SCIENTIFIC, TECHNICAL AND VOCATIONAL EDUCATION OF GIRLS IN AFRICA

Summary of 21 national reports

by

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1. INTRODUCTION

1.1 Background

"The most urgent priority is to ensure access to and improve the quality of education for girls and women, and to remove every obstacle that hampers their active participation. All gender stereotypes in education should be eliminated".

World Declaration on Education for all

Pursuing its long-standing commitment to the improvement of the status of women, UNESCO pays special attention to the equal access of girls and women to scientific, technical and vocational education and training. In its Agenda for Gender Equity, UNESCO commits itself to encouraging the equal access to knowledge in all fields, notably within science and technology as well as aiming at substantially increasing the participation of women in science and technical education programmes and encouraging their access to scientific and decision-making bodies. The policy of UNESCO to promote the equal access of girls and women to scientific, technical and vocational education is based on the Revised Recommendations concerning Technical and Vocational Education, the Convention on Technical and Vocational Education, and the Project 2000+ declaration.

AFRICA, **WOMEN** and **GIRLS** have a special place in UNESCO's current medium-term Strategy (1996-2001) having been recognized as priority groups for action. In this context a special project on "Scientific, Technical and Vocational Education for Girls in Africa" was launched in 1996 with the aim of reducing gender disparities in science and technology education and in technical and vocational training. This project was started by holding a sub-regional workshop in Harare, September 1997 and by initiating national surveys in 21 African countries to assess the participation of girls and women in scientific education and vocational training; the underlying reasons for low participation as well as initiatives undertaken at national and regional levels to remedy the situation. Concurrently, a special project on "Women and Science and Technology" was also launched by the Science Sector to promote women's participation in science and technology education and related careers at a global level, which was started by the organization of a series of regional fora as a preparation for the World Conference on Science.

The current report summarizes results of the national surveys conducted within the special project on "Scientific, Technical and Vocational Education for Girls in Africa" in the following African countries: Benin; Burundi; Chad; Ethiopia; Ghana; Kenya; Madagascar; Malawi; Mali; Mozambique; Namibia; Niger; Nigeria; Senegal; South Africa; Swaziland; Tanzania; Togo; Uganda; Zambia; and Zimbabwe. The report does not claim to provide complete updated statistical data for the region, but rather draws up general trends, national and sub regional differences.

Guidelines for a country survey paper

I. Introduction

- *Brief statement on the status of girls and women in the social life (recent trends in four categories: at home, in school, in the community and at employment places) and a generalized evaluative statement of the effectiveness of gender-related policies/measures;*
- *Perspectives for the role of girls and women in socio-economic development;*
- *Current trends in employment opportunities for girls and women;*
- *Current trends in participation of girls in science subjects in school;*
- *Current trends in employment of women in teaching profession (particularly in science education);*
- *Current trends in enrolment of girls and women in the technical and vocational education system.*

II. Factors (both positive and negative) determining the orientation of girls towards science education and technical/vocational

- *Economical (trends in national economic development);*
- *Sociological (cultural, traditional, religious, etc. including the social attitude towards science education and technical/vocational education);*
- *Technological (related to the changes in the world of work);*
- *Employment-related (employability, labour marker structures, wages, etc.);*
- *Education (in general education, science education and technical/vocational education).*

III. Present measures to promote equal access of girls to science education and technical/vocational education

- *National strategies, policies and legislation affecting the social attitudes of students, parents and others towards science education and technical/vocational education;*
- *Innovative practices, (curriculum, guidance and counselling, public awareness campaign, facilities, training methods, etc.);*
- *Efforts to provide employment opportunities (including self-employment) in both public and private sectors;*
- *Difficulties and constraints encountered in the implementation of the above measures, and policies and strategies developed to overcome them.*

IV. Specific information required concerning science education

- *Information on science, technology and environmental education at primary and secondary levels, notably as concerns: compulsory or optional science education; integrated science vs. subject specialization; early or late subject specialization; inclusion of health and environmental issues; - teaching of skills and values; academic background of science teaching.*
- *Data on girls attainment in science, technology, environmental and health education.*

V. Brief description of future strategies and plans

VI. Summary

1.2 Science and technology for development

Recent history has demonstrated the potential of science and technology (S&T) for improving the quality of people's lives. Indeed, during the last few decades especially, developments in various fields of S&T have had a profound impact on the quality of life of the major part of the human population, eliciting thereby significant societal changes. As a result, it is now widely accepted that socio-economic and indeed cultural development, is largely dependent on the harnessing and application of S&T achievements. The unprecedented pace of the globalization process therefore also causes some unease when seen against the unequal development of science and technology

Currently, developed countries with only 17% of the world's population, dominate the field of science and technology with 95% of all research and development (R&D) being executed by them. In contrast, developing regions of the world, where 70% of the world's population live, possess only 5% of the world's research and development capacity. In this lop-sided equation, the African situation is even more dismal, with most of its countries representing the least scientifically advanced in the world in terms of basic input and output, with an almost negligible contribution on the basis of S&T indicators such as science enrolment in secondary, vocational and tertiary institutions, national spending on science and technology education, national research and development spending by universities and other institutions of higher learning, and the institutional infrastructure of science and technology. In Africa, the area of science and technology have the highest shortfall of national human resources, with R&D representing only a fourth of the budget. It is estimated that the developing countries of Africa need at least 200 scientists per one million individuals for effective industrial development. By the year 2000, Ghana will require about 12.000 engineers and 48.000 technicians and Nigeria around 230.000 engineers and 920.600 technicians for science and technology development to take off. The importance of science and technology makes it imperative that the entire human resource potential of Africa be tapped for economic and social development. Many countries are required to seek expertise from other countries, e.g. Botswana recruits a large proportion of its scientific and technological personnel from outside the country at a very high cost, over 70% of the lecturers at the Botswana Polytechnic are expatriates.

If this level of scientific and technological input is to be achieved, no African country can afford to leave 50% of its population i.e. women out of the process. Yet, to date, a combination of factors have prevented women from gaining equitable access to the information they need and have thus limited their ability to participate fully in the transformation process in Africa. Increasing science and technology investment and enhancing productivity becomes imperative - all Africans, women and men, should be able to enjoy the economic, socio-political and intellectual benefits of science and technology. It is clear, however, that gender inequalities are not unique to Africa, as outlined in Volume VII of UNESCO's publication "Innovations in Science and Technology Education" devoted to gender issues.

The ever-increasing technological content of competitive modern economies requires a society, with the lifelong learning ethos integrated into the competitive strategy of the nation. Access to information is empowering, enabling people to monitor policy, lobby, learn, collaborate, campaign and react to legislation. It is also one of the most powerful mechanisms through which societal and economic progress can be achieved. The democratisation of society and elimination of poverty can only occur if people have equal access to the services and resources they need to be productive. Democracy implies being aware of choices and able to make decisions. This requires a society which understands and values science, engineering and technology and their critical role in ensuring national prosperity and a sustainable environment. This in turn requires that science and technology information be disseminated as widely as possible in ways that are understood and appreciated by the general public.

The international economic environment is highly unfavourable and unpredictable for African countries. The price of their export commodities continues to decline, the costs of debt servicing are higher than at any other time in the past. All these negative trends impact at the level of people's and especially women's lives, and are linked to long-term problems leading to increasing poverty, food insecurity and declining health and education conditions. These externally generated constraints throttle the capacities of African countries to develop viable education and professional institutions for the training and mobilization of their human resources in science and technology.

To bridge the gap and to improve the lives of their citizens, by increasing their economic and technical production through the mobilization of human resources potential, African countries have to exercise full control over their own resources and knowledge systems. Men and women in all groups of society can contribute positively to enhance the impact and benefits of science and technology on the development process.

Africa is one of the world's richest in terms of natural resources, and there are various examples of the existence of rich indigenous and traditional scientific knowledge in traditional medicine and various health; agriculture and environmental issues in a holistic and comprehensive manner. The fusion of indigenous African knowledge and modern science is one of the possibilities to alleviate many of the problems facing Africa today.

Since women form the majority of African populations, and are specifically involved in issues concerning agriculture, health and the environment, it is crucial that regional and national development efforts specifically target girls and women, thereby promoting autonomous scientific and technological development. Such re-orientation requires fundamental changes to the educational structure; efforts need to be directed towards educational planning and the development of appropriate training systems so that access to education is more equitable between the sexes.

1.2 Scientific, technical and vocational education of girls: an imperative for the future

"In a world increasingly shaped by science and technology, scientific and technological literacy is a universal requirement.... it is vital to improve scientific and technological literacy among women and girls, whose unique educational function within the family makes them such a major determinant of the attitude of present and future generations"

Federico Mayor

Science and technology have been a determining factor in human history since time immemorial, contributing to economic competitiveness on a global scale and providing essential services, infrastructure and effective health care. Currently the gender disparities in science and technology are unacceptably high; we need to address this imbalance pro-actively, not just because its right to do so, but because if we do not, we will simply not have adequate human resources to deal with our problems.

There is no doubt that improving the quality of general education, and of science education in particular, is essential in building science and technology capabilities in Africa. The recognition of women's roles should be given a platform by being considered a major part of what South Africa's Deputy President Thabo Mbeki has called "The African Renaissance". Women have been given a worthless education in the past designed to "domesticate" them. Traditional authority structures hold women back and conspire to conceal women's contributions to the economy. This leads to a poverty much greater than a financial one: lack of knowledge or access to knowledge and being on the periphery of decision making. Poverty in itself is an illness with a multiplier effect of social and medical disease and is the antithesis of well being creating a downward spiral of dependence and desperation. These diseases of poverty are preventable, showing how interconnected all aspects of development are.

It is in this context that the role of girls and women in the scientific development is seen as a crucial means of building and reinforcing the continent's scientific capacity. Women in Africa constitute more than half of the population and their significant under-representation in science and technology deprives the continent of a substantial input. Many factors have influenced, and continue to influence the status of science and technology and the role of women in its definition, development and application. Such factors are both endogenous and exogenous and they become manifest at both the macro and micro levels of science and technology.

Traditionally women have been excluded from the scientific and technological development process, having a larger role in family life. In addition, despite their traditional knowledge system, women in Africa have been unfairly considered "scientifically illiterate". Yet today's science is no longer in the test tube, but in the home and in the community, and since we are now concerned with subjects like bio-ethics which brings science into a close relationship with philosophy we need to involve all sectors of society. For a more equitable future, it is essential that women participate in and benefit in the process of development from the design level to the application stage. This can only be achieved if girls and young women are encouraged to study and work in science and technology areas.

When educating a boy one educates one person, whereas educating a girl educates a whole family. Girls' scientific, technical and vocational education is therefore crucial to raising the scientific and technological literacy of the next generation of African children who may not all receive formal schooling. The level of their education will determine whether they can apply the benefits of science in their everyday lives by reading news items, understanding directions for using fertilizer, promoting effective community health practices or appreciating the benefits of family spacing.

Compelling reasons to promote girls' participation in scientific, technical and vocational education:

1. the nature of the job market is changing, and women and girls can no longer rely on the traditional, limited range of occupations.
2. with the increase in the number of technical occupations women will continue to suffer from unemployment, unless they have the ability to access them
3. the application of technology pervades our daily lives and women's increased participation in this field can provide important knowledge in areas of food security, health care and community needs in general and
4. African women account for more than 50% of their national population and as a human resource cannot be left at the margin of economic development of their countries particularly during this period of social, cultural, and political upheaval in the continent.

2. GIRLS PARTICIPATION IN EDUCATION AND TRAINING

2.1 Setting the context

The issues of gender disparities in scientific, technical and vocational education must be placed in the context of Africa's problems of poverty, disease, malnutrition, famine, drought, civil strife and war, combined with poor access to shelter, electricity and basic health services. Over 30 of the 47 countries designated as the world's poorest are located in Africa. The region's average human development index (HDI) value, as compiled by UNDP, stood in 1994 at 0.380, whereas the average for all developing countries was 0,576. The corresponding figure for the industrialized countries was 0.911.

Poverty is one of the most important factors adversely affecting the education in general, and the education of girls, in particular. Some reports mention the poor living conditions of the population, which affect particularly girls and women, e.g. in Ghana in 1995, one third of the population lived below the national poverty line. The poor constitute 36% of all households and 43% in rural households. In general women make up a greater percentage of the poor in society. Female households in Zambia and Nigeria had a higher proportion of extremely poor with 80% compared to 72% for male-headed households. The crisis in income levels has led to major changes in survival strategies for households and communities and has led to a biased perception of schooling. Research shows that the opportunities for girls to attend school are strongly determined by the socio-economic position of their families. In Namibia, for example, where the majority of the population is living under poverty and extreme poverty, schools are expensive and most families cannot afford to educate their children. In Malawi, the annual capita income has dropped from $200 in 1995 to $150 in 1996 resulting in a negative effect on the expansion of educational facilities and general living standards. Often families can afford to send only some of their children to school and, more often than not, poverty-stricken families choose to educate boys.

In most countries covered by the survey women represent more than 51% of the population, and play an important role in many key sectors, such as agriculture. Women constitute 53 % of the population living in rural areas in Malawi, are mainly agricultural workers in Uganda and Namibia (51%), and produce more than two thirds of the food requirements in Kenya (70%) and Mozambique (68%). Most of the women in the French speaking African countries live in the rural areas (e.g. Burundi and Mali, 78%) and a life of poverty. However, one has to remember that these countries represent the poorest in Africa and women are the most affected by the economic crisis.

However, in all countries under review, their contributions and potentials are still scarcely acknowledged, and their access to information and education is limited. According to the 1990 Census data, approximately 42% of women in Zambia had no formal schooling. Of those women who had attended school, only 40.2% completed primary school. The gap in education is noticeable between women from rural areas and those from urban areas. Of the females over 15 years of age living in urban areas: 22% had no formal schooling; and 43% had completed primary school. Of the females living in rural areas, 54% had no formal schooling.

The illiteracy rates in the countries also bears testimony to this. Of the 21 countries covered by the survey, there are more illiterate women than men, with the exception of South Africa and Swaziland where the illiteracy rates do not differ substantially between the sexes. In sub-Saharan Africa alone, 87.1 million women aged 15 and above were estimated to be illiterate as compared to 53,4 million men. In the year 2005, the number of illiterate women is estimated to rise to 91 million 62,5 % of the illiterate population in this region.

With the implementation of the Structural Adjustment Programmes (SAP) initiated by the World Bank in the early 1980s, the development of an educational infrastructure has been severely restricted. These Programmes obliged the governments to reduce their spending on education, thus increased fees were introduced and it has become impossible for families to send their children to school; therefore when the choice is made, girls are preferred over boys. Nigeria cut investment in education leading to the re-introduction of school fees, thus school facilities deteriorated, science laboratories became demoded with obsolete equipment and a lack of necessary equipment for the advancement of science and technology. Understandably there was a drop in school enrolment as well as poorer performance by students, especially in science and technical subjects.

Decreased investment in public education combined with economic factors resulted in continued absolute poverty in Zambia. The economical difficulties seriously affected the country's capacity to invest in the social service, including education. The country's low economic performance has led to an emphasis on educational cost-sharing by parents and the community since the government was unable to build, maintain and provide educational infrastructure; a situation which was complicated in 1989 with the introduction of school fees. In Tanzania, increased budget cuts in education have led to the development of a cost-sharing policy, leading to reduced supplies of training materials especially in science and technical subjects and a decline in teachers' incentives. The overall result has been a severe decline in the school environment and in examination performance, which affects girls more critically. In South Africa, poor school performance is a direct result of education policies established under the apartheid regime which have led to very poor teaching and learning conditions with under-resourced schools, overcrowded classrooms, under-qualified (or unqualified) teachers.

It's not only poverty that plays a role in the education of girls, history, religion and culture are also important influencing factors. Young pregnancies and early marriages are a major problem and also cited as the reasons for girls abandoning school. These socio-cultural barriers are even more pronounced when it comes to scientific, technical and vocational education. The "ethos" of working together as the "nations feeders" and the "nations builders" has to be instilled. The low participation of women in science and technology is a concern from both views of equity and efficiency since the revitalisation of Africa's economy rests in the hands of her women and all her children! Traditional norms affecting the status of women still persist. At the same time, however, it has been emphasized that, without doubt, social and cultural transformations in response to external influences are occurring though not at a sufficiently fast pace.

2.2 General primary and secondary education

World-wide enrolment trends in **primary education** show that the gross enrolment ratio (%) in primary education has increased in the past decade, from 99.1 % to 99.6 % between 1985 and 1995, and girls' enrolment from 91.8 % to 94.2 %. However, the figures for sub-Saharan Africa during the same period have decreased from 76.1 % to 73.9 %, and girls' enrolment from 68.2 % to 67.1 %. The net enrolment ratios in sub-Saharan Africa around 1995 amount to only 52.3 % girls and 60.7 % boys of the primary-school age population. Over 24 million girls of primary-school age are estimated to be un-enrolled in sub-Saharan Africa.

Gross enrolment ratios for girls at primary level have risen in half of the countries within the survey during the period 1985-1995 (Benin. Burundi, Chad, Malawi, Mali, Niger, Senegal, South Africa, Swaziland, Togo and Uganda). In Malawi, South Africa and Swaziland almost all girls of primary enrolment age are enroled. In Togo and Zambia these figures are three quarters, Benin, Burundi and Senegal almost half, in Mozambique a third and Ethiopia and Mali only one fifth of the girls are enroled.

On an average in all the countries covered by the survey, except Malawi, South Africa and Swaziland with an equal enrolment ratio, the enrolment rates for girls are much lower. There are many reasons for the lower enrolment rates for girls, including household responsibilities placed on girls as they get older; gender preference, i.e. boys are chosen to be educated rather than girls; many families can only afford to educate one child; and parental and cultural influences. A survey undertaken by TWOWS in 1996, indicated an exception to this trend, two countries, Botswana and Lesotho, where there were more females than males in primary schools, and that this was related to the traditional roles played by boys in herding livestock especially in rural areas.

Although at the **secondary level** the gross enrolment ratio in sub-Saharan Africa during 1985-1995 show an increase from 21.7 % to 24.3 % for boys and girls, and from 17.6 % to 21.6 % for girls, the enrolment ratios are still very low compared to the world total of 58.1 % for boys and girls and 53.4 % for girls. The apparent survival rates to Grade 5 is only 67 % for the sub-region.

It is also clear that there is a marked decrease in the percentage of girls who attend and complete secondary school when compared to their attendance in primary school. Most girls drop out at secondary and higher due to early marriages, (normally in the 12/13 years of age) and financial requirements of the family. In Senegal, girls represent only 3.8% in secondary school first cycle; 1.1% second cycle and 0.3% in superior secondary. Of those girls who did complete primary school in Zambia, only 16.4% continued and completed secondary school, with a mere 0.1 per cent receiving any higher education. In Zambia, of the females living in urban areas 31% had completed secondary school and 0.2% went on to higher education as compared to those living in rural areas: 37% completed secondary and none had reached higher education.

2.3 Science and Technology Education at primary and secondary levels

Although science education systems are widely well established, the developmental context for science education has changed as human resource demands evolve to reflect changes in production technologies and increased proportions of the population that benefit from scientific and technological literacy.

With reference to a global survey undertaken by UNESCO in 1986, the fact that African pupils spend on average 5.6 hours/week studying science (compared to 6.4 in Europe or 3.7 in the Arab states) must reflect its relative importance in the curriculum. However, the actual quality of education is an emotive subject and has many dimensions. Hence, in the poorest countries, it may simply be measured in terms of resources available for education, class size, pupil-teacher ratios or the years of schooling. More meaningful measures, however, must be related to the goals of the educational system, and its contribution to social and economic development. Quality of science learning will also be a function of the nature of the curriculum, the way it is presented by the teachers, and the attitudes and perceptions of the pupils, among other factors. Furthermore, examination results are no longer universally accepted as reliable indicators of the quality of education, unless they can be shown to be correlated with the successful future performance of the candidates.

In 1991, a total of 120 science educators from fifteen different countries met in Harare with the purpose of not only sharing, but also generating, new ideas for science teaching and teacher education in Africa - the Harare Generator. The report also discussed recent developments in school science curricula in African countries, and stated that due to the difficulty in developing programmes specifically related to the local environment and designed to promote the goals of education in Africa, and the costs involved, many countries still use science curricula quite closely based on European models which were drawn up with different objectives in mind, and to which pupils come from very different backgrounds. All countries have statements of educational aims and goals related to policies for development, but it is difficult to translate these into actual practice of science teaching in the classroom. Most developing countries do not have the resources to make comprehensive changes to curricula starting from principles, so have to compromise by adapting science syllabuses and materials from elsewhere..

Areas of African science education identified as in need of urgent review research and development

- indigenous African science and technology in education.
- use of environment and technology in science in science teaching.
- comparative studies of science teacher education programmes.
- comparative studies of science teacher education programmes.
- in-service teacher education for scientific and technological literacy.
- science teacher recruitment and retention problems.
- attitudes and training of principals and administrators for STL.
- regional and sub-regional resource centres and training programmes.

The Harare Generator

The approach to science education at primary classes is almost invariably an integrated one, and one which usually draws inspiration from the environment, and most countries require pupils to take a 2, 3 or 4 year course in integrated science education on entry into secondary schools. However, general or integrated science have been less popular at school certificate level where Biology, Chemistry and Physics (or Physical Science) are still the commonest science subject choices in Africa. However in some countries there are moves away from separate subject specialisms which could well be an indication of future trends towards core science curricula of the kind now adopted in Zimbabwe on integrated science programme. Whereas conventional approaches study scientific concepts and principles before relating them to some actual applications, the new Zimbabwean course emphasizes a practical study of applications of science and technology currently in use in the country. Although the goal is to extract all the relevant scientific concepts and principles from the study, it begins with applications of science in agriculture, industry, energy uses, structures and mechanical systems, and the community. These provide the focus for all the Zimbabwean secondary school core science and extended science up to O-level (School Certificate).

Inequalities between girls and boys participating in science education increase at the post-primary level. Whereas at the primary level, science education is often presented in an integrated manner, specialization comes with secondary education. Increased absenteeism on the part of girls concurs with the introduction of subjects such as physics, chemistry, biology and mathematics.

The patterns of enrolment in the different countries clearly reveal that girls are under-represented in science subjects. In Zambia for example, even though the participation of girls in science has continued to increase since 1985, females formed approximately 15-16% of students in Physics and Chemistry. The participation of girls in Physics and Chemistry is low in Uganda and in Kenya with most girls opting for biological sciences, avoiding pure sciences which comprise chemistry and physics. Most girls choose biology and only one tenth the exact sciences in Mali. Less girls do technology and science in Burundi and only 13% are in the first scientific. The same trend is reported in Tanzania. Accordingly, a diversification programme of secondary school was launched in 1970, when schools were required to specialise in either science, agriculture, technical education, business education or home economics. As a result, science and technical education were optional for both boys and girls at this level and very few girls chose these subjects. In Ghana, regardless of the fact that both boys and girls are avoiding the study of science at the secondary level, enrolment of girls in science is increasing at a very slow pace. In 1992 girls made up 23% of the total number of students enrolled in science at the Senior Secondary School (SSS) level, 13% at Lower six level and 15% at the Upper six level. In the 1992-1993 school year, the participation rate of girls (2.4%) in a scientific education programme offered at SSS level was extremely low suggesting that technical subjects are not preferred by girls.

With regard to the performance of girls in science and mathematics, which is typically measured by results in national examinations, most countries did not have any reports on this issue and it is thus difficult to make an overall observation. However, in Kenya girls are reported to perform less well than boys in science, at the end of 4 years of a secondary school cycle in mathematics and science subjects. In 1993 for example, only 3% of the girls attained B grades and above in math as opposed to 8% for the boys and the performance in physics was approximately the same. In Zimbabwe, female representation at A-level is very low (10% for Physics, 26% for Chemistry and 34% for Biology). In Physics, 47% females obtained the A-level, compared to 59% males. The failure rates for Chemistry and Biology are basically the same for males and females (6.3% for females and 6.6% for males). The report suggests that once a female student takes up A-level, she performs as well as, if not better than her male counterparts, except in subjects like physics which have traditionally been stereotyped as "masculine" subjects.

Clearly the question of gender differences in academic performance in African secondary schools is neither conclusive nor unanimous. In some countries girls have lower academic performance than boys do in examination. By contrast, in other countries girls perform better than or at least as well as boys in examinations. Surveys by the Pedagogic Institute in Mali have shown that there was no difference in the aptitude tests in mathematics and that girls could follow the same mathematics studies if they were in favourable conditions. This data confirms that the issue of elementary schooling of girls in mathematics and sciences is the same for girls and boys and sometimes even better.

Their performance of girls decreases considerably at the end of the first cycle in the second degree where they loose confidence in their capabilities to master the disciplines. Even if they do well they choose studies such as human sciences with very little or no mathematics. Parental attitudes greatly influence the choice of girls e.g. in Togo, because of the pressure of parents the schools have closed down the section in the exact sciences since parents believed that children should rather learn literature.

The preference by the majority of girls to study general science bars them from enrolling in maths, or subjects which will enable them to follow careers such as Medicine, Dental Surgery, Engineering and Agriculture. This means that the majority of girls have only one option when enrolling in university, that of studying arts-based courses.

In most countries very few women participate in Science and Technology programmes e.g. in Zimbabwe, 2% or less females enrol in disciplines such as science or engineering. Targets are set by the government or the universities but do not necessarily get filled because of various factors in the socio-cultural milieu.

Another general trend noticeable in the education systems of these different countries is that at the elementary level there appears to be little difference in performance between boys and girls, but at higher levels of schooling the number of men far outweighs the number of women participating in mathematics, science and technical education.

2.4 Technical and vocational education

The term vocational/vocational education indicates education aimed at preparing the student for work in a commercial or technical field, the course content is practical and enables the students to enter the labour force. General education on the other hand prepares students for the next higher level of education, the courses are mainly academic and theoretical. Parity between general and vocational education is achieved if the percentage female enrolments in the 2 types of education are similar. Therefore the term parity is used to indicate equality of educational opportunity in the different types of education between boys and girls.

Some reports mention that over the years technical/vocational education has been seen as less dignifying, only suitable for dropouts in school and children of low-income groups. There is a wrong perception of technical and vocational education. Technical training is used when referring to boys and vocational training when referring to girls. The trend has been that any boy whose parents are poor or fails to gain admission to traditional secondary schools because of poor grades get enrolled in a technical school, such a girl, however, gets enrolled in a "vocational" school.

Limited access to vocational and technical training is the major constraint for women wishing to enter the labour market, especially for those who do not qualify for admission to formal post-secondary training. The general situation as revealed by the analysis of the reports is that the participation of girls in technical and vocational education is generally low with some differences between the countries. This disparity between girls and boys is further intensified when only soft options of courses such as tailoring, dressmaking, and secretarial assistance are made available to girls.

The under-representation of girls in technical training has also been the result of traditions. In Ethiopia, for instance, while technical schools have mainly opened to male students, girls were only encouraged to join separate fields of study such as secretarial and specific vocations assigned for women. There were also subject options in secondary schools specifically meant for girls: secretarial courses and home economics, whereas technical subjects such as industrial arts, mechanical drawing, electricity were meant for boys. Even if girls were interested in the latter stream, they found it difficult to meet the academic demands of high grades in relevant subjects required for admission to these schools.

Only 12% of students attending Diploma Awarding Colleges in Ghana were female. Girls' secondary schools in Tanzania have not traditionally offered technical subjects such as Masonry, Mechanics and Electronics. It was not until 1976 when two of the public boys technical schools were converted into Co-educational, that girls started enrolling. Girls comprise 12% of the total enrolment in these schools. Females attained lower professional/vocational education levels than males in Zambia (1990): 72% had school certificates, 11% had diplomas and 0.9% had degrees after Grade 12. The total enrolment of girls in all technical programmes combined has consistently remained below 30 percent of the enrolment for both females and males between 1984 and 1995 (it was 24.6% in 1984), but there are even fewer girls who enrol to become technicians and technologists.

Of the total enrolments in Technical Schools in Malawi, girls make up only 4.6%. The vocational system is not yet in place in Namibia and there are no instructors trained, girls represent about 11.8% of the overall students enrolled in Technical and Vocational Training. The few girls involved are mostly studying needlework and typing. There is a lack of interest in girls for subjects such as Motor Mechanics, Electricity and Engineering.

The general trend is that enrolment rates for girls have generally increased over the years in Kenya, where the number of girls entering programmes under technical and vocational education has increased to 33.6% since 1984. While the enrolment ratio of students in the Youth Polytechnics is 1:1, female students are under-represented in the science-based courses. The majority of girls enrol in the arts-based courses which include Tailoring, Institutional Management, Secretarial and Business Study. In all the Polytechnics (1991) only 6.3% girls enrolled for Building and Civil Engineering, 3.4% for Electrical Engineering and 2.7% for Mechanical Engineering.

The Zimbabwe report showed that the participation of females, although improved, appears to continue to be in those areas which traditionally were considered "feminine" such as horticulture (20.8%), business studies (30.9%) environmental health (37.1%), secretarial studies (75.4%) and textile technology (90.1%). Only a small proportion, (about 5%) are in engineering fields traditionally gender typed as "masculine". The participation of females in the vocational training centres which offer upgrade training in automotive, mechanical and electrical engineering is worse and represents 1%. The enrolment of women in science and technical-vocational institutions has improved to around 30% of total enrolments. It is outlined that even though there is an increase (male students enrolment in technical and vocational institutions rose 44% while female enrolment increased 53%), constant levels of 93% for men and 7% for women were maintained.

By contrast, in Tanzania, girls' participation has dropped from 25% in 1985 to 16.7% in 1996 due to drastic increase in school fees. This has not affected the males as much. Figures on enrolment patterns in Tanzania indicate that there is a higher concentration of girls in "soft" trades, although some have taken advantage of increasing diversification to take up new trades. Girls form a large majority of trainees in tailoring (95%), Catering (95%), Secretarial and Computer training (94%) office machine (68%). Trades with a very low percentage of girls are Foundry (0%), Panel Beating (0%), Truck Driving (0%), Pattern making (0%), Shoe Making (2%) and Carpentry (3%).

In Uganda, most of the trades such as Carpentry, Agricultural Engineering, Mechanics and Motor Vehicle Mechanics do not have any female students. At the Ordinary Diploma level the situation is the same (1992/1993): there were no women in Ordinary Diploma Courses in Electrical Engineering and only one woman out of a class of 135 in Ordinary Diploma Courses in Mechanical Engineering.

Female enrolment in science and technology is low in Nigeria Polytechnics. Only 3.6% were in Metallurgy (1991), 9.6% in Civil Engineering Technology, 5.4% in Mechanic Engineering Technology and 7.4% in Physics. At the same time improvements in the enrolment of women have been noted in subjects such as computer science from 28.7% (1990/91) to 32.6% (1993/94); and from 16.9% in Topographic Science (1990/199) to 20.5% (1993/94). Women represent 35% in Microbiology (1993/94) an improvement over the 8.3% (1990/91).

Of the 21 countries examined: Senegal did not provide any data; the percentage girls in both Nigeria and Togo in both secondary and vocational education were the same i.e. parity; 8 countries showed a higher percentage enrolment of girls in vocational than general education; and in 10 countries, the percentage enrolment in vocational education is lower than in general secondary education. It should be noted that even though girls may be represented in the technical/vocational education, their participation in technical subjects such as engineering, electronics and mathematics is extremely low. Zimbabwe is a good example: of the 100% female participation in technical/vocational education, only 5% are engaged in studies such as engineering and the majority are involved in so called "soft subjects".

The failure of girls to meet the mathematics entry requirement for the technical subjects was cited as the major factor inhibiting their entry to these areas. The fact that technical subjects were regarded by men and women generally as "male preservers" was also cited as a major reason why women could not choose these even if they met the entry requirements. Research on gender-related attitudes indicate, however, that the absence of women from traditional "male" fields of technical education cannot simply be overcome by making such subjects available for girls in schools. Several studies state that "by the onset of adolescence, girls are already biased against technical careers". The pupils' own biases were indeed compounded by the biases of their parents, and that the "masculine" content of the subject matter itself and the predominance of men in the teaching, study and working environment related to the subject area are also factors alienating women.

Two critical factors influencing the under representation of girls in technical and vocational education is that: i) there are no female teachers in technical education or the number is very low, and ii) technical schools are usually situated in regional towns and accommodation facilities are not easily available. This lack of lodging facilities makes parents reluctant to send their daughters away from home. The limited access to technical and professional education is important factors which prevent women from entering this field of work. However, it should be noted that even though technical and professional teaching is traditionally valued low in contrast to general teaching, the inverse tendency has been observed. In some countries the number of girls in technical teaching has increased.

The Programme of Social Adjustment in place since 1986 affected the technical schools. The public service is saturated therefore pushing girls into the so-called "boys" technical schools. The PSA, however, affected the financing the professional and technical teaching since one technical school costs 2-3 schools of general teaching. All reports indicate that the financial resources for technical and professional teaching programmes are not sufficient. The only existing infrastructure is the buildings, materials are degraded and not enough. The scarcity of qualified teachers has been noted in all the reports.

Percentage women in technical schools and in "male dominated" disciplines

	Civil Engin Tech	Elect Engin Tech	Mech Engin Tech	Chem Engi Tech	Gen Engin Tech	Maths & Stats
Burundi	-	7,3	-	-	-	-
Kenya	6,3	3,4	2,7	-	-	29,4
Malawi	-	-	-	-	4,3	-
Nigeria	0	0	0	13,7	-	0
South Africa	-	-	-	-	4,3	-
Tanzania	-	18,7	-	-	-	-
Uganda	-	0	1,5	-	-	-
Zimbabwe	-	0	0,6	-	5	-

2.5 University level

Graduate production for selected African Universities, by gender and field of study

Country	Date	Science graduates * M	Science graduates * F	All other graduates M	All other graduates F
Burundi	1988	61	8	214	62
Ethiopia	1989	1164	89	884	160
Ghana (UST)	1987	140	20	474	95
Ghana (Cape Coast)	1987	49	3	183	56
Madagascar	1989	539	315	1025	772
Swaziland	1992	55	23	121	101
United Rep. of Tanzania	1989	317	28	488	115
Zambia	1989	276	39	330	103

UNESCO World Science Report 1996

* Science comprises the natural sciences, mathematics, medicine, engineering, and agriculture.

The low representation of girls at secondary levels has repercussions at the university level. There has been a general increase in enrolments in behavioural science, social science and education as compared to Engineering, Architecture, Mathematics and even Agricultural studies. The low participation of females in agricultural studies is highlighted in those countries where agricultural activities predominate and women are the backbone of the agricultural labour force and thus largely responsible for the food security of the country.

Two main points emerge from the examination of university-level education in Africa. First and foremost there is a lower participation rate of females in Science and Technology courses at the university level. Secondly, there has been at the same time, a general increase in enrolment in these fields e.g. in Togo and Swaziland, although the percentage or number has doubled, the percentage of girls is still low compared to that of boys. There is a general lack of diplomas in Mathematics and Physics on the national plan in Togo, generally girls follow the channels of literacy. There were no girls in the Centre for Computing and Calculations, 2.15% at the University of Agronomy and only 6.52% at the University for Engineers. There is an opposite tendency in Benin, in 1986 girls represented 17% of students at university and only 15% today.

The percentage enrolment of students in Science and Technology courses in Nigerian Universities, show that females occupy the lower proportion in all the disciplines. In terms of trends, there is a definitive but small increase in the number of girls enrolled in science based courses between 1985 and 1992. For instance, in Agriculture female enrolments increased from 13% (1985/86) to 23% (1992), while in Engineering it increased from 5.4% (1985/86) to 10.9% (1991/92). Enrolment rates for women have generally increased over recent years in Zimbabwe and Kenya. The percentage of women enrolled at the University of Zimbabwe increased from 22.4% (1985) to 26.6% (1993) and in Kenya enrolments increased from 25.8% (1990) to 30% (1993). In Kenya in the 1990/91 academic year only 18.7% of the girls enrolled for the undergraduate courses in Medicine, 23% in Pharmacy, 36% in Dental Surgery, 21% in Agriculture and 16% in Science. The enrolment in Engineering was 5%. During the same period, for the post-graduate courses, only 22% of the girls enrolled in Medicine, 31% in dental Surgery, 25% in Agriculture, 17% in Science and Engineering.

However, in all countries female enrolment by discipline follows the typical pattern of higher female representation in the Social and Behavioural Science and Education as compared to Engineering, Architecture and Mathematics. In these faculties female enrolments in Zimbabwe range from 6.8% in Engineering to a high of 36.6% in Medicine. In the other faculties female enrolment ranges from 33.2% in Commerce and 40% in Law. In Uganda, at University level, Medicine, Food Science and Technology are among the subjects where the enrolment of women has grown in number over the past five years. The Engineering, Forestry and Veterinary Medicine have had lower enrolment growth rates in 1991. The actual figures from Ghana show, that on an average, a slight increase in enrolment is visible over the years. In 1994, women constituted 5,8% in Science related departments at the University of Ghana, 11.5% at the University of Science and Technology, 4.7% at the University of Cape Coast and 7.5% at the University College of Education, Winneba. In 1995/95 women represented 27.49% of total students at the University of Burundi, but their participation in science is still low, only 3.9% are in Applied Sciences and they are not attracted by Electromechanics, Civil Engineering, Geology and Agronomy. Most of the women are found in institutes of short cycles e.g. Institute of Commerce. In Senegal and Burundi only 12.9% of women are found in University Agriculture courses and less than 10% in the Faculty of Agronomy Sciences in Benin. This low representation of women in a key sector of the country draws attention to the fact that it's in agriculture that the majority of women work. The numbers provided by Chad were modest and eloquent on the situation of girls in the Faculty of Exact Sciences: no women in the second year of Maths-Physics and Physics-Chemistry for 1995/6 and 4 women in the Faculty of Health Sciences.

On an average in all the countries under survey, there are very few women enrolled in the Natural Sciences, Engineering or Agricultural studies at University level. Unfortunately no data were available for Tanzania, Madagascar and South Africa for these disciplines. Available data on the percentage ratio of women in Engineering and Agricultural Sciences at Universities indicate that with the exception of Uganda (17%) all the other countries show less than 10% participation of women in Engineering.

Tertiary level: Number of graduates by ISCED level and field of study

		Natural Sciences		Mathematics/ Computer Science		Medical courses		Engineering		Agriculture	
Country	Date	M&F	F	M&F	F	M&F	F	M&F	F	M&F	F
Burundi	91/92	207	25	-	-	262	62	125	1	252	34
Ethiopia	94/95	2878	217	1273	161	1384	198	1728	57	3426	284
Kenya	90/91	1306	181	131	36	1132	280	3325	55	1175	233
Madagascar	92/93	7820	2886	1627	295	5912	2576	2349	175	233	78
Malawi	93/94	195	25	./.	./.	145	83	221	-	70	5
Mali	90/91	-	-	-	-	456	104	700	24	1119	112
Mozambique	94/95	69	21	-	-	162	82	541	42	321	97
Nigeria	93/94	19917	4689	-	-	11396	2983	11272	604	9123	1500
Senegal	91/92	2348	266	./.	./.	2486	861	207	29	258	16
Togo	94/95	742	34	./.	./.	508	84	73	1	379	8
Uganda	94/95	760	118	174	15	467	118	256	5	537	91

UNESCO Statistical yearbook 1997

3. CURRENT TRENDS IN EMPLOYMENT OPPORTUNITIES FOR GIRLS AND WOMEN

In general, women have been more affected by the economic recession than men. Work in the car industry is now encouraged and women are therefore pushed into avenues of enterprise and building. The Senegalese Government has now encouraged both women and men to initiate private enterprise and to set up individual entrepreneurs to realise their objectives.

All the reports mention that there is a disparity in employment opportunities in the countries under review between men and women and that most women are in occupations with low earnings. The history of discrimination against them, the poor access to education and training and unfavourable patriarchal societal attitudes towards the status of women affect their chances for employment. Cultural, patriarchal traditions but also the lack of education makes access to employment virtually impossible. In many countries formal sector employment opportunities have declined and as a result, there is an unprecedented growth of the informal sector where a greater proportion of women are involved. The employment opportunities are non-existent in Togo and Benin therefore at least 90% of women are in the informal sector. Women represent 6% in the private sector in Benin and as far as the public sector is concerned there are now very few in the development, equipment and transport ministry.

The informal sector has also become an important source of employment for women in Ghana because of the government's Structural Adjustment Programme. Women have been affected directly by the retrenchment and they have not benefited much from the World Bank's initiated programmes even though women generally are covered under policies for poverty alleviation. Economic circumstances in this country are modifying gender assigned roles both at home and in the labour market and current trends show a break-through of what used to be the status quo. The Ghana report refers to a study into female trades traditionally occupied by men, "females are now venturing into these skills because of the need to diversify their skills in order to survive and support their families. Women are now found in every aspect of auto-industry, construction, welding refrigeration, photography etc. Some have found their way into driving commercial vehicles ». Most young girls and women are involved in small-scale petty trading, cottage industry and traditional trades like dressmaking and catering. An increasing number of girls and women are now entering non-traditional technical trades. The main concentration is Auto Industry (52%), Auto Spray (38%) Auto Mechanics (8%), Auto Electrical (5%) Carpentry (4.3%), Plumbing (3.8%) and Welding (3.3%).

There is very little employment for uneducated women in Burundi. In rural areas women form co-operatives and are mainly illiterate. They represent 40% in the public service and the majority is in the health and education sector. In Chad 25% women are in the public services, any other data is unavailable at the moment.

According to the World Bank, in Malawi, the majority of women are not employable because they lack skills. Women are found in food and beverage processing, pottery and beer brewing and only 25% of tailoring using machines are women. Apart from those who are teachers, nurses and secretaries, there is a small fraction in other professional and business fields.

However, positive trends in employment are reported for Kenya and Zambia. Since Kenya's independence, the number of women in wage employment has risen from 12% in 1964 to 21% in 1987. In Zambia the percentage of women employed in the category of professional, technical and related fields has increased by 15 percent between 1986 and 1993.

In some countries women are found in greater numbers in agriculture. In Malawi and Zambia, the majority of women is subsistence farmers (83.7%) and have had no specialized training. Likewise women make up a large percentage (59.3%) of all the employed persons in agriculture related occupations in Zimbabwe. In the developing regions of the world, employment trends are notoriously difficult to analyse because of the very large agriculture and informal sectors, but there are signs that women are steadily increasing their share of non-agricultural employment. In many countries women are regarded as cheap labour and tend to be concentrated in unskilled jobs with few if any social rights.

3.1 Employment opportunities for women in scientific and technological fields

Employment opportunities for women in scientific and technological fields have been very low, and the TWOWS 1996 survey of Southern African countries, notably revealed that women are under represented in many science based occupations. In the formal sector women still work in occupations such as nursing, teaching, sales, clerical or secretarial. This under representation in highly specialised occupations such as Mining, Engineering, Medicine and the Computer Industry means that women are left out of the "skilled" labour market.

Not all the reports of the present survey mention the situation of women in scientific and technological occupations. However, the existing data confirms the tendency of the above-mentioned TWOWS survey. In Zimbabwe, only 5% of Engineers and Technicians are women. In Mining and Construction, women make up 7% of the labour force. Only 1% of mechanics and less than 10% of machine operators are women. These occupations seem to be gender-typed against women in comparison to education, social science, clerical and secretarial occupations where females represent 35% of the labour force. Although their numbers have increased from 1985 to 1991, only 8.0% of women are employed in the Construction sector in Swaziland. Employment opportunities in Zambia are very low for educated women: Natural sciences (0.8%); Surgery (0.56); Veterinary (0.05); Food, Drink processing (0.6%); Agriculture, Forestry, Fisheries (1.0%).

Inequalities in South Africa's labour market ran both along racial and gender lines. Because of these inequalities, whites dominated all Science and

Engineering fields. In 1983, White scientists and engineers made up 92% of the workforce and Blacks 8%. In 1983 the Science and Technology Workforce was composed of 81% males and only 19% females. In 1990, Whites made up 82% and Blacks 19% of the local Science and Engineering workforce. The share of Blacks in the country's engineering workforce rose from 1.4% in 1983 to 4% in 1990. Traditionally there are very few female engineers as compared with male engineers. In 1990, for every one female engineer there were 78 male engineers. The situation changed slightly in 1990, where males constituted 72% and females 28% of the workforce. Although males still dominated the workforce in the field of science, the number of female scientists increased in the country. In 1990 women made up 34,3% of the science workforce. Large increases in the number of female scientists occurred in Agriculture, Mathematical and Computer Sciences. Current labour statistics for Nigeria indicate the same trend with the proportion of females employed in Professional and Scientific jobs having risen from 21.2% in 1991 to 22.8% in 1992, while those employed in scientific and technical jobs rose from 20.9% (1991) to 22.3% (1992).

3.2 Employment of women in teaching profession

Percentage of female teachers

	Primary		Secondary	
	1985	1995	1985	1995
Benin	24	24	17	...
Burundi	47	47	23	...
Chad	4	8	...	4
Ethiopia	26	27	11	10
Ghana	40	...	26	...
Kenya	34	40	37	33
Madagascar	53	56	...	...
Malawi	33	38	...	...
Mali	22	23	16	18
Mozambique	22	23	24	19
Namibia	...	65	...	46
Niger	33	34	17	23
Nigeria	41	46	...	...
Senegal	27	26	17	15
South Africa	...	58	...	64
Swaziland	80	77	46	43
Togo	20	14	13	11
Uganda	31	32	...	...
United Rep. of Tanzania	39	43	25	25
Zambia	43	43	25	...
Zimbabwe	43	41	30	32

World Education Report 1998

The percentage of female teachers in primary education in 1995 was estimated to be 57.8 % world-wide, and 41.7 % in sub-Saharan Africa. However, although there are several women in the teaching profession at primary education level, their participation in educational management is low.

Teaching in the primary schools in the BOLESWA countries is dominated by females, the proportion ranges from 77-80% in Swaziland to over 80% in Botswana and Lesotho. In South Africa and Swaziland the figures are 58% and 65 % respectively. Females account for 35.2% in Malawi and 39.9% in Mozambique. For Zambia and Zimbabwe the numbers are almost balanced. In Zambia in relation to male teachers, the percentage of female teachers rose from 41.4% in 1984 to 45% in 1994. At primary school education level, the number of female teachers is significantly high, except for Chad and Togo.

At the secondary school level the percentage of female teachers decreases, and the general picture is that women are out numbered by men, with the exception of South Africa. In sub-Saharan Africa, the percentage of female teachers at secondary level is 32.9 % compared to 41.7 % at the primary males in Zambia. It should be noted that in this country there is a large presence of foreign teachers especially in Science subjects at secondary school education level, 33.8% in 1994.

The proportion of female secondary teachers has risen from 29% in 1985 to approximately 32% in the 1990s in Zimbabwe. However their participation in Science is lower than that of men. Reports in Zimbabwe show that the total staff in technical-vocational institutions increased by 39% between 1990 and 1993; male staff increased 40% while female staff increased only 28% and therefore in the period under review the proportion of male staff remained relatively constant at 89% and females at 11%. Female secondary school teachers in Namibia are mostly involved in Biology rather than in Physical Science and Mathematics. Of the eight educational regions in Namibia, there are only 23% female teachers involved in the profession of science education. Women represent 29% of technical and profession teachers in secondary schools in Mali. At the Teacher Training College in Chad, of the 12 teachers, one woman teaches science.

There are not enough scientific and technically qualified teachers in Burundi, there were only 0.9% teachers in science and technology per class in 1992/93. In addition, only 20% of women who finish the primary cycle have access to the secondary and to technical teaching and this decreases to less than 5% in careers considered masculine. Girls opt for short cycle courses in terms of professions in Togo and only 1.57% go to the industrial sector. Also in certain schools in Togo there are only 3 teachers for all the scientific disciplines. Even though there were 31% female technical teachers in Togo, there were none in Engineering, Plumbing, Auto Mechanics and Electronics. A lot of girls are in the Management and Health sectors in Benin and even though they represent 29% of the total professional and technical teaching, they are in fashion, hotellery and absent from industry. Women represented 8.5% of the teaching staff in vocational training in Tanzania in 1996.

Only 12.69% entered the technical and professional teaching in Nigeria in 1995 and 40% in private school Teaching, Bookkeeping, Accounting, Administration and 30% in Car Mechanics. Only a small proportion of women is technicians or instructors. At the College of Education while more female staff were employed in Business Education, Building Education and Computer Science between 1990/1993, the number of female staff in areas such as Woodwork, Agricultural Science, Electrical/Electronics, Physics and Mathematics is still quite low.

Not all reports present data on science and technical teacher training. However, what emerges from available data is that there is a trend for women to predominate in technical teaching training for home science and are rarely found in technical teacher training colleges or courses that prepare teachers in Engineering, Masonry, Carpentry and Electrical studies. Hence the participation of males was higher than that of females in these technical/vocational institutes. In addition enrolment in agricultural teacher education programmes in 1995, which come under the vocational/technical education category, has a higher level of male than female participation.

3.3 Women Staff in Scientific Institutions

Women are under-represented in teaching at scientific institutions and at the higher levels of academia in Science and Technology.

At the University of Burundi science is taught exclusively by men and women represent only 5% of the technical teaching. Likewise there were no women staff in Chemistry, Physics and Mathematics at the University of Cape Coast in Ghana in 1995 and only one woman teaches biology at the University in Nigeria. In addition at the University of Nigeria, the proportion of female lecturers in science based disciplines is not only low but has either remained static or dropped. In Engineering/Technology the percentage has stayed below 3.0% while in Veterinary Medicine it has dropped from 5.6% to 2.2% between 1988 and 1992. At the University of Zimbabwe male staff increased 76% and female staff decreased 17% so that overall, male increased from 85% to 92% while female staff decreased from 15% to 8%. The National University of Science and Technology has predominantly male staff (86%) compared to females (14%).

The Report on the Study into Gender participation in Engineering and Science Areas 1990-1993, concludes by stating that "while efforts to increase absolute number have yielded positive results, the same cannot be said for efforts to close the gap between males and females. Indeed, the proportion of females has remained at nearly a constant and disappointedly low level. "

4. FACTORS INFLUENCING THE SCIENTIFIC, TECHNICAL AND VOCATIONAL EDUCATION OF GIRLS

According to Jan Harding in her study under the auspices of the project on "Planning science education provision in general secondary schools" of UNESCO-IIEP, research on the factors influencing gender-specific differences in scientific achievement reveal that they can be classified into three distinct categories: 1) policy factors, comprising objectives and organization of education; 2) academic factors, such as the quality of science education, curricula, teacher involvement, text books; and 3) socio-economic, cultural and social factors with reference to parental and students' attitudes towards science and technology.

4.1 Objectives and organization of education

Government commitment and support is critical to the success of the integration of women's concerns into national plans, notably in areas such as science and technology where educational outcomes differentiate between boys and girls. Discussions during the Harare sub-regional workshop on the Special Project strongly emphasized this point, and included some specific recommendations in this field:

- Governments should enforce the implementation of gender-sensitive policies in all the processes and organs of the education system in order to ensure positive role modelling and also that the issues specifically concerning girls are addressed.
- Governments should commission action-research into possible ways of improving girls' sustained participation and performance in STVE addressing issues such as: gender-inclusive content to make the curricula more relevant to all learners; institutional factors that encourage girls' increased participation and performance in education in general and STVE in particular (single sex schools, boarding facilities etc.): classroom environment (attitudes of teachers and peers, methods of teaching employed etc.).
- There must be a policy on education that clearly articulates the imperatives of a nation's development that will benefit from scientific and technological education and that favors girls' education particularly in the STV areas of study such as policies on the minimum physical facilities in a school at each level; the deployment and qualifications of teachers in a school and the quality and relevance of STVE.
- Advocacy must be used as a tool to garner support for the implementation of policies.

As concerns organization of education, three options were discussed by Jan Harding: 1. compulsory or optional science; 2. early or late specialization of science; 3. single sex or mixed sex student groupings.

The national reports did not provide sufficient information as to the effect of the first two points, except for the fact that they showed that the inequalities between girls and boys participating in science education increase at the post-primary level concurring with the introduction of subjects such as physics, chemistry, biology and mathematics. However, general trends in science education that seem most likely to impinge on developing countries in the 1990s include the tendency towards making science available to all secondary school students with more integrated/combined/ coordinated/modular approaches which balance content from the traditional disciplines and broader definitions of science education that absorb health education, environment linked to attempts to reduce stereotyping of science with a view to improving participation of disadvantaged groups.

For the third point, however, notably the Ghana report put a lot of emphasis on single sex or mixed sex student groupings. In a mixed class teachers are found to spend more time putting questions to, and answering the question of boys. Gender differences are influenced by several factors: the lack of role models for girls in materials and amongst staff; poor career guidance and a lack of motivation or experience on the part of staff in proposing equal opportunities. In discussions as to which type of school offers the best environment in which girls can study science, it would seem that single sex schools have done the best in Ghana. Not only have girls achieved more in such schools but in some instances they did better than the boys and their attitudes to mathematics are more positive than their counterparts in co-educational schools. The implication is that single sex-schools are better for girls. This is not necessarily the case, however, as single sex schools may get better results because they are more selective socially and academically and because they have better facilities and more highly qualified staff.

Since research has shown that girls in single-sex schools perform better in science subject than their counterparts in co-educational schools, establishing single-sex secondary schools has been proposed as a strategy to improve girls' performance and to promote girls' participation in science and technical/vocational education. Their successes have been attributed to various factors including: a) more opportunity for class participation and leadership; and b) less gender stereotyping by teachers and girls themselves. However, some studies have shown that the single-sex environment does not of itself have a significant effect on academic performance: only when single-sex schools are also good schools that admit girls with high academic performance that this is so. It therefore does not form an adequate basis for increasing single-sex schools. The approach should be to deal with the many issues that affect the performance of girls together not in isolation.

4.2 Academic factors

Education has the potential to challenge stereotypes about male and female roles, to offer alternative ideas and to equip young women to pursue a range of possibilities. But because gender impacts on education as on other social systems, school is more likely to echo and reinforce prevailing attitudes.

Some subjects are seen as more appropriate or useful for girls, and others for boys. Girls rarely receive positive encouragement to try the technical and scientific subjects for which boys are supposed to have a natural aptitude; they are not shown the practical application of these subjects to a wide range of occupations, as well as outside the work environment. Girls seem to internalize the prevailing expectations, and many give up, especially when it comes to the study of science and mathematics. One of the negative attitudes of girls appears to be the acceptance of the myth that boys are better in mathematics and science than girls. Girls in primary school see themselves on an equal footing with boys and many do outstrip the boys academically. Some girls in adolescence tend to be self-conscious and erroneously believe that it is not feminine to be brilliant in technical, scientific or mathematical matters.

The school curriculum plays an important role in making a discipline relevant and attractive to students and encouraging their involvement. The conclusion drawn from the reports is that in many countries the school curriculum is still structured to reinforce the societal perception of a women's role in family life, gender role stereotyping in textbooks, teaching methods and even a lack of female teachers as role models. In Namibia, for example, the recent review on gender curriculum highlighted the extent to which differentiated learning pervaded the curriculum, and its built -in assumption that practical subjects for girls should relate to the future roles as mothers and home-makers, whilst boys would likely need preparation for entry into the world of formal employment.

With reference to science education, a major determinant of women's negative attitude toward under achievement in S&T stems from the structure of the secondary schools curriculum which is based on foreign countries and disregards the needs of African students. Secondary level curricula have commonly channelled girls from subjects traditionally considered as masculine into more feminine type subjects like domestic science and handicrafts. Important forms of gender bias in text and other curriculum materials include lack of gender inclusive language, masculine images and exclusion of the feminine in course content and images; sexist assumptions, decontextualization and lack of reference to the social relevance of science and to domains of interest to women, lack of reference to the community of distinguished female scientists and of science careers for women. The scientific education system is dominated by gender bias. The present education and training received enforces the negative attitudes of girls towards scientific and technical subjects. Health and environment education can be used to increase participation and broaden science education of girls. In other words teaching and learning science and technology should be applicable to everyday lives of both girls and boys. Textbooks are all gender based with women portrayed only in the traditional roles- the masculine construction of these subjects is of concern. However, in some countries initiatives have been undertaken in order to make curriculum more gender sensitive. In Kenya and Malawi the curriculum has been reviewed to develop gender sensitive content at all levels and to reflect the needs of the society, including women.

4.3 Socio-economic, cultural and social factors

Socio-cultural barriers include unconscious or conscious influences in the home from parental, family opinions and social and cultural norms. In general the education of boys is given preference since girls will marry and transfer their knowledge, prestige and income into the family in which they marry. The ability of girls and women is also take into question. The negative social attitudes create a lack of self-confidence among girls and women in their ability and motivation to opt for science. Government commitment and support is critical in the success of the integration of the girls' and women's' careers into national plans. National policies have been formulated to promote equal female access to resources for the enhancement of women's' full participation in economic development. With reference to this last point it has been outlined in the reports under review that the apparent limited chances of employment for female science graduates in the recent deteriorating economy of Africa is a negative influence on the orientation of girls and women towards science and technical courses.

The cost of education, affects the education of girls. In most countries the education of children depends on the availability of funds. Most parents recognize the need to educate their children. However, when funds are limited, male children are educated and the females are expected to help with domestic chores and hope for a good marriage. Many parents' expectations are different for their sons and for their daughters. A girl's future is more often seen in terms of marriage than a job. It is generally more "worthwhile" to devote resources to the education of sons than to daughters. Pursuing Science and Technology exacerbates these problems for girls. Pursuing a science degree is more competitive and hence more costly and difficult than a non-science degree and demands an unusually high investment of family resources. It also poses exceptional threats to women's marriageability. In some communities particularly in rural areas, higher education makes women less marriageable. Pursuing science degrees especially engineering, implies immersion in a male environment, close contact with unrelated males and residence in a campus hostel which makes parents reluctant. Family expectations also play an important role. In fact boys and girls do not arrive at school on an equal footing: gender affects both their access to schooling and their experience at school, shaping their expectations of what school can offer them and of what they themselves can achieve.

However, one can remark that the situation is changing. The Ghana report pointed out that in recent times some parents, having been made aware of the benefits of girls education, have taken advantage of government equity programmes and are not only sending their girls to school, but also reducing their household chores to enable them to devote more time to learning. Analysis of recent examination results from one rural district shows that such girls are making a break-through. They are performing equally well as boys and some times even better, and separate studies based on data collected and analyzed in Swaziland, indicates the same tendency.

5. POSITIVE ACTIONS TAKEN

5.1 National policies

Fundamental for the integration of women in the developmental process is the political intervention and support of the government. The issue of gender imbalance has become a topic for discussion at all national fora and national policies have been developed to promote equal access of females to resources for the enhancement of women's full participation in economic development. For example in Togo, Burkina Faso and Chad a special Minister was appointed in charge of the Promotion of Women, in Nigeria a National Plan was adopted by the Minister of Social Development for the Promotion of Women and the Protection of Children in 1996.

All countries surveyed have long recognized the value of education for the production of appropriate human resources to carry out the diverse task of development, including utilization of science and technology. To ensure that the disadvantaged situation of girls in science and technology is addressed, a number of policies, strategies and legislations have been put in place in the different countries by the ministries of education, the Government, Donor agencies, and Non-Governmental Organizations (NGOs), that have affected the social attitudes of students, parents and others towards scientific education and technical/vocational education. Most of these measures were not designed to address gender issues in science and technical education but they have had a positive influence in these areas.

Zimbabwe has no policy concerning women and the Ministry of Higher Education plans to increase female participation in science and technology fields by 30% by the year 2001.

Zambia has a national policy on education that allows girls to choose any technical training programme to achieve gender balance. There are few national strategies, policies and legislation that have been designed specifically to promote equal access of girls to scientific and technical/vocational education. One of the most common difficulties encountered in the implementation of measures that there were too many projects and programmes addressing the same issue. There was very little co-ordination and co-operation among the projects/programmes addressing gender issues. This resulted in fragmentation in provision, financing and missing important problem areas in education and training. To overcome the problem of fragmentation, the Zambian Government has set up the Integrated Education Sector Investment Programme to deal with all issues pertaining to the formal and non-formal education and skills training. One of the strategies used is the use of role models. At the same time, the Ministry of Education put in place a policy which requires both boys and girls to learn Home Economics and Industrial Arts. Previously Home Economics was offered to females only and Industrial Arts to males only. The Ministry of Education Policy document has a section dealing with gender issues in Education. It addresses the problem of inadequate access to education, low achievement and low participation of girls in Mathematics, Science and Technology.

In Ghana the Free Compulsory Universal Basic Education was launched in 1996 and the Government is determined to expand particular action-oriented programmes which have had a positive impact in addressing the various disparities. The National Technical and Vocational Education and Training Plan, jointly set up by the Ministries of Education, Employment and Social Welfare, is addressing the policy of a systematic apprenticeship programme with specific activities directed at improving access for girls. A special effort is being made to introduce girls and women to emerging fields in Science and Technology such as Informatics, Genetic Engineering, Biotechnology and Computer Technology.

The TWOWS survey of the 7 Southern African countries revealed that all governments have general objectives about the equality of opportunity but few have explicit policies: Mozambique has no policy but the government has progressively introduced compulsory education and scholarships to girls from low income families.

The South African government's White Paper on Education, highlights the need for addressing the issues of gender inequality specifically by identifying means of correcting gender imbalances in the enrolment, drop-out, subject choices, career paths and performance. It further seeks to address sexism in curricula, textbooks, teaching and guidance. To achieve this the Ministry of Education proposes to appoint a Gender Equity Task Team led by a full-time gender Equity Commissioner. Special reference is made of the need to have more females involved in Science and Technology "achieving equitable education requires that new ways be found to encourage more girls to select those subjects (non-traditional subjects such as Mathematics and Science). It is thus a national priority not only to promote Science and Technology Education, but also to encourage women to pursue these fields."

In Tanzania, the Policy on Women in Development identifies problems arising from planning without gender focus. The government commits itself to increasing women's access to education and particularly access to higher levels of education and training by the year 2000. Tanzania has expressed a strong commitment for the participation of women in scientific development. The National Science and Technology Policy states that in order to enhance the active participation of women in the promotion and utilization of science and technology, the government will take deliberate measures to raise the level of literacy among females, expand the enrolment of girls and women in education institutions and increase educational training opportunities for girls and women in Science and Technology.

No particular measures have been taken in Nigeria to encourage girls and boys towards scientific careers, but to promote a general teaching in the formal education. Practical Activities and Productions were re - introduced in school programmes from the 1st degree and a project AESES/FAD concerning the amelioration of teaching the sciences in the first and second cycle in the second degree was started. Technical schools and colleges were created which are insufficient and not well developed, however, girls are relatively present in these establishments. The emergence of private technical and scientific teachings are favourable to girls since several years, more so because of the difficulties encountered in public schools due to repeated strikes.

Malawi has a policy under the constitution of the country and a policy statement on women under the development policy. The Development Policy made a specific mention of the improvement of technical education for women, however, statistics from the Ministry of labour indicated an average of 4.6% enrolled for a period of 5 years. Statistics from the Polytechnic, a constituent college of the University of Malawi showed a steady increase in the enrolment of girls/women in Diploma/Degree and Technician programs for the period between 1987 and 1991. The policies and measures have to a certain extent been effective but the effect has not made much impact on the status of women especially in the rural areas where the majority of people live. The Science and Technology Policy advocates equal and adequate opportunities for all to acquire basic science education in Malawi. The National Youth Policy in its objectives mentions the creation of educational and training opportunities to enable the youth to use basic scientific and technological principles. In its priority areas for action, the policy intends to encourage females to take up science and technical subjects.

Sure most countries recognise the importance of teaching science and technology and educating girls and women but there are no specific measures taken to encourage women or oriented towards science and technology. Some countries have a women's component attached to either the Ministry of Education (South Africa), or Ministry of Social Affairs (Swaziland, Namibia). Other countries have a special Women's Division within each ministry and yet others have established a special Women's Bureau (Malawi, Uganda, Ethiopia) or machinery with inter-ministerial authority which co-ordinates activities (Zambia). Benin has no national policy, however the government has reported that to increase the participation of women it is necessary to: encourage equal access to women; increase the literacy, perhaps free schooling for girls or other measures to increase their access to teaching facilities; adapt teaching methods to the requirements of girls; and promote technical participation to orientate girls towards "masculine" domains. Some of the measures taken include the access to Internet for girls in technology and the creation of prizes for girls.

5.2 Positive actions

Under the Commonwealth Association of Polytechnics in Africa (CAPA), programs aimed at sensitizing heads and Senior women lecturers in Polytechnics have been launched, in encouraging women to enrol in science. The Canadian International Development Agency (CIDA) supported the Technical Institutions' pilot advocacy program for attracting females into non-traditional trades. The program consists of support to Parent-Teacher Associations, organization of workshops to sensitize technical and polytechnic teachers, provision of incentives such us fee-free special classes, tools and weekend remedial classes in Mathematics and Science. The Female Education in Mathematics and Science in Africa (FEMSA) project of the ADEA Working Group on Female participation was set up to verify the status of girl's access to education, science and technology and their performance in these subjects. In order to help girls to do better in science subjects, different initiatives such as positive discrimination for girls, quota systems, lower University entry standards, special science schools for girls or specific actions encouraging girls have been undertaken by different countries.

It is worth noting that the first Regional Ministerial Conference on Education, held in South Africa (MINEDAF VII, 1997), emphasised the "status of science education in Africa" and committed themselves to: collaborate, develop and share teaching and learning materials in order to strengthen science, mathematics, technical and vocational education in Africa. The first conference on Women (Lutsango) in Science in Technology in South Africa was held in September in 1998. A call was made to the government by women academicians, politicians and NGOs to increase the participation and access available to women in Science and Technology.

In Ethiopia positive actions are being taken to encourage more female teachers. In the recruitment of trainees in the teacher training institutes, special criteria are set to encourage female applicants. Teacher Training Institutions reserve 30% of the admission seats for female trainees. The grade point average, one of the entrance requirements to Higher Education, at the Ethiopian School Leaving Certificate Examination, (ESLCE) has been minimized for girls to give them a better chance at entrance. This mechanism has enabled girls to raise their numbers in universities and colleges.

Deliberate affirmative actions have been taken by the Government of Uganda in order to improve the status of women. For example under the 1995 Constitution of the Republic of Uganda one third of the membership of each local government has to be reserved for women. Women in Uganda who enter University are given an additional 1.5 bonus weight to boost up their aggregate total. Thanks to this measure the percentage of women in tertiary institutions has increased from 25% to 34% in a period of three years. Science departments likewise have recorded higher intakes. In Uganda, a number of renowned science teachers and professors conduct holiday classes for those students who want to excel. About 80% of participants are girls from secondary schools. This measure has enabled many more girls to join professional courses in tertiary institutions. Professional organizations, notably the `Uganda Institution of Professional Engineers has an Educational Committee where Counselling and Career guidance are emphasized.

In Botswana, Ghana, Kenya and Zimbabwe, science camps are being organised to attract girls to science education and technical careers. Some countries such as Zambia, Zimbabwe and Malawi adopted the general strategy of making science compulsory for boys and girls at secondary level.

The Tanzanian government adopted the initiative of increasing the number of girls in secondary schools by lowering the entry standards but it is reported that it does not seem to benefit them within the secondary schools, since they are not given special help to compensate for their under-achievement at entry. The positive discrimination enjoyed by girls resulting from the quota system of Form 1 selection ends at Form 4. The Form 4 national examination which sanctions Form 5, is competitive. Thus although girls do enjoy a certain limited advantage regarding minimum entry requirements, it is not surprising that they perform more poorly than the boys at "O" level examinations particularly in Science, Technology and Mathematics. The quota system for girls in technical institutions has also not benefited them because very few of them opt for science subjects at secondary school level and even fewer still pass them. Hence there are not enough girls that qualify to take up the places reserved for them in technical institutions. In most cases these places are left unfilled or are eventually filled by the boys who qualify in large numbers.

In Ghana, following the Science, Technology and Mathematics Education Clinic for Girls, more girls are aspiring to career areas originally occupied by men. Evaluations made in 1997 showed an increase of 75% in girls wanting to venture into fields of Science and Technology at the end of the program. The Introductory Technology programme, which is compulsory for both boys and girls, into the junior secondary school curricula has been adopted in Nigeria in order to expose students early in life to rudiments of technical skills and applications as well as inculcate a positive attitude towards technology. Through this way, girls are encouraged to handle tools, construct and appreciate what technology is all about. Many States have established Special Science schools for girls to increase girls' access to science and technical education. These all female schools have recorded a higher achievement in science and their products are choosing science-based careers.

Affirmative action intervention strategies adopted in Zimbabwe in 1995 appear to be effective with A-level schools, universities and technical-vocational institutions achieving at least 33% female enrolment. In 1995, institutions such as the University of Zimbabwe adopted an affirmative action policy which admits into university aspiring female students who may have lower entry points than males in order to increase their participation.

The activities undertaken in Zambia under the Ministry of Education project supported by ODA in order to improve English, Mathematics and Science, have affected the social attitudes of students, parents and others towards STVE. The Zambia Association for Science Education has increased the participation of women in the activities of the association. Through seminars and conferences organised by the association, gender issues are discussed and positive attitudes of science teachers towards girls in science are beginning to appear. Since 1985, the government of Zambia has promoted a number of women in the fields of science and technology to higher positions, thus providing role models. Instead there is a need to put more emphasis to improve the quality of education given to girls. However, the mere presence of women in a position of responsibility does not provide adequate role modelling. Same-sex role modelling is not the only appropriate policy mechanism for addressing gender issues in STVE. According to some analyses there appears to be no valid research basis for concluding that the increase of female staff in a given discipline or occupation would in itself result in the increase in female students or trainers in the discipline or occupation.

There is no unanimity on the issue of the positive discrimination of girls. It has been observed that this favourable discrimination damages the academic image of girls both in their own eyes and in those of their teachers and peers. They become second-class citizens in secondary schools. This no doubt lowers their status and puts a ceiling on teacher expectations. The combined effect of these processes lowers the expectations for girls and results in poor performance. The answer rests in improving the quality of education given to girls not in lowering the standards of performance required.

All the reports recognize that despite the many initiatives which have been taken, it appears that there is still an enormous female drop-out rate in these subjects which confirms that **the issue of scientific education of girls is a complex one requiring an holistic approach**.

6. CONCLUSIONS

The actual socio-economic, cultural and educational conditions vary from country to country and affect the educational participation of girls. Out-of-school and in-school factors have been shown to affect the participation of girls in science and technology. Family poverty- reinforced by cultural norms and traditional conceptions of the division of labour in the household, from tasks ranging from the care of siblings to fetching water and collecting firewood are less favourable to girls' than boy's participation in school. The in-school factors which generally influence the attendance of girls include the presence of female teachers as role models, pedagogy and the "ability" of the girl child. The idea that girls might be less able to learn science and mathematics, to a large extent explains gender differences in school subject choices and learning performances. There is no doubt that improving the quality of general education and of science education in particular, is essential in building science and technology capabilities in Africa. In this context the participation of girls and women require special attention.

All countries have long recognized the value of education for the production of appropriate human resources to carry out the diverse task of development, including utilization of science and technology. The issue of gender imbalance has become a topic for discussion at all national fora. All national policies have included gender-specific considerations. The findings of the different reports lead to the conclusion that in all countries, even though there is no discrimination in enrolment in science and technology fields, the percentage of females enrolled is still lower than that of men and that certain socio-economic factors militate against the access of girls in these fields. The percentage enrolment of girls in primary schools is extremely low in Niger and Mali (18 and 14% respectively), when compared to the other countries under survey. In Sub-Saharan Africa, less than half of the 6-11 year old girls are estimated to be in schools. More than half of the girls in that region are therefore unlikely to receive any formal education. For the 12-17 year olds the net enrolment ratios in all the regions are much lower.

The data available on enrolment in general secondary level and technical/vocational education are at best only indicative because of differences within countries in their definitions (and reportings) of vocational, technical and general education at this level. Caution is therefore required in making inter country comparisons. Nevertheless, it is clear that females generally account for significantly higher percentages of enrolments in courses of study and training oriented towards commercial and service trades or occupations rather than courses towards industrial and engineering trades and occupations. Yet it is in the core academic subjects that determine access to higher education and that secondary education plays an important role. Recognising this, countries such as Zambia, Zimbabwe and Malawi adopted the general strategy of making science compulsory for boys and girls at secondary level. Girls are performing poorly in Mathematics and Science at the secondary level in each of the countries. In most of the countries examined there are very few girls in secondary level Physical Sciences and Mathematics. In none of the countries does the number of girls inscribed at University for studies in exact and natural sciences exceed 30%, and if they are in sciences they are mainly in disciplines such as biology and medicine. Their poor performance in secondary level education has affected their entry not only into technical fields but also into higher education.

There are considerable similarities among the countries and the interests and achievements of boys and girls in the different countries are influenced by the same factors. Most of the problems and constraints are common across all countries under review. Not only the participation of girls in secondary level is low in terms of numbers compared to boys, but also the type of courses offered or opted for by them are the traditionally accepted "feminine" courses. Most of them do not cater to the modern technological demands and thus fail to generate employability for girls. This results in very few opportunities for their socio-economic independence, thus further accentuating inequality of sexes. One of the ways that can be used to increase the participation of girls is "educating awareness" of teachers to encourage girls. One of the major problems identified was also the relative absence of women from the so-called "male" areas of scientific and technical teaching. Despite increases in the numbers of women at higher levels of the education system, there is a persistent concentration of women in traditional "female" courses, especially vocational training. Technical secondary and professional teaching is very stereotyped. In terms of professional teaching, girls prepare mainly in the fields of secretarial, hotellery and design. When this phenomenon is explained, is the social system one of the causes? The masculine image associated with science is one of the main reasons for "non-orientation" of girls in this field in addition to their lack of confidence in their scientific capabilities. The manner in which science is presented is also a "put off" for girls who are mainly interested in human aspects of life and things related to daily applications. The partitioning of the sexes among fields of study in particular the apparently universal under representation of females in the natural sciences, engineering and agriculture is well defined empirically - every region of the world-industrial and developing countries alike - that it would seem virtually to constitute an “iron law” of education. What does it really mean? Specialization or discrimination - the truth lies somewhere in between, varying from country to country.

The teachers have a large capacity to give to their students but the secondary students also demand a lot from their teachers and expect more and indicate that these teachers are mainly stereotypes and should understand that these students are in the prime of their schooling which naturally will determine their futures and the careers they will choose. This lack of understanding of the students needs manifests it self at a higher level i.e. that of employment, particularly in the informal sector where technical competencies are demanded and this naturally excludes girls since they do not have the formal schooling to access this domain. The shortage of facilities in science education in many girls' schools is also an issue that deserved considerable attention. Disparities exist in the facilities and resources available for, and the standards of teaching science in girls' and boys' educational institutions. In general the prospects of achieving rapid advances in the scientific and technical/vocational education of girls in countries where their participation is currently most limited and tied up with these countries' development prospects overall.

Seven countries in Southern Africa namely, Botswana, Lesotho, Malawi, Mozambique, Swaziland, Zambia and Zimbabwe, participated in a TWOWS survey on girls in science based occupations. All these countries are regarded as developing and with the exception of Botswana and Zambia, all have agriculturally based economies. Female participation in education has increased but is still particularly low. Girls are instilled at an early age with normative values that negate the taking up of challenges and relegate critical thinking and experimentation. The economic background of the parents and earlier marriages were contributing factors to the low level of participation of girls. The FEMSA 2 year Africa region project was piloted in 4 countries, namely, Cameroon, Ghana, Tanzania and Uganda. The main aims were to improve access and performance of girls in mathematics and science at the primary and secondary school levels. Conclusions drawn from this survey indicated some of the factors affecting girls access to education including: major poverty at household levels; negative attitudes of parents and society in general; early pregnancies and marriages; and the greater need for girls labour at home. These factors were also highlighted in the present survey.

The education of boys is given preference over girls'. Girls are discouraged from taking technical courses. Parents want their daughters to enter fields considered "proper" for women. There is a prevailing attitude of hostility and cynicism towards girls who are interested in taking up science and technology professions. It is also generally thought that science is a difficult subject and therefore appropriate only for men. It is further believed that higher education, particularly at postgraduate level, jeopardizes women's chances of getting married. Marriage is viewed by society as a woman's ultimate achievement in life. This negative social attitude creates a lack of self-confidence and ambition among women. Girls usually underestimate their potential for understanding and succeeding in science and technology. They are afraid that scientific subjects will make them loose their femininity and become less attractive to men. This may reduce their chances to get boyfriends and consequently husbands. It has been observed that women and girls are locked into a cycle of poverty and early marriages, with illiterate mothers bringing up illiterate daughters, who are married off early into yet another cycle of poverty, illiteracy, high fertility and high mortality. Breaking up this cycle requires more than just educational reform but a developmental transformation that transforms basic conditions of life and attitudes.

There still exists social and cultural stereotypes that women are suitable for professions considered as "women's jobs". These gender stereotypes have a great influence on the choice of fields of study by boys and girls. Women are marginally represented in the scientific and technical professions which is a result of their low enrolment in science-based courses. All the reports pointed out that this is due to cultural and traditional practices and beliefs as well as to economic constraints. Traditions and society dictate that women stay at home and be subservient to their husbands. Economically-troubled families prefer to invest their limited resources in the education of boys rather than of girls who might eventually marry and abandon their profession. While some of the factors in the socio-cultural milieu have negatively influenced girl's access to science and technical education, some current social and cultural innovations touching on the status of women are having positive influence. Non-Governmental Organizations of women are using public campaigns, seminars and workshops to modify or eliminate aspects of culture. Despite the recognition in each of the countries constitutions, that there is inequality between women and men; women still suffer from an unfavourable social status. However, it is noteworthy that change is taking place and parents are becoming aware, more open and recognise the need to educate women and girls, therefore the number of girls going to school has increased e.g. in Mali.

Role models, both in and out of school, are a crucial factor in encouraging the greater involvement of girls in science, thereby improving their performance in these subjects. Women in science and technology in Africa face the major challenge of encouraging other women to enter the field and influence society's outlook on women. This group of women can act as the nucleus and catalyst for bringing science and technology to other women. It appears that much still needs to be done in order to attract African women to science and technology areas. So far, despite the progress made in some countries, the number of women in these disciplines is still insignificant compared to their percentages in the countries' population.

It has to be noted that in the countries examined there were not many women in the agricultural faculties. This merits particular attention since women play an important role in agriculture and sufficient alimentation is one of the priorities. Ignorance as regards the role of women is an obstacle which prevents the amelioration of the situation of women. The programmes in place have a tendency to exclude women and thus do not benefit women in terms of technological and scientific innovations. It is also worth noting that because of the economic depression, the informal sector is increasing in all the countries. At present one finds in this sector not only illiterate women, but also uneducated women, without qualifications to develop technical project. Special attention should be made to technical training for these women aiming to improve their working and thus living conditions.

Fundamental changes of attitude are necessary before women can make progress in STVE. A multi-level, integrated approach is necessary for the vocational education and training to lead to greater equality in the labour market. On the one hand this entails addressing the constraints on girls' and women's' access to and performance in training; areas such as the streaming of students, gender bias in learning materials, trainers' attitudes and vocational counselling. On the other hand it means recognizing the broader social, economic and political context of education and training, in particular the issue of the roles women are being trained to perform. Key partners need to be identified, from parents to policy makers. Methods used might include public information through the mass media and support incentives for trainers.

Some schemes and programmes have been devised in certain countries with the aim of changing structures and attitudes to give girls more encouragement, especially in the secondary schools. These have been initiated by Ministries of Education, local authorities and/or national women's bureau. However, it is clearly not enough simply to "encourage" girls to make different choices: pedagogical methods must be improved. Science and Mathematics teaching must help to remove the self-censure and cognitive self-discrimination. These subjects should be more closely related to the interests of girls and should offer an early learning environment which allows for concept building and the development of positive attitudes through enjoyable experiences.

Scientific, Technical and Vocational Education is not, only a question of institutions, a broad range of forces influence the development of individuals, their educational experience and their later working life. Cuts in public spending on education have resulted in schools closure and reduced opportunities for girls and women. Attendance is also influenced by local attitudes to the value of education. Ensuring that scientific, technical and vocational training has a positive impact on the status and role of women is more than just a matter of checking enrolment rates. While the numbers are important, and parity must be a target, it is also a question of content, methodology and structures of learning. Despite the progress of the past years and the fact of having laws that indicate the equality of the sexes in education and employment, the reality is that this equality does not exist. Cultural and economic obstacles in most of the countries, attitudes, values and cultural stereotypes disadvantage the girls to access opportunities especially scientific. There is more potential for female participation in technical fields than has yet been realised.

African countries need to address the urgent needs of those citizens who are less able to assert themselves on the market, namely women. This can only be achieved through the propagation of Science and Technology in: promoting employment; enhancing the quality of life; developing human resources; working towards environmental sustainability; and promoting an information society. All these latter will liberate the society from the "freedoms of want, ignorance, hunger, suppression and deprivation" as outlined by South Africa's President, Nelson Mandela's opening speech, to a Joint Sitting of Parliament, May 1994.