education that suggest that a single-sex education is not entirely a solution in the case of female access to science and technology education. Though science and technology subjects are available to all in secondary education, far fewer females take the subjects and more under-achieve at KCSE than males (see Table 1). Regarding this trend, the appropriate question to ask is, 'how accessible are science and technology subjects under the 8-4-4 system of education'?

To adequately respond to this question, it is important to understand the need to deviate from mainstream discourses on education equity, particularly access figures. Table 1 shows that males and females almost equally access science subjects;

the exception is Physics, which has low participation both for males and females. Access figures can be presumptuous, however. According to Gaidzanwa (1999:271), access figures conceal the social, economic and political features that accompany the construction and real nature of disparities. More importantly, they conceal gender, which in Kenya is an important feature of trends and patterns in education. As Kiluva-Ndunda (2001:8) states, 'gender determines the way in which power, property and prestige, educational and employment opportunities are organised, regulated and distributed'. Gender permeates and entrenches itself within education and, if left unexamined, gives an appearance of education equity. Thus, Gaidzanwa (1999:271-272) considers the reassessment of the history and theory of education in Africa to be of critical importance to the examination of gendered patterns.

Table 1: Participation in Science, Mathematics and Technology Subjects by Gender, 2001 KCSE

	Female			Male		
	No. of candidates	%	Mean % pass	No. of candidates	%	Mean % pass
*Mathematics	89,481	46.17	15.83	104,334	53.83	21.20
Biology	85,499	48.30	29.52	91,525	51.70	34.48
Physics	16,225	29.67	22.22	38,425	70.33	26.84
Chemistry	84,534	46.61	29.39	96,862	53.39	23.41
Home Science	10,365	95.17	58.26	526	4.83	51.65
Art and Design	418	35.04	53.64	775	64.96	54.91
Agriculture	44,309	45.45	45.54	53,181	54.55	48.67
Woodwork	24	1.84	51.33	1,277	98.16	50.62
Metalwork	3	0.82	56.00	365	99.18	59.08
Building Construction	46	5.31	39.89	821	94.69	49.31
Power Mechanics	9	2.30	36.77	313	97.70	54.36
Electricity	16	3.22	52.31	481	96.78	54.85
Drawing and Design	93	4.98	25.52	1,774	95.02	42.17
Aviation Technology	0.00	None	43	100.0	60.88	None
Computer Studies	543	48.79	54.44	570	51.21	57.64
Typing with Office Practice	970	95.85	54.15	42	4.15	55.86

Source: Kenya National Examination Council.
*Subject that is compulsory for all.

Framing Issues of Female Participation in Science and Technology

This paper asserts that gender intersects race, class and ethnicity to create a unique set of experiences that give rise to the development of distinctive perspectives. This occurs because being male or female within a social context carries certain connotations in which there is constructed difference based on sex (Sow 1999:45). Where sex is accorded oppressions and privileges, as in education, males and females access and experience education differently because gendering disadvantages females more than it does males at both macro- and micro-structural levels of education.

Given the need to understand that education, and more particularly science and technology education, is situated more broadly in a social, cultural and economic context that extends beyond classroom learning and interactions, this paper takes a feminist standpoint (Harding 1987). Feminist standpoint theory is decisive in extrapolating the causes and reasons for low female participation and achievement in science and technology subjects. Since it focuses on what might be described as distinctly 'female' knowledge (Harding 1991), it constitutes a legitimate way of knowing that is situated specifically in the experiences of women. It accepts that knowledge is socially constructed and interrogates the social processes that construct science and technology education as male. Thus, it provides a means for the analysis of how the history and development of an education system structures and institutionalises gendered frames not only within education but also among school subjects. Standpoint theory takes cognisance of the context and locality, or social location, of knowledge. 'Social location' refers to the way we express the core of our existence in the social and political world (Kirk and Okazawa-Rey 2001:58). It emanates from what is around us and how we are positioned in relation to others, in relation to the dominant culture of our society and in relation to the rest of the world. Social location also determines the kinds of power and privileges we have access to and can exercise, as well as the situations in which we have less power or privilege. In the case of education, it is seen in the development of education and the policies that culminate in the patterns evident in an education system such as that of Kenya today.

Research Methodology

The multiple case studies are case-specific. Nonetheless, they demonstrate macro- and micro-schooling realities and point to what could easily be viewed as typical ramifications of education policy and curriculum implementation in the choice of science and technology subjects in girls' schools. The first level of discussion is a structural analysis of secondary education in Kenya that includes deliberations on curriculum policy guidelines and enrolment in school subjects in form four. The analysis of subject enrollment patterns in single-sex girls' schools in Murang'a district is combined with KCSE results to pose the question of how equally accessible science and technology education really is. The second level of analysis examines schools as institutions. Descriptive statistics drawn from a stratified sample of stu-

dents in form three and form four in Yellowood, Fort Hall and Dominican (all pseudonyms) illustrate the institutional realities as far as science and technology subjects are concerned. This analysis sets up the foundation for a thematic analysis of individual subject preferences and perceived career futures in science and technology. This micro-level analysis is the third level and uses data drawn from focus-group interviews.

Research Findings and Discussion

The analysis of policy can be divided into two categories, that which determines the effects of policy on different population groups and that which examines content in order to determine the values and assumptions underlying the policy process. Analysis 'for' policy is not entirely different from analysis 'of' policy, except that the latter is more applied. Since policy is an instrument of function with philosophical underpinnings, tracing how gender, science and technology are treated in the 8-4-4 education policy documents reveals how gender, science and technology are constructed at the three levels at which policy operates, the symbolic, regulative and procedural levels[2].

The symbolic is the outer level; it constitutes the vision of the ideal future. As far as science and technology in Kenya are concerned, this future is espoused in *Sessional Paper No. 2 of 1996* (Republic of Kenya 1996), which envisions Kenya as an industrialised nation by 2020. However, with regard to education, a key vehicle in this transformation, the *Master Plan on Education and Training: 1997-2010* advocates the promotion of 'scientific concepts and skills' but is silent on the specifics (Republic of Kenya 1998:198-208) of how this will be done. However, the need for increased relevance and quality in education is cited as a strategic means to improved equity and achievement (Republic of Kenya 1998:72-73). At the regulative level, laws and regulations are designed to put the vision into effect. Education that gives priority to the development of science and technology education, like the 8-4-4 system, is one example (Republic of Kenya 1988). All the same, even with an education system that purports to be scientifically and technically geared, gender equity is still far from being realised in education generally, never mind in science and technology education specfically. Some explanation for this can be found in the place women have in Kenyan legislation generally. Mucai-Kattambo et al. (1995:80) argue that, because patriarchal practices remain unchallenged, many East African women are relegated to the social periphery. According to Kibwana (cited in Ndunda-Kivula 2001:165), 'women's role in Kenya society is fleetingly recognised', and official documents hardly mention the issue of gender equity, a gap that is seen in the peripheral treatment of gender issues in nine education and development policy documents released between 1964 and 1991 (Ndunda-Kivula 2001:55-81). The Ominde Report, the first policy document on education in post-colonial Kenya, is a classic example. It is silent on gender equity except for recommendations that girls' boarding primary schools be established in sparsely populated areas (Republic of

Kenya 1964:65). This silence may be understandable, given the climate of the 1960s, but it set a precedent for future policy that was blind to gender and, in particular, female access to science and technology education (Sifuna 1990:42). The legacy of low female participation and achievement is traceable to the omissions of the Ominde Commission report and others after it. On the ground, it is a regulative and procedural policy problem whose ramifications in education occur in the gender-biased ways that curriculum implementation guidelines are interpreted in schools.

Access to and Participation in Science and Technology Education: The Reality

The foundation of a science- and technology-based economy is in education. Thus, the 8-4-4 system aims to 'provide for a practical oriented curriculum that will offer a wider range of employment opportunities' (Republic of Kenya 1984:1; Republic of Kenya 1988:8). In terms of education output, the aim is to 'ensure that students graduating at every level have some scientific and practical knowledge that can be utilised for either self-employment, salaried employment or further training' (Republic of Kenya 1984:1). In practice, this means that both males and females should have equal access to science and technology education and, more importantly, should both study the subjects up to at least form four. Table 1 shows that such a level of participation is yet to be achieved. Even though the curriculum makes provision for these subjects to both males and females, participation and achievement in science and technology subjects is still gendered. Females appear to have less access to technical subjects. No female has access to Aviation Technology. Percentage scores for females are also lower in all the other science and technology subjects, except Home Science. Interes-tingly, this pattern is even replicated in girls' schools in Murang'a district, warranting one to question where the achievement advantages in single-sex schools lie.

At university level (see Table 2), female enrollment in the natural sciences, agriculture and veterinary medicine, engineering and architecture, medicine and pharmacy raises questions with regard to whether the pattern is a self-made choice or circumstantial, as males clearinsicaly appear to enjoy better access. To determine whether this pattern is preferential rather than circumstantial, it is important to point out that the implementation of the national curriculum is governed by regulative policies that are regularly updated by the Kenya Institute of Education and that public schools have little autonomy.

Curriculum implementation in public schools in Kenya is standardised. The size of a school (i.e., the number of classes it has) determines how many subjects can be offered in the school. This means that there are restrictions on the variety and kind of subject that a student can study. In many instances, the advantages and disadvantages of school size and, subsequently, of subject variety are linked to the history of the school, its regional location and the quality of its facilities and resources.

Table 2: Public Universities Degree Course Enrolment by Gender for 2002

	No. of Students		Percentage per Programme	
	Male	Female	Male	Female
Education	37,932	19,320	66.3	33.7
Humanities and Social Sciences	7,488	11,405	76.7	23.3
Natural Science	15,037	2,466	85.9	14.1
Agriculture and Veterinary				
Medicine	12,875	1,851	87.4	
Engineering and Architecture	7,974	1,139	87.5	12.5
Medicine and Pharmacy	3,416	837	80.3	19.7
Total	114,722	37,018	75.6	24.4

Source: Universities Joint Admission Board.

Among the 3,000-plus secondary schools in Kenya, 17 are national schools, among which are some of the now-defunct 'high-cost' schools (Republic of Kenya 1988:15). Most of these schools are large, single-sex establishments located in Nairobi or its environs. They have four, five or even more streams and for this reason can offer their students a broad selection of subjects ranging from seventeen to twenty-three (see Table 3 after). These schools tend to attract middle-class children.

A few provincial schools are as large as national schools, but the majority have only three or four streams, and many are also located in rural areas. District schools are more complicated. Many of them fall in the now-defunct 'low cost' category, and some even have *Harambee*[3] school characteristics, which include, among other things, poorly qualified teachers and poor facilities. Most district schools have only one or two streams, so the number of subjects that they can offer is restricted to fifteen (see Table 3). The majority of secondary schools in Kenya are small, with

Table 3: Secondary School Curriculum, Forms 3 and 4

Type of School (Stream)	Core Subjects	Physical Education	Science	Humanities	Technical /Applied Science Subjects	Cultural Subjects/ Foreign Languages	Maximum Number of Subjects
1-2	3	1	3	4	2	2	15
3	3	1	3	4	4	2	17
4	3	1	3	4	4	4	19
5 and above	3	1	3	4	8	4	23

Source: MoES&T, Management of the Primary and Secondary Education Curriculum 2001: Circular INS/ME/A/2/1A/124.

only one or two streams. These schools are scattered across rural Kenya. Many of them are day schools accessible even the children of the poor, because school fees are affordable, although not much else is.

There are substantial returns on economic development when women have secondary education, but even more when they are educated in science and technology subjects. However, the realities of Kenyan education militate against this ideal. The schools with four or more streams are unduly advantaged over those with two or less, as they have a wider choice of subjects to choose from in the technical/applied science category. The schools with few streams serve the majority of Kenyan children, but they are too small to provide access to quality education. For many of these schools, the restrictions are a consequence of social location. The same feature restricts girls from accessing equal educational opportunities with boys. Furthermore, the curriculum implementation guidelines are intended to guide schools to interpret the national curriculum, but instead they create differences among schools, setting students on different paths to adulthood. For girls, there is double disadvantage, first, from the kinds of schools they most attend and, second, from the attitudinal problems known to restrict them from participating in science and technology education. When combined, these two factors effectively relegate girls to 'soft' technical subjects like Agriculture and Home Science.

Girls' Participation in Science and Technology Subjects: A Case Study of Murang'a District

At time of this study in 2002, the most recent statistics on Murang'a district showed that it had a total of 19,422 students in 69 mixed, 7 single-sex boys' and 11 single-sex girls' secondary schools. More girls (10,831) than boys (8,591) were in secondary education, an indication of gender parity (Murang'a District Education Office 2001). 68 percent of girls (7,094) were enrolled in mixed-sex schools and 32 percent (3,737) in single-sex schools. At least 90 percent of all teachers had a university degree or a teaching diploma. However, there were considerably more male teachers (62.45 percent) than female teachers (37.5 percent). There was also a shortfall in science and technology teachers and English teachers (Murang'a District Education Office 2001).

According to KCSE results for 2000, all eleven girls' schools offered three science subjects, Biology, Chemistry and Physics. At least 32 percent (3,737) of the girls in secondary school in Murang'a had the opportunity to study three science subjects. However, the indications are that they did not seize the opportunity. Only five of the eleven schools had girls studying Physics to form four. This pattern shows that the availability of a subject in the school curriculum does not make it accessible. In fact, with the exception of Kiriani, where all form fours studied Physics, the total number of girls taking Physics in the five schools was only 30 percent (225). This pattern is odd, because single-sex schools are associated with achievement advantages, especially for girls. All the same, there are conclusions that can be drawn. First, it appears that girls opt for Biology, Chemistry and Physics rather than

Physical and Biological sciences, which are considered softer sciences, because of the higher value awarded to them in the Kenyan education system. Still, the majority of girls in Yellowood, Dominican and Fort Hall avoid Physics. It appears that being in a single-sex school makes little difference to subject preference.

With regard to subjects in the Applied/Technical category, four of the possible eleven are offered in girls' schools in Murang'a. None of the schools offers wood technology, metal technology, power mechanics, electricity technology, drawing and design technology, building and construction technology or aviation technology. However, these 'hard' technical subjects are found in boys' and mixed-sex schools (Murang'a District Education Office 2000; 2001). The national curriculum has marked them out as boys' subjects. The 'masculine' and 'feminine' construction of school subjects invariably excludes girls from technical subjects. With Home Science and Agriculture as the main technical subjects on offer in all eleven schools, and Computer Studies and Art and Design in two, the full advantages of a single-sex education are limited. The limited variety of technical subjects disadvantages girls with regard to higher education and future careers. The irony of this is that girls in Kenya are expected to compete with boys for courses and jobs that require a background in technology education, yet they do not have ready access to relevant subjects. It is important to note that girls know what is relevant to the job market; for example, only 23 percent (246) study Home Science. Girls in single-sex schools appear to be phasing out the subject, despite its availability and reasonably good KCSE scores.

Patterns of Participation in Science and Technology Education in Three Girls' Schools

High academic achievement among girls has become common in secondary education. Girls' schools have held top positions in the KCSE examinations for the last five years (Aduda 2001). Yellowood has featured among the top hundred schools nationally. It has also held top-school status in Murang'a several times (Murang'a District Education Office 2000). While the high rankings of girls' schools in KCSE examination league tables is an indication that girls have become competitive, it is important to note that only a few girls' schools merit this ranking every year (Okwemba 2001). The more important thing, therefore, is to interrogate whether top performance has any link to participation in science and technology education or to quality outcomes in science and technology subjects.

Murang'a district reveals some interesting contradictions as far as equity and participation in science and technology education are concerned. Alhough more girls than boys are enrolled in secondary schools, female participation in key science and technology subjects remains low. Participation and performance patterns in the 2000 KCSE were not very different from those at the national level, where only 13 percent (734) of the 5,644 candidates taking 'hard' technical subjects in the 2001 KCSE were female (see Table 1). Single-sex schools had no advantage in subjects in the technical/applied category. In fact, all eleven single-sex girls in Murang'a offered

two subjects only, Home Science and Agriculture. Subject elective participation patterns among form threes and fours in Yellowood, Dominican and Fort Hall show Home Science to be a dying subject. Only 19 percent (146) take the subject, a trend that is similar in all eleven girls' schools (see Table 4). It may be thought that girls are breaking away from gender stereotypes linked to this 'feminine' subject, but the growing lack of interest in Home Science is actually due to the fact that girls no longer perceive it as having value in higher education or the job market.

There is a slight difference in science subjects. At 96 and 94 percent for Biology and Chemistry respectively, female participation is nearly equal to that of boys nationally (see Table 1). However, participation was extremely low in Physics (18 percent). The pattern was equally dismal in 2001, when less than 30 percent of the KCSE candidates that took Physics were female (Wassanga 2003:579). This skewed pattern is similar among the eleven girls' schools in Murang'a and also in Yellowood, Fort Hall and Dominican (see Table 4). From this pattern, it can be concluded that access to a school is not enough. Biases abound, and the preference for Biology and Chemistry is evident even in single-sex schools like Yellowood, Fort Hall and Dominican, where three science subjects are offered (see Table 4). The same patterns are reflected in girls' career preferences. Science-related careers such as medicine are preferred to those that require a background in technical education, such as information technology or aviation.

Table 4: Participation in Science and Technology Subjects by Forms Three and Four Students

	Maths	Science		Applied Science & Technology				
School	Maths	Biology	Physics	Chemistry	Home Science	Agric.	Art & Design	Computer Studies
Yellowood	100 %	82%	26%	100%	9%	11%	3%	none
N=367	(367)	(300)	(97)	(367)	(34)	(40)	(10)	
Fort Hall	100%	100%	18%	90%	18%	27%	16%	16%
N=237	(237)	(237)	(43)	(214)	(42)	(65)	(37)	(37)
Dominican	100%	100%	22%	100%	46%	46%	none	none
N=152	(152)	(152)	(34)	152	(70)	(70)		
Total	100%	90%	23%	96%	19%	23%	6%	5%
(761)	(761)	(689)	(174)	(733)	(146)	(175)	47	(37)

Construction of Science and Technology Careers in Three Girls' Schools

Table 5 shows preference patterns for careers in science and technology among a select sample of form threes and form fours in Yellowood, Fort Hall and Dominican. Medicine is the leading choice, followed by nursing and engineering, but these choices are riddled with contradictions. For example, there is a high preference

for nursing (28.9 percent) among girls in Dominican, but it is an induced choice. While all form threes and fours in Dominican take Biology and Chemistry, nursing is preferred not entirely because of philanthropic reasons but because, with low grades and a negative attitude towards science subjects, nursing is perceived as a 'softer' entry point into a medical career. It is an easier bargain as compared to medicine, which is the career of choice in Yellow-wood. Medicine is the focus of career interest in all three schools. It can be attributed to the fact that Biology is a favourite subject among these girls. All form threes and fours in Dominican and Fort Hall take the subject and 302 out of 367 in Yellowood. Women are said to feel encouraged to study science when they know that they will have influence over the uses of advancing technology (Rosser 1993). For many girls from Yellowood, Biology appears to be attractive because, unlike Physics, it is not abstract. Science tends to view the world from a male perspective (Rosser 1993), and this perception clearly filters into school subjects. When scientific theories, practices and approaches are viewed as masculine and used to interpret the natural and physical world, certain perceptions, such as that 'girls cannot normally do well in Physics' or, worse, that 'it is impossible for girls to pass Physics' are encouraged because they are built into science subjects and the science curricula.

Medical careers are prestigious, and the economic returns are conspicuous, especially in rural areas. However, in this case, the influence of role models is also important, as statements such as the following show: 'I admire those who work in this profession'; 'I have admired a family friend who is doing surgery at university'; 'I follow my role model, Ben Carson'.

Pharmacy, Psychology and Veterinary Medicine fall far behind medicine and nursing, and the reason is simple. Dominican girls have no interest in psychology or veterinary medicine as careers. Pharmacists and psychologists are rare in rural areas, while veterinarians are associated with farming, which does not command the prestige of nursing and medicine and is not perceived as a profession that requires education and training like nursing and medicine. The reason for this is lodged in the realities of rural life. Also, the curriculum focuses on commercial agriculture, while women's lived experience of agriculture is small-scale crop production for family food. It is probable that girls fail to reconcile the value of agriculture as a subject with the low economic returns that characterise subsistence farming, which is the reality they see.

The construction of careers related to technology is more complex. As I have already pointed out, the national curriculum tends to restrict girls to the 'soft' technical subjects. Even single-sex girls' schools do not have any advantage in this matter, and as the three girls' schools show, there are few aspirants for careers linked to technical subjects (see Table 5). With the exception of engineering, which straddles both science and technology, there is a poor showing in all the other technical-related careers. Particularly striking is the low preference for computer-related careers. Computer Studies was a relatively new subject in Kenyan schools at the time of this study. The lack of interest in computer-related careers was mirrored in

Table 5: Preferred Careers in Science and Technology Among Forms Three and Four Students (%)

	Science					**Applied Science & Technology**									
School	Medi-cine	Nur-sing	Pharma-cy	Psycho-logy	Veteri-nary	Architec-ture	Engine-ering	Meteo-rology	Aviation	Com-puter Science	Infor-mation Tech	Agricul-ture	Land Economics	Fashion Design	Interior Design
Yellowwood N=184	32.2	7.1	6.0	1.6	0.0	2.7	11.5	0.5	0.5	0.0	1.1	0.0	0.5	0.5	0.0
Fort Hall N=104	25.4	6.1	3.5	1.8	1.8	0.0	6.1	0.9	0.9	4.4	1.8	0.0	0.9	0.9	0.9
Dominican N=81	22.4	28.9	2.6	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0	1.3	0.0	0.0	0.0
Total (369)	28.2	11.3	4.6	1.3	0.8	1.3	7.8	0.3	0.5	1.3	1.1	0.3	0.3	0.5	0.3

the negative attitude towards the subject. In Dominican, where the subject had been newly introduced, girls complained that it was 'hard'. The Computer Studies teacher in this particular school also felt that the subject was too advanced, an attitude that perhaps led girls to believe that they had no future in computers. In Yellowood, orientation to the subject created a desire to study it as an elective in forms four, but in Fort Hall the converse was the case. With an established Computer Studies department, the best in the district, girls in this school perceived a value in the subject, but the competition to secure a place in the small Computer Studies class was discouraging. Many girls therefore opted for other subjects rather than face the disappointment of not being listed among the twenty that could take Computer Studies as an elective subject in Form 3. Finally, Computer Studies is totally delinked from other subjects. Its application as an interactive learning tool that enhances and facilitates computer literacy across the curriculum remains unexplored. Thus, there was a general feeling in all the three schools that Computer Studies was a subject that one could catch up with outside school. Another perception influencing how related careers were chosen lay in the gendered perception of the subject. Girls perceive Computer Studies as a modernised extension of Typing and Office Practice; they see it as a technology that simply enables the ordinary secretary to become a 'computerised' secretary. However, although the future of Computer Studies may therefore seem precarious in Yellowood, Fort Hall and Dominican, there is interest shown among females as indicated by the 48.79 percent female candidature in the 2001 KCSE results (see Table 1).

Aviation Technology is a curious choice of career because the subject is not offered in any of the three schools or any in the district (see Table 1). An interesting finding is that the choice is made mainly on the basis of gender equity. The few girls that had interest indicated that they wanted to penetrate Aviation Technology because it is a male-dominated occupation. Such careers are perceived as fighting stereotypes while also being well-paying and prestigious. The same argument can be extended to careers in meteorology, architecture and even engineering, the most popular in the technical category.

The impact that procedural and regulative polices have on curriculum implementation in schools is visible in subject and career choice patterns. While I have shown that regulative polices do limit subject variety, it is important to point out that, in all three schools, there are classes that are yet to fill up for the subjects offered (see Table 4). Concerning the question of whether a wider variety of subjects would help girls' access the kinds of technical subjects they would enjoy and benefit from in terms of career choice, the answer is no. With the prevailing attitudes in the three schools, a wider variety of subjects is unlikely to benefit girls any more than is already the case, because subjects guide career preferences, and the potential of the subjects on offer has not been fully exploited. To increase the career potential of subjects, science subjects like Physics require attitudinal change if the number of girls studying the subject is to increase. Established technical subjects like Agriculture and Home Science require value to be added to their content and

application. Others, such as Art and Design and Computer Studies, require more resources so that more students can be accommodated. If this does not occur, secondary education will remain an education of restricted opportunities as it was for working-class females in the UK (Gaskell 1985). Worse still, the mistaken perception that girls cannot study science *because* they are female (Ndunda and Munby 1991) will continue to prevail.

Conclusion

At the outset of this paper, I stated that social location differentiates schooling. I have argued that, within single-sex schools, girls access and participate in science and technology education differently, partly because of gender bias towards these subjects but also because the allocation of school subjects is not uniform. I have illustrated this using as a case study Murang'a district, where access and participation in science and technology education do not match high female enrollment. In concluding, it will be useful to point out that the problem of female access to science and technology is far bigger than an attitude problem. Regulative policies such as national curriculum guidelines *appear* to equalise access to science and technical subjects, but, as this paper demonstrates, these subjects are not accessible equally to individuals or schools. Although both males and females have access to three science subjects, Biology, Chemistry and Physics, girls do not study Physics. Even those in single-sex girls' schools are not exempted from gender-biased attitudes to the subject. In addition, female access to technical subjects appears to be restricted to 'soft' technical subjects like Home Science and Agriculture, which ironically are conceived as uncompetitive in the job market. Bias towards certain school subjects is also not just a question of preference or of a culture of learning that inhibits full participation and quality achievement. It is a problem with roots in the legacy of education in post-independence Kenya and, particularly, in the historical construction of 'male' and 'female' school subjects (Sifuna 1990) and the dictates of an examination-oriented schooling system where subject choice is pegged to potential examination scores rather then the value of a subject in terms of opportunities for higher education and competitiveness in the job market.

Access to subjects in the applied science/technical category depends on school size. This is a structural barrier that has consequences for the kind of technical subjects that females can access. Schools with four or more streams can offer more subjects than those with only one or two streams. However, the great majority of Kenyan youth live in rural areas, and rural secondary schools tend to be small. Many such schools have two streams or less, so they offer fewer subject options in the science and applied science/technical categories. Ironically, these are the schools that girls access most easily. Concerning the structural barriers that schools create in science and technology education, it would seem that while subjects like Physics remain inaccessible because of attitudinal factors (Wassanga 1997), girls are kept out of technology education because the polices guiding curriculum implementation

are gender-blind. The challenges of gender bias in science and technology education are endemic to education sub-Saharan Africa (Beoku-Betts 1998). However, it is important to note that, while the rural location of a school does not prevent the availability of science and technology education, biased regulative policies advantage some schools over others. From this study, there is evidence that the problem of gendered policies shuts out even the best of girls' schools.

Finally, with this kind of trend, it is unlikely that many girls will achieve their dreams of pursuing careers in science and technology. For this reason, a science and technology education has to become an integral part of the education system if Kenya is to realise its goal of becoming an industrialized economy by 2020. Regulative and procedural policies that hinder access to Biology, Chemistry, Physics and all subjects in the applied science/technical category must cease to use gender and school size as criteria for access to these subjects.

Notes

1. The 8-4-4 system of education includes eight years of primary education, four of secondary and four of university. Primary school lays the foundation for a study of science and technology education at the secondary level. Mathematics and science subjects are taught as compulsory subjects in the first two years of secondary school, so there is. However, the quality of this exposure and the selection of related subjects is a critical question.
2. The symbolic level, the regulative level and the procedural level are the three different levels at which policy operates or functions. The symbolic points towards the vision of the ideal future which is the future what policy makers work towards. The regulative level is where policy introduces regulations and rules and laws that should be enforced to assist with reaching of the ideal vision. The procedural level refers to the guidelines and the explanations of who should do what and how it should be done.
3. Harambee schools are community schools. They are a phenomenon of the 1960 and 1970s, when local communities pooled resources and built secondary schools because the demand for secondary school places was higher than the government schools available. Harambee schools were mainly established in rural areas. They are under-resourced, with poorly qualified teachers and often poorly managed day schools.

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