

10. Improving Girls' Participation and Performance in Science, Mathematics and Technology-based Education

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Introduction

This chapter discusses some efforts specifically aimed at improving girls' participation in science education in the sub-Saharan countries of Africa. While mathematics is an independent subject and cannot be subsumed into science, in most sub-Saharan African countries it is a major tool of science and is usually a requirement for the pursuance of science-based subjects at post-primary levels. Mathematics is generally considered to be difficult, as are science and technology. In most of the countries of the region, technology has not yet been developed as a subject at the primary or secondary school levels, but much that is included in science at these levels involves technology. Most countries have technical education at the post-primary levels as a separate strand of education parallel to mainstream secondary school education. Given this scenario, and knowing the close interrelationship between science, mathematics and technology (SMT), particularly at lower levels, the efforts that have addressed any of these three areas of education will be referred to as SMT-based education. The chapter will not be exhaustive because of the paucity of literature and information on the theme under discussion as well as on the many developments in sub-Saharan Africa. This needs urgent remedy and is something which this publication is trying to address.

Girls' Participation and Performance in SMT

The poorer access, participation and performance in SMT education of girls and women relative to boys and men, is a worldwide issue that was recognised long ago in developed countries who have been addressing it for some time. As a result, in developed countries the gender gap in SMT-based education has been greatly narrowed, while that in access to education in general has been almost closed. Unfortunately for Africa and other developing countries, the gender gap, with girls and women being greatly disadvantaged, is still a

major problem that contributes to the lack of rapid development being experienced in these regions. Hence it needs urgent attention.

For a long time, the study of SMT subjects was considered the preserve of boys and men and a 'forbidden' area for girls and women. In Africa, this fallacy was exacerbated by the cultures, traditions and practices that deem women less intelligent, and even less hardworking, than men! Consequently, on the African continent, girls and women still lag very far behind boys and men in SMT-based education, jobs and careers. This presents a major problem for the continent, particularly in this era where knowledge and application of SMT is vital for survival and development.

That girls' access, participation and performance in education in general and SMT-based education in particular is much lower than that of boys has been well-known in Africa for some time. However, this was not seen as a problem because it fitted in with African cultures that generally perceive a woman's major roles as being only those related to reproduction, making a home for the family and social care. With such attitudes and beliefs, girls' education, particularly in the 'hard' SMT-based subjects, has been seen as a luxury rather than the necessity it has turned out to be. In the recent past, the problem of gender inequality in education has been clearly recognised in Africa and in other regions as a major issue that needs urgent attention. For example, the Forum for African Women Educationalists (FAWE) was founded in 1992, with the overall goal of closing the gender gap in education in Africa, where women continue to lag behind men in access and participation. The 4th UN Conference on Women, held in Beijing in September 1995, further highlighted the problem of lack of education of the girl child as a critical area. Since then, countries have endeavoured to double their efforts to close this gender gap in education, with increased assistance and support from funding agencies and world bodies that have long recognised the problem, such as UNICEF, UNESCO and the World Bank.

Background

This chapter is a series of overviews of what is happening in Africa in gender and SMT-based education. Some initiatives that address gender issues in SMT-based education in the different countries of the region are discussed. A more elaborate treatment has been given to those interventions that are major and involve many countries in the region, as well as to those that are innovative since if Africa is to develop, particularly in the SMT field, there is a need for multi-pronged, innovative cost-effective approaches to alleviate the problems, given the lack of financial resources. The different initiatives are divided into the following categories:

- ◆ Major regional programmes and projects;
- ◆ Other innovative projects;
- ◆ SMT education research and networks in Africa.

Each initiative is briefly described, its achievement outlined, its significance highlighted and its prospects indicated.

Major Regional Programmes

Female Education in Mathematics and Science in Africa (FEMSA)

In 1996, the Association for the Development of Education in Africa (ADEA), through its Working Group on Female Participation (WGFP), funded the first phase of FEMSA. This is an African regional project whose overall goal is to strengthen girls' participation and achievement in science, mathematics and technology through improvement in the quality of teaching and learning at primary and secondary school levels.

Information on girls' access, participation and performance in SMT subjects in Africa was already available. However, not much was taking place to address the problems. The FEMSA project therefore decided to probe more deeply to seek solutions among those most intimately affected by the problem, namely the girls themselves, their male peers, their teachers and their parents. Consequently, during the pilot phase of 2 years, the FEMSA studies concentrated on an in-depth study of a sample of between 12 and 16 primary schools and between 10 and 14 secondary schools in each of the four pilot countries, Cameroon, Ghana, Tanzania and Uganda. In each country a local team of researchers, led by a national co-ordinator, carried out the work. The studies verified the current status of girls' access to education, and their participation and performance in SMT subjects and national examinations. The problems the girls experience in their study of SMT, as well as possible solutions, were also identified. The main outcome of this phase was a Country Profile of the status of girls' participation and performance in SMT in each of the four countries, the problems they experience and suggestions for possible solutions to address the identified problems. The detailed country reports are available from the FEMSA secretariat, FAWE offices, in Nairobi, Kenya.

The data collection approaches

Empirical data from schools, the 'School Studies', were complemented with data from 'Desk Reviews' on issues of policy, curricula, access and performance; examinations; and research, interventions, innovations and donor support with reference to gender and SMT.

Several research methodologies were employed in the school studies to obtain triangulated data, and hence more reliable information. The instruments were originally designed by a central project committee, including the national co-ordinators, but each country team had the liberty to, and did, modify them to suit their own situation. However, care was taken to ensure that the key questions to be answered remained the same for the four countries. The instruments included questionnaires, classroom observation schedules and guidelines for group discussions and interviews.

The participatory learning approach (PLA), using group discussions with students, teachers and, where possible, parents and community leaders, was an effective and interesting strategy. PLA was pioneered by the Uganda team and used extensively by them in their school studies (O'Connor, 1997). It involved intensive brainstorming, first with female and male only groups, and then in mixed groups of participants to discover the reasons for the poor participation and performance of girls in mathematics and science, and then to come up with solutions that might alleviate these problems. The PLA methodology ensures a systematic and deep analysis of issues. The method was extremely effective in creating awareness and sensitising the participants about the seriousness of the problem. Participants were assisted to realise that they themselves and their traditional and often chauvinistic attitudes were the principal cause of the situation and that the solution, therefore, lay largely in their own hands (Mulemwa, 1997).

The two-year phase culminated into the organisation of National Dissemination Workshops and Seminars, held between August and December 1997.

Major findings of phase 1

While there were results peculiar to each country, there were some major findings which generally applied in all four countries (O'Connor, 1997; FEMSA Country Reports, 1997). These are briefly discussed below.

Some general issues

1. Access, participation and performance of girls in SMT is poorer than that of boys, and the gap widens at the secondary school level.
2. There is a paucity of both research and interventions in the area of gender and SMT.

Reasons for girls' poor access to education

Two major reasons identified for girls' poor access to education relative to that

of boys are the negative attitude of parents and society towards girls' education and poverty at the household level. Thirdly, girls' dropout rates from school are higher, particularly at the upper primary and lower secondary school levels, due to early marriage, pregnancies and poor academic performance caused by factors beyond the girls' control.

Major reasons for girls' poor participation and performance in SMT

1. *Negative attitudes*

There is a strong, deep-seated, traditional and conservative belief among parents, teachers and students, including the girls themselves, that the study of mathematics and science subjects is only for boys and men. Despite much lip-service to the equality of girls and boys, there is a strong belief among all these categories of people that most girls have neither the ability nor the determination to study and succeed in SMT subjects because these are very difficult subjects. Therefore, many people, including teachers, advise and actively discourage girls from studying SMT subjects. Moreover, the girls believe that even if they succeed in SMT, there are very few opportunities for them and they are not likely to attain their full potential in what they perceive to be male-dominated professions and careers.

2. *Lack of awareness of gender issues in education*

Many teachers are not aware of gender issues in education and the difficulties that girls face in learning SMT. They are insensitive to the different out-of-school experiences that girls bring to the study of SMT. They do not take account of the anxiety many girls experience when they start menstruating, when topics such as reproduction are discussed in the classroom, or when girls are asked to use unfamiliar equipment and apparatus or cope with live specimens. They do not understand when girls, especially from traditional and conservative backgrounds, seem unwilling to enter into discussions or ask questions, especially in mixed classrooms. Girls therefore appear less bright and capable than boys, and are relegated as less enthusiastic and intelligent.

3. *The instructional methods employed*

The classroom approach to the learning of SMT at the primary level was found to be almost entirely didactic. It consisted mainly of a lecture, followed by note taking and question and answer sessions. Then long exercises were often given as homework, particularly in mathematics, whose objective seemed to be to drill pupils into recognising, rather than understanding, the principles and concepts involved. Although there was often a shortage of equipment and consumables, very little practical work was done even when these materials were easily found in the environment. Hardly any group work

was observed and pupils were discouraged from 'talking in class' thus prohibiting any useful peer discussions, sharing of ideas and learning from each other. In general, the development of a scientific way of thinking and of inquiry was abandoned in favour of learning nomenclature, definitions and standard procedures.

4. Inappropriate and irrelevant syllabuses

O'Connor (1997) summarised this problem, stating 'Most mathematics and science syllabuses do not take account of the needs of girls in their lives after school, both at the primary or secondary level. An exception is the Uganda Primary Science syllabus, which is the only one examined that addressed girls' needs. Most secondary school syllabuses put far too much emphasis on definitions, laws, formulae and abstract procedures and little on mathematics and science as a way of thinking and looking at the world around us.'

5. Lack of role models and information on SMT-based careers

In all four countries, the majority of girls in the education system come from rural homes or from the urban poor. They rarely see a female scientist, mathematician or technician. Consequently, the world of SMT hardly ever enters their dreams. This lack of role models is exacerbated by the girls' almost total lack of information on jobs or careers where a mathematical and scientific way of thinking would be an advantage.

Main solutions proposed

1. Sensitisation

The major strategy that emerged as a solution was the sensitisation of the different categories of society to the vital need for girls' education, particularly in SMT. People need to be aware that girls have just as much ability to study all subjects, including SMT, if they are provided with an appropriate environment. Such people include policy-makers and implementers, parents, teachers and students, both the girls themselves and the boys.

2. Training of teachers

Modules on gender issues in SMT and in education in general must be developed and included in all teacher-training pre-service and in-service courses. Teachers must also be equipped with effective teaching strategies and methodologies which address girls' needs.

3. Revision of syllabuses and examinations

SMT syllabuses need to be revised so that emphasis is put more on the processes than the products. They must help the development of scientific and mathematical ways of thinking which reflect the needs of girls, as well as of

boys, in life outside school. Similarly, the examinations should test more of the students' ability to apply their knowledge rather than simple recall and rote-learning.

4. Role models and information on careers open to girls

More serious efforts must be made to use effectively the existing successful women scientists, mathematicians and technologists to encourage more girls to enter these fields of study. Information must be provided to girls regarding the SMT-based careers that are open to them at each of the different levels of education. This strategy is equally important in helping to change the attitudes of parents and society towards girls' education in SMT education. It would further help in raising the aspirations of parents for their daughters and thus motivate them to encourage and support the education of girls.

5. Further research

There is need for research that determines the kind of SMT content which is relevant to girls' lives outside school, so that it can be included in the school syllabuses. There is also need for research into the instructional methods and other strategies that facilitate girls' active participation and improved performance in SMT.

Lessons from FEMSA Phase 1

1. A comprehensive partnership between key players must be developed to address the problem effectively. These include Ministries of Education and departments dealing with curriculum design, examinations and teacher training; the school communities, namely students, teachers and parents; interventionist organisations and NGOs; funding agencies; and society at large.
2. There is a great deal of good will towards funding pragmatic solutions to the problems.
3. People are not unwilling to take action, but the problem has never been recognised as serious, particularly at the grassroots level, and hence it has never been given serious thought. Having been sensitised to it, people seemed ready to take some action, with assistance and guidance.
4. There is need for some umbrella body to co-ordinate the activities required to address the problems, which will inform overall policy decisions and liaise with other bodies, NGOs and funding agencies active in the field.
5. The literature review indicated that girls' access, participation and

performance in SMT in other African countries was generally similar to the situation found by FEMSA. Therefore, other countries should be encouraged to begin with the prioritisation of the identified problems and/or solutions, using PLA discussions, so that they can design their own appropriate national plans of action and quickly move into the phase of implementing interventions.

The significance of FEMSA Phase 1

1. In addition to quantitative information, FEMSA provided current solid qualitative data by probing deeply into the views, feelings and attitudes of the key players. Such information is most appropriate in terms of what can be done to alleviate the problems.
2. The research deeply involved those categories of people who are often not consulted and yet are directly concerned and affected, namely the girls themselves, the male students, their teachers and parents, and the political and opinion-leaders in the communities. The research documented their views and started to build a partnership between them.
3. Through the National Dissemination Workshop, the key policy and decision-makers and implementers, and other concerned people, were sensitised to the issues. FEMSA highlighted a problem that is most pertinent to the developing countries of Africa, at a most opportune time when many countries are planning future approaches to faster development through education, particularly the learning and application of SMT.
4. Since the problems and the solutions were identified by those most affected, any interventions based on the finding are likely to be more effective at alleviating the problems if they are properly implemented.
5. Some audio and video materials were gathered. These materials can be edited and made into modules appropriate for enriching both pre-service and in-service teacher-training programmes that aim at building awareness of the complexity of girls' problems in SMT education and sensitising teachers.

Otherwise, the findings of Phase 1 were published in small, 'user friendly' booklets, under 16 different themes, and disseminated widely particularly in Africa and to other organisations interested in SMT education both within the region and internationally.

The activities of Phase 2 of FEMSA

The second three-year phase of FEMSA started in June 1998, with eight additional countries joining the project, namely Burkina Faso, Kenya, Mali, Malawi, Mozambique, Senegal, Swaziland and Zambia. The major focus of this phase, particularly in the four pilot countries is the implementation of interventions to address the problems identified in Phase 1. The action plans, consisting of global and wide-ranging proposals devised at the national workshops and seminars, are being translated into pragmatic and feasible activities on the ground. The new countries are studying Phase 1 findings and working out how they can use them to move fast into the FEMSA Phase 1 focus of implementing interventions.

Each country has set up a national FEMSA centre to implement and co-ordinate FEMSA activities. They are located in institutions of national repute, but have reasonable autonomy to engage in FEMSA activities and try to incorporate FEMSA concerns into mainstream educational activities. Interventions are being developed at both the national and school and community levels.

The bulk of the activities so far implemented in the four pilot countries can be categorised into four broad areas. First, there are the sensitisation and awareness-building activities for male and female students, the parents, policy-makers and implementers, and the general public. These have included the use of mass media, short talks, seminars and workshops. Sensitisation materials such as video and music tapes, calendars, posters and T-shirts have been produced and distributed. The communities continue to be sensitised and mobilised to support the FEMSA schools' activities through songs, dance, drama and plays. The second category of motivational activities includes FEMSA clubs, visits to female SMT-based practitioners in the field, FEMSA awards for good academic performance, as well as career guidance and counselling programmes for girls and parents. The instructional materials development intervention involves the identification of gender biases in the existing scholastic materials and the preparation of gender-sensitive and gender-inclusive supplementary materials for the school curricula. The fourth category of activities is teacher capacity building, where teachers are given in-service training workshops to discuss teaching of difficult SMT content as well as gender-inclusive classroom instructional methods and practices. Other activities being carried out are remedial classes in SMT for girls, social guidance and counselling on AIDS and sexual harassment.

It is expected that by the end of this three-year phase in June 2001, the 12 countries will have developed a rich repertoire of methods and interventions

to address different problems that girls experience in access and learning of SMT at both school and national levels. These will be shared with other countries in Africa and elsewhere.

The UNESCO special project on Science, Technical and Vocational Education of Girls in Africa

The special project in Science, Technical and Vocational Education (STVE) of Girls in Africa is a six-year project (1996–2001) executed by the UNESCO Section for Science and Technology Education, and Technical and Vocational Education Division for the Renovation of Secondary and Vocational Education. The project is taking place in collaboration with local, national and international NGOs, notably Gender And Science And Technology GASAT. It is in line with UNESCO's International Project on Technical and Vocational Education (UNEVOC), which was launched in 1992 (Dyankov, 1996). The organisations have identified two target areas of action (UNESCO Project Document):

- ◆ Enhancing scientific and technological literacy for all through non-formal education;
- ◆ Ameliorating the quality, relevance and appropriateness of STVE through curricula programmes, education materials, teacher training, career guidance and counselling, social environment and linkage with the world of work.

Activities

The project started with an assessment and planning phase prior to development of project activities. In this phase, 31 countries were requested to participate in a survey to determine:

1. The status of girls and women in social life (recent trends at home, in school, in the community and in the workplace) and a generalised evaluative statement of the effectiveness of gender-related policies and measures;
2. Factors (both positive and negative) determining the orientation of girls towards science education and technical and vocational education;
3. Existing measures to promote equal access of girls to science education and technical and vocational education;
4. Specific information concerning science education such as data on girls' attainment in science, technology, environment and health education, and on whether science is compulsory or not, and integrated;
5. A brief description of future strategies and plans.

The findings of Phase 1

The results of the above survey were presented at UNESCO sub-regional meetings on STVE for girls in Africa. For example, during the September 1997 workshop in Harare, Malpede (1997) summarised the results of the surveys in Ethiopia, Ghana, Kenya, Malawi, Namibia, Nigeria, South Africa, Swaziland, Tanzania, Uganda, Zambia and Zimbabwe. Similarly, Simelane (1997) presented her findings from the Southern African countries of Botswana, Lesotho, Malawi, Mozambique, Swaziland, Zimbabwe and Zambia. On the whole, the findings of the surveys reflected what has been described in some detail in the discussion of the FEMSA project above. Girls' access and participation in STVE, particularly at the secondary school level, was poor in most countries relative to that of boys. There were even fewer girls in the area of technical education, and few women in STVE fields of employment.

The workshop was attended by participants from at least 13 different African countries, and discussed and developed skeletal frameworks for interventions in key areas such as 'Teaching Methodologies and Learning Materials', 'Teacher Education' and 'Preparing Girls for the Workplace'.

In its second phase the project is collaborating with bodies that have similar interests, such as FEMSA and GASAT, to implement the identified solutions. It will, therefore, be another source of relevant strategies for improving girls' participation in STVE. For example, the project commissioned a booklet concerning the promotion of girls' participation and performance in STVE (Mulemwa, 1999). It is primarily written for developing regions, particularly Africa, where the gender gap in STVE is still wide. It is intended specifically for teachers and for developers of curriculum and material who are involved with STVE at the upper primary and lower secondary school levels. The booklet is titled *Scientific, Technical and Vocational Education of Girls in Africa: Guidelines for Programme Planning* and addresses curriculum and educational materials, teacher training, guidance and counselling and motivating girls in STVE.

The African Forum for Children's Literacy in Science and Technology

AFCLIST is an informal association of African educators, scientists, technologists, media specialists and international resource persons, who promote children's literacy in science and technology. The AFCLIST mission is to develop the base for a strong science and technology culture among the young people in Africa. It aims to generate understanding by young people in Africa of practical applications of S&T, an understanding based on an active interaction between learners and their environment, peers, teachers, other adults in the community and the accepted views of science. Only then,

AFCLIST believes, can young people develop the confidence and ability to adopt and use the ever-increasing science based technologies that impinge on their lives. AFCLIST further believes that any attempt to popularise science must be sensitive to local educational and cultural practices.

Activities

AFCLIST supports small innovative projects by groups, or even individuals, that aim at improving children's interest, understanding and effective participation in S&T subjects and activities. All projects must address gender issues and work closely with FEMSA and FAWE. AFCLIST also supports projects that link school and community science and action research that develops models for how schools can change at the system level or within an individual school. It have supported media-related projects that sensitise and increase awareness of science issues. AFCLIST has supported projects in more than 12 countries, including Ghana, Kenya, Lesotho, Malawi, Namibia, Nigeria, Sierra Leone, South Africa, Swaziland, Uganda, Tanzania and Zimbabwe. Some of the projects so far supported by AFCLIST, which specifically target girls, include:

- ◆ **Girls Learning Science from Toys.** This is an interactive exhibition of African toys, developed by FAWE, to show how toys can be used to encourage girls' learning in science.
- ◆ **Girls' Performance in Science Subjects.** This Nigerian study looked at factors that contribute to secondary school girls' choice of, and performance in, science subjects.
- ◆ **Girls into Science.** This project in Zanzibar was a community-based participatory project aimed at increasing girls' interest, participation and performance in science subjects.

In a publication edited by Savage and Naidoo (1997), *Improving Girls' Participation and Performance in Science Education in Africa*, five AFCLIST-supported projects are described. These are:

- ◆ **Enhancing Girls' Participation in Science and Mathematics**, carried out in Zanzibar;
- ◆ **Gender Issues in Science and Technology: Lessons from Nigeria**;
- ◆ **Improving Scientific Reasoning Skills of Students in Secondary Schools in Malawi**;
- ◆ **Biographies of Black Women Scientists: Case Studies from South Africa; Science and Technology Education Through Home Science**, carried out in Sierra Leone.

The significance of AFCLIST

AFCLIST has supported at least 100 small-scale projects. Its major contribution and significance is in its support of innovative projects that demonstrate alternative strategies for improving children's literacy in science and technology. AFCLIST-supported projects must be gender aware. They encourage group work to ensure continuity and proliferation of good projects, a strategy that can also promote the participation and training of young researchers, particularly women. This is of vital importance because the African region is still in dire need of a critical mass of researchers, including women, in all SMT-based areas.

Future prospects

AFCLIST is now working to implement its plan of setting up and developing Centres of Excellence in different parts of the continent, known as 'AFCLIST Nodes' (Fabiano *et al.*, 1997). This is an effort towards capacity building in different parts of Africa, while addressing some of the most pressing problems of the region in science education. The nodes include:

- ◆ **Gender and Action Research**, to be developed in conjunction with FEMSA;
- ◆ **Large classes**, to develop strategies and methodologies of teaching large classes;
- ◆ **Industrial and Indigenous Technology**, to explore the relationship that should be developed between industry, indigenous technology and school science curricula;
- ◆ **Assessment and Evaluation**, to develop appropriate methodologies;
- ◆ **The Fellowship Programme**, to assist members to travel and reflect, and analyse and document their work in supportive but challenging intellectual environments.

Each node will be hosted by countries that show interest and have done some work in the area. For example, the Industry and Indigenous Technology node is now being developed in Ghana and Swaziland, while Environmental Education nodes are becoming established in Malawi and Zanzibar. AFCLIST also offers consultancy services through its unique network of science education scholars, practitioners and media specialists throughout the English-speaking world and greatly encourages the participation of women in this service.

The planned activities of AFCLIST, many of which are being implemented, promise to be beneficial to the continent, as they will address some of its main

problems in SMT-based education. They will develop expertise and eventually a critical mass of gender-aware science educators who will work to improve existing systems. AFCLIST has started institutionalising its planned regional nature by having its programme secretariat hosted in two different countries, South Africa and Malawi. In addition, it has appointed professional associates who act as its representatives in West Africa, East Africa, Central Africa and Southern Africa. Professional associates assist AFCLIST to identify, develop and monitor fundable, gender-aware proposals and projects; assist with the establishment of nodes; and act as AFCLIST advocates in their sub-regions and elsewhere.

The Teacher Management and Support Programme

The central role of the teacher in the education system has long been recognised, particularly in Africa where the learning process still heavily depends on teachers. The Teacher Management and Support (TMS) Programme is a programme of the ADEA Working Group being implemented by the Commonwealth Secretariat. It is organised so that different countries and regions of Africa work in collaboration.

The July–September 1995 Newsletter of the then Development of African Education (DAE), now ADEA, reported on the meeting of the Francophone TMS group held in June 1995. The group, comprising delegations from Burkina Faso, Chad, Côte d’Ivoire, Gabon, Guinea, Madagascar, Mali, Mauritania, Niger and Senegal, deliberated on action plans on issues such as ‘The rationalisation of personnel management so as to enhance the quality and efficiency of education’. *TMS News*, January 1998, reported on work being done in the East African countries of Kenya, Tanzania (mainland), Uganda and Zanzibar (EAC-TMS) and the SADC countries – Botswana, Lesotho, Malawi, Mozambique, Namibia, Zambia and Zimbabwe (SADC-TMS). Each region has a secretariat which co-ordinates activities. TMS also operates in the West African Anglophone countries of Ghana and Gambia.

In Uganda, for example, the programme is known as the ‘Teacher Development and Management Systems’ (TDMS) programme. It targets the primary school level and is complemented by another programme, the ‘Support for the Uganda Primary Education Reform’ (SUPER) project. While SUPER originally provided textbooks, it now works closely with the TDMS programme and the Curriculum Review Task, and together they have produced a number of materials for this level, including:

- ◆ National integrated syllabuses for the primary leaving examinations for Integrated Science, Mathematics, English and Social Studies. The new

curricula emphasise 'Integrated Skills Production' and an 'Integrated Approach' to all disciplines. The curricula are gender inclusive.

- ◆ Self-study modules as an alternative way to train teachers since the formal two-year teacher education pre-service programme, presented problems. The plan is to develop this form of distance education, through a 'National Primary Teacher Education Self-Study Series' into a nationally recognised certificate course. This strategy is likely to benefit women, not only because of its flexibility, but also because female teachers are in a majority at the primary school level.
- ◆ A community mobilisation called 'Community Mobilisation Training Manual: Training Parents and Community Leaders in Improving Quality Education' developed in response to the need to sensitise parents and the community about the important role they play in education, particularly at the primary level.
- ◆ *TMS News*, 1998, reported that the SADC-TMS group had developed training modules for school inspectors to induct them and assist them do their work more efficiently. Botswana had plans to start a three-year project in support of management development training at the basic education level. This would have a teacher upgrading component through distance education; school-focused interventions to develop training and teaching materials; teacher-focused interventions that would organise short school-based and residential upgrading programmes in mathematics, science, English and social studies; and an information technology support-for-schools project that would train teachers to pilot a computer awareness syllabus for junior secondary schools.

The 'Improving the Education Quality' Project

The 'Improving the Education Quality' project (IEQ) is a project of the Institute for International Research, in collaboration with different countries in the developing world. It has three major purposes: to learn about the school and classroom experiences of educators and pupils; to work in partnership with host country colleagues; and to gather and share information that reflects the educational priorities of each country. African countries so far involved are Ghana, Mali, South Africa and Uganda. The data gathered through IEQ has resulted in the re-examination of some national initiatives. It '... becomes a catalyst for dialogue, seminars and workshops, and a basis for proposing changes such as instructional strategies at classroom level, and re-examining national initiatives to support girls' education' (Schubert, 1996).

In Uganda, IEQ was implemented as a research arm of the national reform effort at the primary school level. It identified five factors that seemed to be

central in determining the effectiveness of primary schools in Uganda. These were the state of the basic facilities, community involvement, support from the education system, leadership of the head-teachers and quality of teachers. The data analysis indicated that the teacher factor was the most important variable. The second phase concentrated, therefore, on the context in which primary school teachers operate, their perceived and actual experience of this context, and how these impinge on learning outcomes. The major finding was that the working environment of teachers was generally bleak, and that in such a situation most teachers become apathetic and are either unable or unwilling to update their teaching notes (Munene *et al.*, 1997). Such a situation affects a practical subject such as science more than other subjects. It further affects girls' participation more adversely than that of boys, as the FEMSA findings indicated. The overall recommendation was, therefore, that emphasis in the reforms should be placed on the teacher. This is a conclusion that underscored what was already known and the challenge is how it can be implemented effectively, given the huge numbers involved and the limited financial resources.

Improvements in curricula and test design

Currently in Africa, there is an ever-growing realisation of the need to make SMT curricula more gender-sensitive and relevant to national and community needs (Mulemwa, 1999). Many countries have therefore undertaken curricula reviews in content, methodology and examinations, as exemplified below.

Some curricula reviews

The ZIM-SCI and BOTSCI curricula

Zimbabwe reappraised its national science curriculum to provide science for all. The new Zimbabwe science curriculum, known as ZIM-SCI, produced science kits that make use of materials that are available in the local environment. These were more affordable and hence enabled the provision and popularisation of science education in many schools, particularly in remote rural areas. The ZIM-SCI curriculum received recognition in some other African countries that studied it for adaptation and adoption. One such country was Botswana which produced a curriculum known as BOTSCI. ZIM-SCI won the Comenius Medal, awarded in recognition of curricula innovations, at the 45th International Conference on Education held in Geneva in 1996 (Takundwa, 1997).

Curricula reforms in Uganda

Uganda is undergoing substantial SMT curricula changes in the education sector, starting at primary school level. There is a new science curriculum for

the formal school which is being improved through development of appropriate supplementary materials, including teachers' guides, to support its more effective implementation.

Another curriculum effort is the 'Complementary Opportunities for Primary Education' (COPE), a project for out-of-school youth that specifically targets girls. It employs and trains community-based school-leavers as instructors. COPE condensed five years' work of the primary school curriculum into a three-year curriculum that is flexible, child-centred and practical. It also developed a corresponding set of instructors' guides and pupils' books. It has been piloted for three years in four districts of Uganda and has gained growing community recognition as a significant alternative way to impart basic education. The plan is that graduates of COPE should be able to join the upper primary school at primary six level. The challenges for COPE include forging linkages with the formal school system and developing modalities to involve communities in sustaining such a programme. If COPE proves to be successful it will address one of the major problems in many countries of the region, namely that of educating out-of-school young people, who include many girls. Review efforts to improve the SMT curricula at the secondary school level are also in progress (Mulemwa, 1998).

Curricula review efforts in South Africa

South Africa is in the unique situation of having to develop new policies and strategies in all areas of development in order to redress the huge imbalances created by apartheid. Its S&T curricula reforms in started with a White Paper. It carried out a baseline survey of macro indicators in preparation for 'Education 2000+' (Bot, 1997). The development of curricula content and materials which aim to achieve the stated general policies is the major educational challenge with which South Africa is now grappling. The Science Curriculum Initiative in South Africa (SCISA), a network of individuals and organisations concerned with change in science education, has provided a model for teacher education that seeks to bridge the gap between pre-service and in-service functions (Savage, 1995). All these efforts have gender components.

Improving test design

Many African countries have examination-driven curricula and hence any improvements in the quality of learning greatly depends on what is examined and how. Most examination systems in the region use norm-referenced types of final examinations that do not provide information about the success of an education system in imparting the knowledge and skills as stated in the curricula. In recognition of this, many countries are making efforts to improve

their assessment instruments. In two volumes, entitled *Improving Test Design*, Bude and Lewin (1997) discussed the efforts of more than 12 Southern and East African countries to improve their examination instruments for science and agriculture, in terms of their validity, reliability and technical efficiency. Similar efforts in West Africa include those in Ghana where the role critically examining the role of assessment in the current education reforms (Harris, 1996).

Recently, Bude and Wippich (1999) edited another volume of primary leaving examination papers for science and agriculture from 12 African countries. The papers of each country were reviewed by a group of colleagues from the region who discuss the papers in terms of their cognitive demand, relevance, reliability, practical activity and gender balance. They '... contain a wealth of constructive criticism and helpful proposals that might assist countries to further improve future item design in their examination papers', says Bude.

Project 2000+

The UNESCO Project 2000+ is a worldwide project aimed at improving the relevance, and the teaching and learning of science (UNESCO, 1993). In Africa, the project concentrated on fundamental key areas of concern, namely the need to popularise science in such a way that it becomes a culture and way of life rather than subjects to be learned at school. It was therefore code-named 'POPSTAFRIC', standing for Popularising of Science and Technology in Africa and is organised on a regional basis. The themes focused on include:

- ◆ The development of supplementary materials for school-based S&T and S&T Clinics for Girls;
- ◆ S&T audiovisual materials for the out-of-school populations.

Some sub-regional workshops have taken place as part of Project 2000+, such as one for the Southern African region in Harare in 1994. Since then, however, few activities have been undertaken, basically because of lack of funds, though many countries are carrying out projects that address the objectives of Project 2000+. The project has produced materials such as the UNESCO book, *Practical Guide For the Development of Instructional Materials For EPD in Africa South of the Sahara*, 1996.

Some Other Innovative Projects

In this section some country-specific projects are discussed.

The In-Service Secondary Teachers' Education Project

The In-Service Secondary Teachers' Education Project (INSSTEP) is a four-year programme of support to secondary education in Uganda. It aims at '... increasing the efficiency and effectiveness of secondary education through establishing a national network of Teacher Resource Centres (TRCs) and developing a systematic programme of in-service teacher education in the core subjects of English, mathematics and science'. The project has created a TRC in each district in Uganda and equipped them with resources and facilities for teachers including basic reprographic equipment, mathematics and science teaching resource boxes for loan to schools, materials for in-service teacher-training courses and reference materials for teaching. The TRCs act as information and meeting centres. In each district, centre co-ordinators and two subject teachers have been trained, workshops held for head-teachers, school management committees briefed and resources made available for loans to schools.

The in-service training and support to teachers through the TRCs is provided by a variety of personnel including tutors from nearby national teacher training colleges, part-time teacher-trainers and district inspectors who have received training through the project. INSSTEP places special emphasis on gender equality and tries to ensure that the project benefits male and female teachers equally. INSSTEP has therefore developed training materials including worksheets for units such as the following:

- ◆ Science Activities: Objectives. Approaches and Outcomes; Improvising Materials
- ◆ Preparing Worksheets; Laboratory Management
- ◆ A module on 'Gender Issues in Science Education'.

The INSSTEP approach to teacher-training may offer a viable, less expensive and more effective alternative for training teachers on the job, both at the pre-service and in-service levels, and improve the resources available to teachers. The TRCs also have considerable potential for the in-service training of teachers at the primary school level.

The Children's Science (CHISCI) Publications in Africa

The Foundation for the Promotion of Children's Science Publications in Africa is premised on the conviction that the development future of Africa

lies in its children, and on how deeply and intimately science and technology is reintegrated into African culture (Odhiambo, 1997). Its mission is three-pronged:

- ◆ To stimulate and promote a reading and creative science and technology culture in Africa – at home, in the villages, at school, out-of-school, at play and at the workplace – from a very early age;
- ◆ To stimulate and promote the design, development, production and distribution of relevant quality children's books and creative toys with innovative, culturally-sensitive science and technology content;
- ◆ To promote ownership of reading materials and a lifelong book-buying propensity by children and their families (siblings, parents, grandparents and guardians).

In fulfilment of these objectives, CHISCI has:

- ◆ Organised more than 55 seminars and workshops focused on the development of skills for writing, editing, illustrating, publishing and marketing children's books in Africa, including science books;
- ◆ Organised a Pan-African Children's Book Fair (PACBF) for one week in Nairobi in 1992;
- ◆ Established a children's library for daily reading, story telling and other activities in 1996. Since then, a creative science workshop and children's toy library (with its own production workshop) have been added. CHISCI reports that on average 80 children use the campus daily and the number greatly increases during school holidays;
- ◆ Piloted the concept of the 'Children's Mobile Reading Tent' and exhibited the tent in Kampala, Uganda in 1998;
- ◆ In 1992 CHISCI established the Children's Science Press on a small scale and now publishes its own occasional newspaper, *Challenger*.

CHISCI has a strategic plan of action for the medium term, starting in 1998, to strengthen and expand the above activities that aim to develop a reading and scientific culture in Africa. It is particularly interesting and exciting because it targets children at an appropriate age. CHISCI promises to become a creative way to improve scientific and technological literacy in local populations.

Science camps for girls

School science curricula tend to build more on the out-of-school experiences of boys than those of girls. Consequently, efforts have been made to give girls extra assistance in learning science such as special camps, like those held for over 10 years in Ghana known as the Science, Mathematics and Technology Education (SMTE) Clinics for girls. In these two week residential 'clinics', girls are given intensive tuition and engage in hands-on-work in SMTE to give them experience, facilitate understanding and help them to develop confidence in handling SMTE subjects and materials. The facilitators of such clinics, who include role models, are carefully selected to create interest in SMTE among the students, and when funds permit, students and role models are invited from other African countries.

In 1995, Zimbabwe tried the Ghana experiment in a two-week 'Science Camp for Girls' (Takundwa, 1997). The camp was organised as a 'booster' in physics, chemistry, biology and mathematics. Participants came from Botswana, Ethiopia, Gambia, Lesotho, Kenya, Malawi, Mozambique, Namibia, Uganda, Swaziland, Zambia and Zimbabwe.

In Zanzibar, annual science camps are held for junior secondary and primary school students and teachers. Gender equity is an important selection criterion. Savage (1995) stated 'The Zanzibar Science Camp and its participants from all levels of education, from the Minister of Education to pupils from schools, actively promote the improvement of science education at the primary, secondary and teacher education levels. This is the most innovative project in participatory curriculum development in science education, at a national level, that I have seen in operation'.

The Zanzibar experience has been a model for at least one other initiative. In South Africa, the Institute for Partnerships between Education and Business (IPEB) hosted two successful camps in association with the national electricity producer (SAARMSE, 1998).

This girls' clinic or camp approach has been evaluated and seems to work, at least in the short run. However, there have been reservations. First, clinics are extremely expensive considering that only a tiny proportion of girls attend, and that for an insignificant percentage of their education. More importantly, it is doubtful whether such a one-off, two-week activity can have any long-term effect on the participation and performance of most girls, particularly when nothing is done to change the school environment to which the girls must return. It may, therefore, be more cost-effective and sustainable to train teachers and provide them with a supportive environment in their schools so

that they can endeavour to implement the concept of science camps in their schools. In response to these and other reservations, the Ghana SMTE camps have been decentralised to the regions to reach more girls while reducing costs.

Science and technology road shows

In 1991 an S&T Travelling Exhibition was organised in Botswana and taken to the two major cities. The exhibition included hands-on experiments and succeeded in arousing participants' interest. However, like the science camps and clinics, it is expensive and not cost-effective in relation to its long-term effect on participants. South Africa organised a S&T road show as part of its 'Year of Science and Technology' in 1998 to serve as a re-awakening tool to all South Africans about what is going on in the world in S&T, and the need for the country to get more involved in these vital areas of human endeavour.

The Girls' Attainment in Basic Literacy and Education project

The Girls' Attainment in Basic Literacy and Education (GABLE) project is one of Malawi's key initiatives in primary education. It aims at increasing enrolment, achievement and persistence of girls in primary school. It supports a Gender-Appropriate Curriculum Unit that develops curricula materials such as pupils' textbooks, teachers' guides and teacher-training support materials which contain positive messages about girls' and women's roles in society and school. GABLE supported the University of Malawi in launching a nationwide social mobilisation campaign for pupils, parents and local communities to reinforce the value of girls' education. In this campaign, the project works with a theatre group from the University of Malawi to present gender-sensitive morality plays. There is considerable evidence that the GABLE project has helped to improve girls' enrolment, retention and self-image in Malawi, and that it has made parents, teachers and government more gender-sensitive (Dorsey, 1996). Malawi produces comic books in SMTE. Other gender-sensitive materials produced include:

- ◆ *JOIN IN*, a mathematics and science magazine for secondary school pupils, produced by the Science Teachers' Association of Malawi (STAM) and the Mathematics Association of Malawi (MAM);
- ◆ *Linking Community Science and Technology with School Science Projects*, newsletter of the Malawi Institute of Education.

The incentive grants scheme

Uganda currently has a grants scheme that specifically targets primary school girls. Under this scheme, funds are awarded to primary schools that excel in maintaining the enrolment of girls from one class to the next up to P7 as well

as excel in the primary leaving examination. The grants range from the equivalent of US\$500–1,000. This scheme targets only those districts that have low enrolment rates, high drop-out rates, low achievement and low transition rates for girls. It is hoped that this incentive will enable school communities to devise effective ways of keeping girls in school for the whole primary cycle so more will be exposed to basic SMT education.

SMT Education Research and Networks in Africa

The African region is developing internal networks and associations to combat issues of lack of SMTE and development. All emphasise participation of girls and women, which is now recognised as a key issue, and encourage research. However, there is a general paucity of research that focuses on issues of gender and science, and particularly on measures to address the problems of girls' access, participation and performance in SMTE. Some of the known African networks in SMTE and a few known research projects that cover several countries are briefly outlined in this section.

The AFCLIST network

AFCLIST has sponsored a number of networking activities including:

- ◆ An intensive two-week print production, science education workshop in Nairobi, Kenya in August 1994, involving professionals from nine African countries. In December 1995 AFCLIST convened a meeting with the University of Durban-Westville of over 100 participants from four continents, but mainly from Africa. This meeting of science educators prioritised issues that are now being used to guide the development of AFCLIST, such as formation of a consultancy service and development of centres of excellence on key SMTE issues in Africa.
- ◆ In January 1991, 120 science educators from 15 countries met in Harare, Zimbabwe, to share and generate new ideas for science teaching and teacher education – hence the title of the conference, the 'Harare Generator'. A report was produced documenting the process and outcomes of the conference. It was supplemented by a set of coloured slides and a three-hour videotape of some of the conference activities. Units were developed on themes such as Encouraging Pupils' Involvement, Developing Creativity and Thinking, Exploring Low-Cost Materials, Using Real-World Resources, Introducing Technology and Regenerating Science Education. While gender sensitivity was not an focus area, the materials were developed with the involvement of actual pupils and are therefore most appropriate for science education and a valuable resource for teachers at all levels of education.

- ◆ A 'WHO'S WHO' of science education professionals and their research interests was produced (Enjiku, 1997) to improve communication and promote an exchange of ideas and networking among interested people. It will be updated from time to time so as to include upcoming professionals.
- ◆ The Zomba workshop was held in June 1997 to disseminate the materials that were developed in the Harare Generator and AFCLIST-sponsored projects. Participants also had opportunities to further develop their project-writing skills.

AFCLIST Publications

AFCLIST has taken on the important and needed role of publishing and disseminating research and information in SMTE. They have, for example, published the following books or manuscripts:

- ◆ *Improving Girls' Participation and Performance in Science Education in Africa*, edited by P. Naidoo and M. Savage, 1997;
- ◆ *African Science and Technology Education into the New Millennium: Practice, Policy and Priorities*, edited by P. Naidoo and M. Savage, 1998;
- ◆ *Using the Local Resource Base to Teach Science and Technology: Lessons from Africa*, edited by P. Naidoo and M. Savage (1999).

Gender And Science And Technology – Africa

Gender And Science And Technology (GASAT) is an international association of people concerned with issues arising from gender and S&T. GASAT holds international conferences every two to three years and has established strong and influential networks of individuals and organisations engaged in research and grassroots level activities that promote gender equity in S&T. The major activity at these meetings is sharing results of research and interventions. A case in point is the international research on 'Science and Scientists' (SAS), which started as a small contribution to the GASAT 8 meeting in India in 1996.

GASAT aims at finding out the images that young people aged about 13 years, from different parts of the world, have of science and scientists, with particular emphasis on gender aspects (Sjoberg *et al.*, 1996). The premise is that it may be important for science educators to address the perception of pupils so as to increase interest in, and facilitate understanding of, S&T. This cross-cultural study was initiated by three researcher from different parts of the world, India, Norway and Uganda. Over 20 different countries are participating in the research, including eight from Africa. Although all the results have not been thoroughly analysed, there are indications that generally

pupils of the developing world, including African countries, believe that science is very useful and reflect hardly any negative effects of science, in contrast to pupils from the countries of the developed world, such as Norway (Sjoberg, 1997) who find science more harmful than useful, and have issues such as environmental pollution and degradation uppermost in their minds.

In October 1997, the Africa region held its first sub-regional meeting, GASAT-Africa, in Lilongwe, Malawi. A major aim was the preparation for the International GASAT 9 that was to be held on the African continent for the first time, in July 1999 in Ghana. The main theme of the GASAT-Africa conference was, 'Towards Sustainable Development Through Gender Equity in Science and Technology'. Research papers were presented on sub-themes such as:

- ◆ Efforts in Reducing the Gender Gap in S&T;
- ◆ The Role of Gender in Natural Resource Management for Sustainable Development: The Effects of Policies on Gender Participation in S&T;
- ◆ The Role of Women in the Development and Utilisation of Indigenous S&T;
- ◆ The Establishment of Information Technology Networks and Gender Issues;
- ◆ The Impact of Cultural Practices on the Participation of Girls and Boys in S&T.

Participants from over 15 African countries attended the meeting, a beginning that the region should endeavour to build on so that it becomes a forum for creating a critical mass of researchers with a focus on gender and SMTE.

The theme for the GASAT 9 conference in Ghana was 'From Policy to Action in Gender, Science and Technology for Sustainable Development in the 21st Century'. The conference had sub-themes and presentations that addressed some of the problems that are most pertinent to the Africa region. These included education and training; gender issues in employment and work; gender issues in information and new technologies; and valuing women's knowledge and skills. About 15 African countries participated, and the conference was a beginning of collaborative and networking activities.

The International Organisation for Science and Technology Education

The International Organisation for Science and Technology Education (IOSTE) was established to advance the cause of education in S&T as a vital part of general education and to provide scholarly exchange and discussion in field of science and technology education. It holds international meetings

every two years and has achieved recognition by UNESCO as an official NGO. A number of African countries have participated in IOSTE activities. The most recent meeting of IOSTE took place 26 June–2 July 1999 in Durban, South Africa. The theme was ‘Science and Technology Education for Sustainable Development in Changing and Diverse Societies and Environments’. One sub-theme was ‘The participation of women and girls in science and technology education for sustainable development’. Small interest groups have developed from these meetings, such as groups on environmental education, and gender and science education.

The Southern African Association for Research in Mathematics and Science Education

The Southern African Association for Research in Mathematics and Science Education (SAARMSE) aims at promoting mathematics and science education research, regionally, nationally and internationally, by means of fostering a sense of community among researchers (Levy, 1994). It has several specific objectives among which are:

- ◆ Promoting research to improve and develop mathematics and science education programmes in Southern Africa in response to current and future needs;
- ◆ Organising conferences at which results of research undertaken by members can be presented;
- ◆ Encouraging research and discussion around key issues in mathematics and science education;
- ◆ Providing avenues for local publication of findings in mathematics and science education research.

Apart from its role in networking and sharing ideas, SAARMSE is another important organisation for the creation of a critical mass of researchers in Africa. It produced the first volume of its journal in January 1998.

The Forum for African Women Educationalists

The Forum for African Women Educationalists (FAWE) is an African regional association of women Ministers of Education, Vice-Chancellors, prominent women educationalists and male Ministers of Education. Its goal is to improve girls’ education in Africa by trying to ensure that good, gender-sensitive education policies are not only enacted, but also translated into action. FAWE therefore engages in advocacy and strategic resource planning programmes, and sponsors innovative projects in advocacy, demonstration, policy, research and tertiary education. As such the education of girls in SMTE is part of its

mandate. For example, FAWE co-sponsored the GASAT-Africa conference and administers the FEMSA project.

FAWE has national chapters in 20 countries: Benin, Burkina Faso, Cameroon, Ethiopia, Gabon, Ghana, Guinea, Kenya, Malawi, Mali, Mozambique, Namibia, Senegal, Seychelles, Sierra Leone, South Africa, Tanzania, Uganda, Zambia and Zimbabwe. It has sponsored projects in countries such as Chad, Seychelles, Ethiopia, Kenya, South Africa Uganda and Zimbabwe.

FAWE is a programme of ADEA through its working group on female participation. ADEA is an umbrella association of African ministers of education donors with an interest in the field. It aims at developing institutional capacities within Africa through technical skills development and networks for the exchange and sharing of successful strategies and innovations.

FEMSA

As pointed out earlier, the activities of the second phase of FEMSA focus on implementing interventions that address some of the problems that girls experience learning SMT. The findings of good practices, strategies and interventions are shared first amongst the 12 FEMSA countries during the biannual regional project committee meetings. The findings are then refined and printed in small booklets for dissemination throughout Africa and beyond the continent.

The African Academy of Sciences

The African Academy of Sciences (AAS) focuses on science, including science education. It has produced materials such as guidelines for gender analysis of textbooks and teaching materials in an African context, as well as profiles of African women scientists, which not only give their addresses but also their areas of research interests, and works to facilitate networking. AAS works closely with the Third World Organisation for Women Scientists (TWOWS), and both organisations carry out gender-focused research in all fields, including SMTE, and disseminate their findings widely, especially in Africa.

The Way Forward

The efforts discussed above clearly indicate that Africa has now seriously woken up to the need to address the problem of gender inequality in education, and particularly in SMTE. As a way forward, the African region and individual countries need to intensify their efforts to ensure a drastic and fast improvement in the access, participation and performance of girls in

SMT-based education and hence in jobs and careers. To maximise their effect, these efforts must, as far as is possible, occur simultaneously at the regional, national and local levels.

At the regional level, another initiative of the Gender Advisory Board (GAB) of the UN Commission on Science and Technology for Development is to set up an African Secretariat to co-ordinate the implementation of its recommendations to the 4th World Conference on Women held in Beijing in 1995. These recommendations are contained in a report of the Gender Working Group of the Commission (UN Report, May 1995). This is in addition to the regional bodies and projects identified earlier, such as FAWE, FEMSA, AAS, TWOWS, AFCLIST, GASAT-Africa and the Africa Regional Office of UNESCO (BREDA-UNESCO) in Dakar, Senegal, that should continue to carry out work in the areas of SMTE.

At a national level, many countries of the region need to re-examine their education systems and programmes to ensure gender equality in access, participation and performance. Many countries are already implementing strategic planning exercises in education, and particularly SMTE, that are at different stages, as the examples given below illustrate.

In Mozambique, the government has plans for '... the promotion of equal access of girls to education' and has defined what should be done. However, none of the actions have been implemented for financial and political reasons (Januario and Mariano da Jasso, 1997). In Botswana, the government has made detailed 'Strategies for Mainstreaming and Institutionalising Gender Equity in Science Education and Vocational Training' and has started implementing some of them (Mannathoko, 1997).

In Uganda, the government is seriously implementing the 'Education Strategic Investment Plan' (ESIP) for its education sector; girls' education in SMTE is included. The six-month periodic review of the implementation of ESIP as it moves into the second year was completed between 3–14 April 2000.

ESIP, which is a six-year, sector-wide plan, developed a series of detailed investment programmes for specific sub-sectors of education, such as primary, and teacher education. Within ESIP, there are major cross-cutting issues that are given due emphasis, such as quality, access, gender and poverty. For example, the 'ESIP and GENDEW' strategy aims at a target of 100 per cent enrolment and universal primary education, and a significant increase in the participation of females at the secondary school level. There is a consultative group on the 'National Strategy for Accelerating Girls' Education', and within

this SMTE is given emphasis. As ESIP, which focuses on the primary level, was being developed, another committee was charged with the development of a strategy specific to 'Science, Technology and Management in Secondary Schools' (STEMSS). It prepared a feasible work plan to develop STEMSS that ensures maximum effectiveness and benefits from the available limited resources in the ministry. It has so far produced a concept paper outlining what should be done and how. It then has to do a feasibility study before producing a report on the implementation of STEMSS.

Conclusion

This chapter has highlighted some current efforts in the African region in girls' access, participation and performance in SMT-based education. The focus of these interventions is and should deliberately be at the primary and secondary school levels because this is where efforts must be maximised to involve more girls if there is to be a substantial increase in women's participation in SMT-based jobs and careers. It is vital that the individual countries and the region as a whole should work towards the development and inculcation of an SMT culture among youth, and hence a scientific and technological way of life. This is because the 'SMT culture' is fast becoming important for personal survival as well as national and regional viability. The efforts discussed in this chapter provide positive experiences for possible ways forward. The FEMSA project, for example, has been discussed in some detail because its findings and broad suggestions for ameliorating the situation, as well as its general approach, are feasible and would be beneficial to many countries of the region.

It is hoped that the sketch of activities presented here will stimulate concerned people and organisations to double their efforts in improving girls' participation and performance in SMTE. This should ensure that the new millennium starts with a promise of having significantly more women in Africa participating actively in science, mathematics and technology.