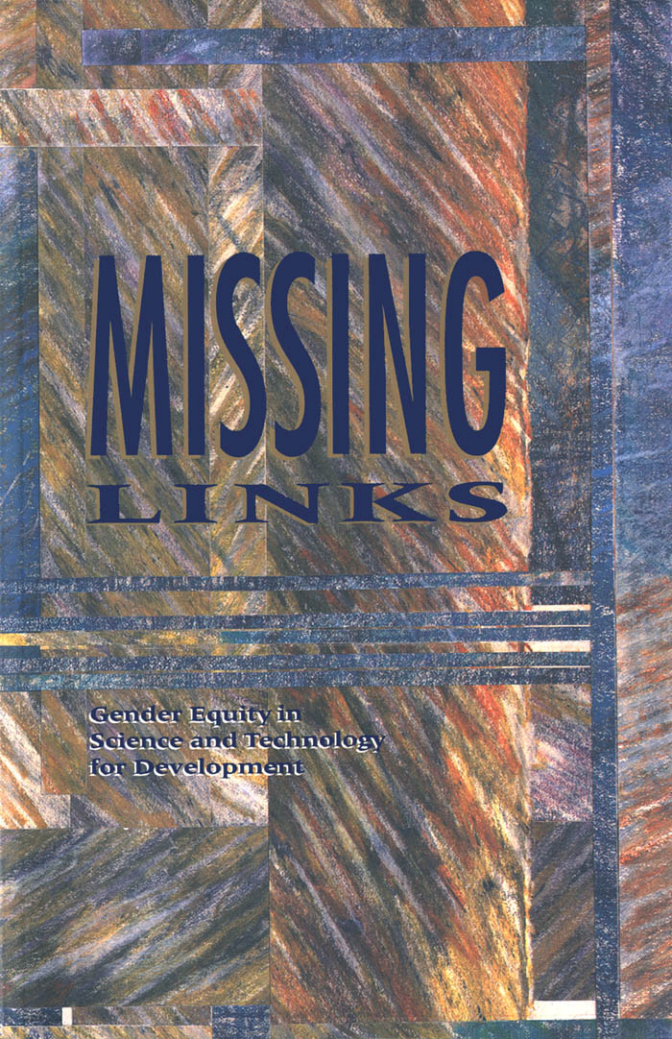
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This book is dedicated to Stanislas Ruzenza,
a member of the Gender Working Group.
Professor Ruzenza died in June 1995,
a victim of civil strife in Burundi.

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Contents

Chapter 9
Literacy for all

Educating and empowering women

Pamela Fraser-Abder and Jayshree A. Mehta

All over the world, education is regarded as the key factor in overcoming the barriers that women face and the basic tool for empowering women and bringing them into the main path of development. The rapid pace of development of science and technology (S&T) and their effect on all walks of life is apparent. No society can keep half its population from basic understanding of S&T developments. Education must play a vital role in establishing equality and empowering women. What type of education will allow women to meet the challenges of the year 2000 and beyond? In a fast-changing economy and global market trends, women's struggle for survival has become increasingly difficult as they encounter social and religious prejudices and economic disadvantages.

Studies, particularly in developing countries, have revealed that there are wide disparities and inequalities between men and women in all areas, including access to education, health care, food, energy, income, and employment. Technological modernization has led to a concentration of women in domestic and labour-intensive activities. Women are being displaced from remunerative and skill-related employment as a result of the introduction of new technology in many regions of the world. The need to shift the focus from women as a target of welfare policies to women as a group for development has been felt by all development agencies, and S&T literacy must be used as a major tool.

Women — the traditional educators and health providers in the family — have benefited least from technological developments. They are the last to receive training, and their unrecorded and unpaid work in all fields, from domestic work to agriculture, has provided them with the fewest assets. Research shows that female literacy plays an important role in raising productivity levels and in reducing child mortality rates and population growth. Women must be exposed to various technologies (from simple to complex) and use

them in their daily lives. Technology must be made woman-friendly and women must learn to be comfortable with technology.

The global perspective

Currently, the majority of the world's out-of-school youth are female. In most regions, girls are underrepresented at every level of formal education. Keeping girls in school, even at the primary level, and their performance depend largely upon socioeconomic factors and upon the attitudes of teachers.

When daily survival involves overcoming problems of pollution, malnutrition, and lack of basic health care, spending on women's education is a social investment. Research has shown a direct link between women's education and child-mortality rates, fertility rates, and income-generation activities. Environmental degradation has affected women most by interfering with their daily quest for fodder, fuel, and water for their families. In most countries, women have been the primary environmental caretakers for generations, and they are often the custodians of indigenous knowledge about herbal medicines, agricultural practices, and food preservation. Yet policymakers continue to ignore the importance of women's interests and needs. Women's participation in the management of resources and in decision-making processes at every level will bring a new perspective to the system.

However, worldwide, one out of three women is illiterate compared with one out of five men. The discrepancy is even greater in developing countries where one in four men and one in two women are illiterate. More than 60% of illiterate people in the world are women (about 600 million). Over 100 million children of school age (mainly girls) do not attend school; most are in developing countries. How do we reach these groups?

- There is a great need to develop S&T courses with several entry and exit points.
- Materials and courses must be developed in local languages and must be easy to understand.
- Female leadership at the local and national levels must be encouraged.
- Programs related to skills development to help women choose a career and work must be developed.

- ✦ Groups of educated, dedicated women must be formed to communicate aspects of science to local and rural women's groups.

Who has access to S&T education?

Several recommendations resulting from United Nations (UN) forums have addressed the need to improve the quality of education females receive, remove obstacles to female access, ensure equity in access to S&T, provide adequate resources, and make S&T mandatory in the school system (UN 1979b, 1984, 1985b, 1990, 1992a; Unesco 1993).

Research indicates that there are no physical or intellectual barriers to women's full participation in S&T. However, in some countries, formidable legal, cultural, or socioeconomic barriers result in the continuing underutilization, devaluation, and disregard of the knowledge women can contribute to the male-dominated S&T fields. Harding (1992) presents a noteworthy argument for including women in S&T.

> Since women are as potentially able as men to contribute to S&T, then national development, which depends on applications of S&T, will be limited if women are barred, and there will be a loss of talent to the nation. Lack of access to S&T prevents women from operating within S&T, where appropriate qualifications lead to financial rewards and interesting work. Barriers lead to alienation and transmission of that alienation to their children, particularly their daughters. Leaving women out results in a loss to science. Men and women bring different specific strengths and limitations to S&T. This is reflected in the type of thinking and problem solving associated with S&T.

Nevertheless, equity of access continues to be a major problem. In principle, nations have declared a commitment to equity in access to S&T and to provision of resources to achieve this objective. Unfortunately many economic and social constraints affect their ability to put these policies into practice. In many cultures, schooling is still seen as a necessity for males, but an expensive and useless experience for females; among the developing nations in Africa, Asia, and Latin America, 38% of school age girls never enrol in school. Even in countries where enrolment rates of females are high, the data do not always accurately reflect the actual situation. These rates often

disguise the problems of absenteeism and dropout that occur predominantly in the female population because of the conflicting work and cultural demands on girls' time. For example, in India and Africa, girls are often withdrawn from school because of early marriage.

Even when girls do attend school, the generally poorer quality of girls' education contributes to lower S&T competence of girls. Because basic education is a requirement for access to S&T, those (mainly females) who are denied access at the basic levels tend to fall farther and farther behind, thus increasing gender inequities. Girls who do have access to basic education must still overcome immense problems as they strive for equity in access to S&T. Most schools still consider science to be a subject for boys, and girls are subsequently shunted into home economics and other "more appropriate" subjects. This practice is often fully supported and reinforced by teachers, guidance counsellors, family, and peers.

If girls do enrol in S&T programs, they are faced with teachers who do not use gender-sensitive pedagogy, but employ teaching strategies that "shortchange" girls. At the secondary and tertiary level, a hostile and unaccommodating climate is also the norm. Those who survive these challenges move into a corporate climate that fosters inequity; to achieve success, females must be part of the "old boys' network." Given cultural norms, this is often not possible and women eventually reach a ceiling that prevents them from entering the upper echelons of science.

In 1980, the UN Educational, Scientific and Cultural Organisation (Unesco) initiated case studies of the access of women to S&T training and associated careers in Czechoslovakia, France, Malaysia, Senegal, and Venezuela, which resulted in training workshops, regional seminars, and fellowships. This initiative has led to some improvement in the quality of education for females in the participating countries.

Policy recommendations

Assist governments to formulate economic policy and training programs to ensure equitable access to S&T by women and girls. Governments should be encouraged to adopt the following action strategies:

- Allocate resources to increase female literacy and their involvement in S&T;
- Develop and implement gender sensitivity and awareness training for educators and policymakers;

- ✦ Develop and implement strategies to increase access to general literacy programs for females;
- ✦ Include science in general literacy programs;
- ✦ Evaluate the effect of female involvement in S&T on cultural values and norms. Is it in the interests of society to change these values? Do these societies want to see changes? Can the society adjust to the differing life-styles associated with exposing women to S&T? and
- ✦ Design systems of accountability to ensure that policies are being implemented.

The successful enactment of this policy requires commitment from national leaders, top administrators, and funders, in principle and in practice; fundamental changes in ethical, cultural, and societal norms; and the involvement of women in the process of change. Economic and training programs should be facilitated by Unesco, governmental agencies, nongovernmental agencies (NGOs), policymakers, educators, and others concerned. They should be informed by what is happening in other countries that are striving toward equity in access to S&T. Networks should be established to publish and disseminate successful models (with details of populations and strategies) to facilitate replication.

What S&T curriculum is taught?

Over the past decade most UN recommendations on the teaching of S&T point to the need to develop "female friendly" science by reorganizing science curricula and textbooks to address women's needs and to create and sustain interest among female students (UN 1984, 1985b; NABST 1988; Aghenta 1989). They also suggest that throughout the education system, from preschool to university level, both girls and boys should be exposed to the same curriculum and types of experience in the areas of science, technology, and technical skills, and children should be encouraged to develop an interest in science and become involved in activities that are considered "more proper" for the other sex.

Curriculum developers must integrate indigenous S&T into the frameworks they prepare for national or global curricula. Currently, the material included in curricula is often borrowed from highly industrialized sectors of society and holds little relevance for the people being introduced to S&T literacy. Irrelevance is a major cause of the massive dropout rate in science. Children and adult

members of society need to hear and understand the impact of S&T on their lives; for example, why they should stop polluting streams. Appropriate curricula transmit such information, and giving this information to more women increases the chance of the ideas becoming inculcated into our societies.

Education must be relevant to people's lives. Curricular reform can address gender roles either by being designed to fit existing roles, or by attempting to alter traditional roles and provide new opportunities for both boys and girls to meet the challenges and needs of a technologically driven society. Local policymakers need to determine which of these directions is appropriate, and curriculum developers need to produce appropriate S&T curricula that will foster progress in that direction and facilitate gender equity.

Most nations have been involved in S&T curriculum revision, and some have included components on gender issues. However, because of the lack of coordination between teacher educators and curriculum developers, issues addressed during the S&T curriculum-revision process often are not included in teacher-training programs. Teachers are not taught adequate gender sensitivity and the awareness necessary to implement the revised classroom curricula.

Consequently, few nations have made a concerted attempt to provide girls and boys with the same kinds of experiences. For example, it was not until the publication of the report, *How Schools Shortchange Girls* (AAUW 1992), that many US science teachers became sensitized to their classroom behaviour which discriminated against girls in a variety of ways.

Policy recommendations

- ✦ Identify in each culture the knowledge, skills, values, and attitudes needed by citizens to function productively in a technological society.
- ✦ Identify in each culture whether S&T education should conform with existing gender roles or should provide opportunities for both boys and girls to meet the challenges of technologically driven society.
- ✦ Provide resources to develop a relevant S&T curriculum that includes elements of "Western" and indigenous S&T and is designed to foster interest and participation of both girls and boys, to create a scientifically and technologically literate population.

The following action strategies should be adopted:

- ✦ Determine the relevance of S&T education for the country.
- ✦ Identify issues that influence the country's ability to incorporate S&T into its educational programs.
- ✦ Establish whether traditional gender roles should continue to define girls' educational needs.
- ✦ Educate parents about the appropriateness of science for girls.
- ✦ Develop plans to educate girls for roles in an S&T-literate society congruent with parental perceptions of relevance and their aspirations for their daughters.
- ✦ Develop S&T curricula and textbooks that are "female friendly" and capable of encouraging girls' participation and interest in S&T.
- ✦ Where appropriate, incorporate in curricula elements of S&T that are traditionally deemed more suitable for the other sex.

What do teachers of S&T need?

Policy recommendations in this area have generally addressed teacher educators' need to be sensitive to the issues of gender and the importance of these issues to the outcomes of all education and training programs (Aghenta 1989; UN 1990, 1992a). Because of the ever-changing and expanding world of S&T, administrators must ensure and support appropriate preservice and continuing-service provisions for those responsible for all forms of S&T education by formulating guidelines for the preparation and continuous professional development of S&T educators. They must also provide leadership, coupled with assistance, to countries implementing them. Nations must recognize the central role of teachers in achieving S&T literacy for everyone and enhance the status of careers in S&T education at all levels.

Achievement in and attitudes toward science are significantly influenced by teachers. Particularly at the elementary level, teachers often demonstrate a negative attitude toward science, which is transmitted to students (Fraser-Abder 1992). The "Pygmalion syndrome" — differential treatment based on expectations affects achievement — plays a significant role in female science achievement (Rosenthal and Jacobson 1968). If teachers expect males to be good at math and females to be good at reading then the students will

live up to these expectations (Brophy and Evertson 1974). Teachers interact differently with the sexes and for varying amounts of time: during reading lessons, females receive greater attention; during math and science classes, teachers interact more with males and give them more encouragement (Sadker and Sadker 1986; Jones 1990).

Again, coordination between curriculum developers and teacher trainers is lacking, gender issues addressed in revised S&T curricula are not adequately addressed in the implemented curricula. Teachers must be aware of contemporary research findings on gender and S&T. Part of their training must include exposure to research findings on teacher–student interactions and the teacher's attitudes and expectations in the S&T classroom. This is an area in which most teacher educators also need training.

Teacher-education programs are slowly beginning to introduce modules on gender sensitization and development of strategies to ensure equity in the classroom, largely because of the inclusion of equity issues on the agenda of the annual conferences of many S&T education associations. Workshop manuals on sex stereotyping developed by Unesco have also been useful to some countries.

Policy recommendations

Develop strategies to ensure gender sensitization and gender equity in the S&T classroom and in all S&T training programs.

In addition, the following action should be taken: educate policymakers, teacher trainers, and researchers on key S&T gender issues.

Pedagogical and contextual frameworks in which S&T is taught

Pedagogical considerations

Previous recommendations have pointed to the need to provide positive and appropriate learning experiences and environments for females (UN 1985b; Unesco 1993). Educators have been called upon to provide a positive and appropriate learning experience so that young women can develop self-esteem. Governments, industry, public- and private-sector interests, and education and other authorities in all countries have been asked to review existing provisions for S&T

education at all levels and in all settings, giving attention to development and maintenance of learning programs responsive to the needs of individuals and communities, and to establish teaching and learning milieus that are conducive to achieving S&T literacy for all. In addition, effective communication, assessment, and evaluation strategies must be developed.

Inappropriate pedagogy is the major factor influencing girls' negative attitude toward S&T and their decision to drop out of science and math courses at the elementary and junior high-school levels. Research indicates that girls' attitudes toward science, their achievement, and experiences in science decline considerably during high school (Mullis and Jenkins 1988).

At the college level, most problems shared by female students are structural or cultural, notably poor teaching, faculty who are unapproachable, the fast pace of curricula, work overload, insufficient faculty help through periods of academic difficulty, inadequate preparation in high school, and financial difficulties (Seymour 1992). Language encourages and strengthens societal norms and mores (Hellinger 1984), but the language used in science and mathematics often reflects a male bias inadvertently directing females away from the field (Damarin 1992). Females are more likely to experience "math and science anxiety" than males. They believe that these subjects become more difficult as they progress through school, causing their anxiety to increase (Brush 1985). Coupled with inadequate pedagogy, this creates a downhill spiral to S&T illiteracy.

Implementing the recommendations mentioned above depends on the ability of teachers to use appropriate methods. For example, at Lehigh University, Pennsylvania, bilingual students involved in a hands-on, nontextbook science program run by graduate students learned the required content and began to regard science as fun.

Stereotyping

Previous recommendations have highlighted the need to eliminate gender stereotyping and suggest the development and implementation of strategies and programs as early as the preschool stage to counteract it (UN 1984, 1985b; NABST 1988). All curricula and teaching-learning materials should be free from stereotypical images of males and females. Guidelines designed to eliminate gender biases and discriminatory practices should be developed on a regional basis and made available to those involved in the administration of educational services in every territory.

A concerted effort is required to eliminate gender biases and stereotyping and promote S&T as avenues for all. Many teachers still identify a scientist as white, male, bald, boring, and unattractive. This inaccurate image is partly due to their lack of interaction with scientists. The traditional image of a mathematician, engineer, scientist, or medical doctor has been a white man, although this image is evolving to include Asians of either sex (Halleck 1993).

Textbooks and many classroom instructional materials continue to reinforce the invisibility of women in science (AAUW 1992) and girls continue to perceive science as a masculine domain (Linn and Hyde 1989). Stereotypes, including media images that show only men as users of science, influence parents' expectations for their children and students' expectations for themselves (Reyes and Padilla 1985). These attitudes may cause females to consider more stereotypical female disciplines and be less motivated in science and math (Stage et al. 1985). They also believe that the time needed to pursue careers in science will usurp time they need to engage in their traditional roles as wife and mother. The traditional gender-role beliefs of household responsibilities and child-rearing practices keep many women away from S&T.

In 1981, Unesco's section on Equality of Educational Opportunity for Girls and Women launched a program aimed at promoting better awareness and understanding of the problem of sex stereotyping in educational materials; stimulating and encouraging action to eliminate such stereotyping; and developing positive attitudes with regard to equality and mutual respect between men and women. This program included eight national studies and three regional guides for North America and Western Europe, the Arab World, and Asia and the Pacific (see Sundal-Hansen and Schultz 1984; Whyte 1984; Bisaria 1985; Jaarsma 1987). The guides present an excellent rationale for eliminating sex stereotyping, with evidence of problems created by stereotyping and workshop interventions for eliminating stereotyping. They could be used successfully in S&T teacher-training programs. A recently published book on female scientists in Indonesia has begun to make inroads in showing girls that women can indeed be scientists.

Participatory factors

In the formal education system, girls often avoid science courses because they lack confidence in their ability to pursue science careers and they do not wish to go against the expectations of teachers, peers, and parents (Sherman and Fennema 1977). Girls' interest in science decreases as they move from elementary through high

school. Accompanying this decrease is a perception of the irrelevance of science to their lives (Linn and Hyde 1989).

Males exhibit greater confidence in their mathematics and science abilities; they view themselves as math learners and have higher expectations of future math courses (Linn and Hyde 1989). Science is perceived as a masculine realm. Consequently, males are more inclined to offer assistance to less able peers and, in the process, learn more science themselves (Linn and Hyde 1989). Females, even when they perform equally or better than males, believe that science is better understood by males. As a result, girls take the minimum number of science and mathematics classes for graduation from high school (Oakes and Rand 1990) and, subsequently, will probably not meet the science requirements of most 4-year college courses.

Research emanating from the Center for Research on Women (Rayman and Brett 1993) highlights four factors that keep undergraduate women in science:

- Encouragement from parents, with mothers' encouragement being as important as fathers';
- Consistent encouragement from mentors and overall interest in the experiences of the student;
- Opportunities to do hands-on research, which is critical to the choice of specialization as well as to whether women stay in science after college; and
- Comprehensive career advice about a range of science-related jobs.

Providing adequate pedagogy, curricula, facilities, equipment, and supplies for teaching girls is an excellent first step toward increasing their participation, but the situation requires continuous monitoring.

Policy recommendations

- Develop guidelines to eliminate gender bias and discriminatory practices in S&T education.
- Provide infrastructure and funding to develop networking of female scientists, educators, and students.
- Provide infrastructure and funding for international interaction and teacher training to increase the involvement of girls in S&T.

- ✦ Develop monitoring systems to ensure progress toward sustained effectiveness of gender equity in S&T teaching and learning.

The following action strategies must be adopted.

- ✦ Identify and adapt teaching content, methods, and student activities to provide a positive experience for girls and women in classroom settings, especially through the use of techniques that are proven to be effective for females.
- ✦ Promote and replicate a broader range of gender-fair methods for testing and assessing S&T.
- ✦ Design S&T lessons that show males and females in nontraditional roles and depict successful women in S&T.
- ✦ Encourage formation of and participation in both regional and international forums to exchange information and data on successful implementations.
- ✦ Design data-collection systems that are always disaggregated by gender.
- ✦ Examine the effect of S&T education policies and programs on females and males.

Nonformal S&T education

An appreciation of nonformal education for S&T literacy is a concept that has developed only in the last two decades, and the various nonformal and formal methods and techniques used in different regions of the world still require careful study and analysis. A diversity of programs and a variety of media have emerged in different societies and one must be careful in using or adapting the ones that are suitable to the social and cultural fabric of the society.

Advantages of a nonformal approach

Educators have felt the limitations of the formal education system in a rapidly changing society that is experiencing a population explosion. Because of its rigid structure and limited resources, the formal system is constrained in some areas. S&T literacy, for example, can be attained through out-of-school learning or through learning in informal situations. Decentralization of the development process, action at a local level, and participation by communities are

important in creating scientific awareness. The strength of the nonformal system lies in its diversity, its vitality, and its ability to respond quickly and creatively to local needs. Materials that provide enjoyment and flexibility have also been missing in the formal system, but can be carefully woven into a nonformal science education and popularization program.

Institutions for informal S&T

Science centres and museums all over the world have a positive role to play in creating scientific literacy. In the last three decades, such institutions have adopted innovative approaches, such as the shift from "touch me not" exhibits to participatory, "hands on" experiences. Science centres operate on the principle that exploration of science is a joyful activity. They emphasize learning by doing, rather than the type of teaching that takes place in schools.

Planning new science and interpretive centres now requires a basic line of thought or parameters, not simple imitation of what developed countries have done. This philosophy is critical in developing countries, where the real needs and aspirations of common people in the various socioeconomic groups are quite different. A cultural backdrop must be woven into the process. A common characteristic of all visitors to science centres is their curiosity, interest, and desire to learn something. Science centres in developing countries have a greater responsibility, because more than half of the children there have never been to school or have left school before completing primary level.

Background experience plays an important role in learning science. The preexisting, sometimes mistaken or naive theories of people visiting science centres must be accounted for in any exhibit design or development strategy. Understanding these preconceptions is indispensable in developing strategies to enhance the effectiveness of informal science experiences; extensive research is required in this area. Few science centres in the world have developed effective programs for women. Science centres should steer away from science "gimmicks," presenting science as something mysterious, and exhibits that do not reveal the way they work.

An important illustration of the way in which science can be related to society took place in one of the poorest areas of Rio de Janeiro. Science events — centred around a total solar eclipse, for example — were conducted in public plazas to develop science awareness before going on to establish a community science centre. "Living science" or practicing science is a good example of informal science teaching in developing countries. Another approach is the

use of indigenous crafts, such as weaving and basketwork, and games to communicate mathematical principles. Such activities are extremely effective, as they relate to people's daily lives.

Folk formats and science theatre have been attempted by several groups in Asia, Europe, and the United States. Science theatre can be an effective way to communicate certain aspects of science. Puppetry and folk farms are extensively used by popular science groups in India.

Intuitive mathematics

For many cultures, the current method of learning science is alien, but their use of mathematics is deeply ingrained. An illiterate woman vegetable vendor or a fruit seller who has never attended formal school can do arithmetic calculations with great speed and accuracy. Women in Gujarat make the most intricate geometric designs on clothes in their traditional art and crafts and create new ones. Where does their knowledge come from?

The language used in mathematics textbooks is complex and abstract. Children often fail to read or comprehend such textbooks. Are we repeating the same mistake in nonformal education? The language or symbols used must be easy to understand or decipher by ordinary people. Few mathematics programs for radio and television at the popular level require analysis. Even science centres and museums have not developed many exhibits or programs in mathematics for the masses. The "equals" program at the Lawrence Hall of Science in California aims at involving girls in learning mathematics and tries to break down their resistance to mathematics learning, because they think it is difficult.

The relation of formal and informal education

Does communicating science require an institution or can it be accomplished by hundreds of science workers and communicators visiting one village after another on a bicycle and talking directly to people, demonstrating simple things, taking examples from the local environment? In the Gender and Science and Technology program, examining water from the village pond on a slide under a low-cost microscope, then talking about the necessity of clean drinking water and methods of purifying water evoked an enormous response. Seeing was believing. Science must be connected to society.

Active science workers seldom write, and writing without sufficient first-hand experience becomes theoretical and bookish.

Women write very little. Most science centres in developing countries are headed or managed by men who decide on programs and policies; education programmers in major science centres of developed countries are women. Does this make any difference in the way the programs evolve or are given importance? Do women educators, curators, program planners, and designers bring new perspectives to informal or nonformal communication of science?

Conclusion

Analysis of the recommendations that have been made over the past two decades reveals a need for better communication, collaboration, and cooperation among agents of change. This need is reinforced by the recommendation of participants at Unesco's international forum (Unesco 1993) that Unesco make provision, in its medium-term plan (1996–2001) in the field of education for an international program, to develop cooperation among all countries and, in particular, to focus on regional and subregional cooperation in the area of S&T literacy for all.

There is also an overwhelming need to record and disseminate available data. Lack of communication mechanisms means that colleagues at the same campus may not be aware of research being conducted by fellow faculty. The results of local research and international studies should be published and disseminated in nonacademic language and made available to formal education institutes, NGOs, and individuals involved in S&T training. This material should include directories of women who have successful careers in fields related to S&T and technical trades and who can act as role models.

Although researchers have tried to account for the underrepresentation of females in science, there is no quick and easy way to redress the imbalance; the causes and solutions are complex. Educators and policymakers must be aware of research findings and realize that the value and costs of S&T courses and careers as perceived by females are influenced by their present intrinsic values, anticipated future values, gender-role issues, and competition with current activities. Success or failure in S&T is determined by self-perceived abilities, attribution processes, stereotypes, and expectations of others. School policies and classroom practices that deal with role models, teachers' expectations, interactions, instructional materials, teaching and learning methods, number and quality of required science and math courses, mechanisms for placement in these courses,

and career guidance all play a major part in encouraging, recruiting, and retaining girls in S&T.

As a community strives to address the issue of S&T for development, it must address the following questions:

- What are S&T?
- Who should participate in S&T?
- Who will be affected by this S&T?
- What is S&T literacy?
- Should we aspire to global S&T literacy? Is local S&T sufficient?
- Should we be preparing a young girl in the middle of Africa or India to be S&T literate at the global level?

At the global level, we need to ask the following questions:

- What barriers exist to female participation in S&T?
- How do these barriers differ from country to country?
- What do S&T mean in a developing country?
- What do S&T mean in a developed country?
- What are the expected end products of S&T education?
- Do these products differ from country to country?
- Are there global end products of S&T education?
- How should we be preparing global citizens for life in a technologically driven environment?

Without collaboration and cooperation we will continue to see billions of dollars wasted as a result of inappropriate replication and lack of communication. It is time for governments, NGOs, the UN, and other intergovernmental agencies to work together to achieve economic development through universal S&T literacy. UN agencies and other intergovernmental organizations should initiate and support programs that allow countries and populations to shape their own future and NGOs active in S&T education should enter into partnership and make their knowledge and experience known to the UN and other intergovernmental bodies and participate in national, regional, and international programs to achieve the goal of S&T literacy for all (Unesco 1993). Successful access to high-quality education that includes S&T requires action by governments, NGOs, and the UN.

Action by governments

- Make the necessary expenditure so that all girls can be enrolled in and complete primary education, including S&T, on the same basis as boys.
- Reform curricula to ensure that education is gender-neutral and that gender awareness is integrated into all aspects of teacher-training programs.
- Make basic and functional literacy programs available to all women and girls.
- Promote women's interest in S&T education and encourage women to enter nontraditional fields.

Action by NGOs

- Monitor the extent to which S&T educational reforms favouring gender equity are implemented.
- Provide community-based informal training in S&T.

Action by the United Nations

- Provide gender-awareness programs for all officers engaged in designing and implementing S&T education and training.

Increasing S&T literacy among women will contribute to higher levels of productivity, a lower rate of child mortality, and stable population growth. It will add female dimensions to biological, agricultural, information, communications, military, and industrial technologies and result in overall economic development for nations that are willing to make the necessary policy recommendations and strategic planning to achieve S&T literacy for all.

With communication, collaboration, and cooperation, we can ensure that both men and women are S&T literate.