

# **GLOBAL STRATEGIES FOR EDUCATING GIRLS IN SCIENCE**

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## **INTRODUCTION**

Science, mathematics, and technology (SMT) education is a key factor to achieving sustainable human development, building and maintaining a strong economy, and improving the quality of life in all countries, yet the scientific talent of many girls and women has not been sufficiently tapped or developed. As reported by United Nations (UN) data, in many developing countries this is in large part due to the fact that more boys than girls receive a basic education. For example, there are 130 million children between the ages of 6 and 11 not attending school and 60% are girls; only thirty-nine (39%) percent of women in developing countries are enrolled in secondary education institutions; and only 11% are enrolled in higher educational institutions.<sup>1</sup>

In most countries participating in the Third International Mathematics and Science Study - TIMSS (1996), boys had significantly higher mean science achievement scores than girls at both the seventh and eighth grade levels, primarily due to significantly higher performance by boys in earth science, physics, and chemistry. And girls and boys had approximately the same average mathematics achievement at both the seventh and eighth grade levels.<sup>2</sup>

Studies indicate that in every African country, performance of students on the national school leaving examinations in science and mathematics has been declining, with performance of girls being worse than boys. In one African country in this study, over 80% to 90% of girls taking the secondary school leaving examinations in mathematics, biology, chemistry, and physics failed the examination.<sup>3</sup>

The reasons for these gender disparities in participation and achievement in education are complex, and are often due to a combination of barriers including:

- family constraints, such as the requirement for families to pay tuition and fees for books, supplies, and appropriate school attire. Also, in many cases families depend on girls working and/or taking care of siblings while other family members work.

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- policies, including insufficient national budgets for universal primary education and absence of policies or laws to address dropouts caused by pregnancy and child labor.
- community infrastructure, such as distance between schools; absence of roads and transportation to schools; and lack of water, electricity, and latrines.
- educational structure, including school schedules and calendars that conflict with girls' domestic and labor responsibilities and non-supportive school environments.
- community traditions, beliefs, and practices (tied to religion, culture, and politics), including gender and cultural stereotypes and issues of personal security.<sup>4</sup>

To gain a better understanding of how countries are going about providing SMT education for girls, amidst these barriers, the Directorate for Education and Human Resources (EHR) Programs of the American Association for the Advancement of Science (AAAS) and the International Women's Tribune Center (IWTC) conducted a study to identify formal and nonformal programs and projects that promote SMT education among girls and women.

Partnering organizations in this study included key members of the Once and Future Action Network (OFAN), including the Forum for African Women Educationalists (FAWE) in Kenya; Ecowoman - Pacific Women Networking in Fiji; the Gender Science and Development (GSD) Program in Canada; Gender and Science and Technology (GASAT) in India; the Third World Organization for Women in Science (TWOWS) in Italy; and the Association for Women in Science (AWIS) in the United States.

Methods for collecting information included utilizing the OFAN partnering organizations to distribute both print and Internet surveys to 500 organizations that participated in the Fourth World Conference on Women (FWCW) in China and WWW searches for information on girls' and women's education initiatives.

## FINDINGS

Of the one hundred and eleven (111) organizational responding to the survey, 33.4% were from the United States and Canada; 29.7% were from Asia-Pacific region; 15.3% were from Africa; 12.6% were from Europe and New Independent States (NIS); 4.5% were from the South Pacific; 2.7% were from Western Asia; and 1.8% were from Latin America and the Caribbean areas. Over 59% were non-governmental organizations (NGOs) and approximately 20% were colleges and universities. The remaining 21% of the respondents included UN agencies, government agencies, science research institutes, and industries. Of the 65 programs and projects that sent information:

- four of the organizations focused on planning initiatives with networks of ministers of education and others. For example, as a part of UNESCO Project 2000+ Science and Technology Education Initiative, more than 80 countries attended a 1993 agenda setting meeting. In Africa, the Association for the Development of Education (DAE) and

FAWE provide on-going technical assistance for ministries of education. The USAID facilitates education planning in 11 USAID-assisted countries.

- over 40% are either solely or partially focused on mentoring and career guidance programs. Of these, 57% were operated by NGOs, such as Femme Scientifiques du Cameroon, GASAT in Madras, Women in Science and Technology in Nepal, Kinnaird College for Women -- Statistics Education Program in Pakistan, Young Women as Voices of Empowerment in Science in the Philippines, the Women in Science Club in Vietnam, the Basingstoke Consortium in the United Kingdom, Centro de Estudios de la Mujer Women in Mathematics Program in Argentina, Association for Women in Science in the US, Math/Science Network in the US, and Girls Inc. in the US.
- approximately 20% focus on research and data collection on gender, science, and education, including Female Education in Mathematics and Science in Africa (FEMSA) a project to create country profiles in Cameroon, Ghana, Tanzania, and Uganda; the International Center for Study and Development in India; the Economic and Social Commission for Western Asia in Jordan; the Science and Scientists Study and the Science, Technology, and Citizen research project at the University of Oslo in Norway, and the Institute for Women's Policy Research in the US.
- approximately 15% focus on vocational education or programs to help female heads of household generate income. Organizations operating these programs include Aga Khan Rural Support Program and Baha'i Vocational Institute in India; Women in Science and Technology in Nepal; Fundacion FES in Colombia; and the Office of Women's Business Ownership of the US Small Business Administration, and Wider Opportunities for Women in the US.
- approximately 23% of the organizations focus on environmental education, including the Chhotanagpur Environmental Society in India, the Kuwait Institute for Scientific Research, and Project Ecowoman in Fiji.
- over 20% of the organizations focus on health education, including the Chinese Academy for Science and Technology, the Rural Institute for Development Education in India, Associates in Development in Ghana, the National Breast Cancer Coalition and the US Health Service's Office of Women's Health.

Although college and university-based programs focus primarily on gender and SMT education research, other examples of programs include a distance learning program for secondary certificates at Allama Iqbal Open University in Pakistan; a pre-college program, the Science Foundation Program, operated by the University of Natal in South Africa, that prepares talented Black students for entry into the university; a University of Zambia program to revise the home economic degree programs to include more science and technology; and a Centre for Science Education at North Eastern Hill University in India.

A smaller number of organizations focus on education funds for girls, including Associates in Development in Ghana, Sri Ramakrishna Tapovanam and the University Women's Association in India, and MANA (a Latina Organization) and the American Association of University Women in the US; inservice teacher training, including FAWE in Africa,

Teknikens Hus in Sweden, and Girls Count in the US; and children and family science programs, including Girl Scouts of the USA, Zirakzadeh Science Foundation in Iran, SMART Discovery Center in the US, and the Ontario Women's Directorate in Canada.

Only a few groups submitted curricula samples. Although the nonformal science curricula are related to everyday lives of students, most appear to be more of the "gee whiz" type of science activities or demonstrations rather than activities that foster the type of skills measured by the international mathematics and science study, including explaining the reasoning behind an idea; using tables, charts, and graphs to analyze relationships; working on problems for which there is no immediate solution; writing explanations about what was observed and why it happened; and putting events in order and giving a reason for the organization. The in-school curricula appears to be more focussed on textbook use and teacher demonstrations. Only six groups reported use of radio, video, computer, or other multi-media tools.

In response to the question on collaborations, it appears that very few of the grassroots NGOs are involved in educational planning initiatives at the national or policy level in their countries.

Findings from Internet searches identified some other key initiatives on gender and SMT education, including initiatives at UN agencies, CARE, the Rockefeller Foundation, the Ford Foundation, and the Carnegie Corporation of New York. In particular, UNIFEM has played a key role in SMT education by linking children and women in development issues to UN agencies that have SMT missions.<sup>5</sup>

## **CRITICAL ANALYSIS AND SUMMARY**

For the last five years, a significant proportion of the gender and SMT education effort has been devoted to planning initiatives and research, particularly in the African region. For the most part, these planning initiatives include multi-sectorial committees that conduct assessments to identify regional, country, or village specific strategies; audit policies; and identifying public/private agencies or offices responsible for implementing policy changes or proposed community action programs or both.

It appears that NGOs, particularly grassroots and rural women organizations, are not involved in many of these multi-sectorial planning committees. Since most NGOs are trusted by their local community, early and continuous involvement of these grassroots organizations can help to speed both the acceptance and dissemination of proposed changes. These grassroots groups have played significant roles in the establishment of democracies as well as in poverty and health-based initiatives. Both the United Nations High Commissioner for Refugees and the USAID have found these groups to be cost-effective promoters for their concerns.

Looking towards future actions, this study points out a number of ways that gender, and

SMT education can be strengthened in all countries by forging linkages between NGOs and SMT organizations:

- Because a large number of girls are outside the formal education system, there is a need to develop alternative mechanisms to get them involved in science. Many of the NGOs in this study, particularly in India, are exploring ways to provide nonformal, out-of-school science and vocational education in non-threatening and positive environments, viewing science as a part of the community rather than separate from it.
- Science, mathematics, and technology (SMT) inservice teacher training programs are needed that include hands-on, performance-based approaches that strengthen the ability of both females and males to reason, analyze and organize data, and write and communicate about science. The same type of training needs to be provided to preservice students, as well as educators in NGOs who provide nonformal community science programs and vocational training programs.
- More attention needs to be given to the development and adaptation of quality science, mathematics, and technology curricula and resource materials that foster strong scientific skills in both females and males in formal, nonformal, and vocational training programs. These curricula and resources need to be designed for use in community centers, one-room schools, outdoor schools and facilities, and home school settings. Materials and supplies for these activities need to include inexpensive supplies as well as laboratory equipment (where appropriate).
- In terms of community science media campaigns to transform perceptions about girls and science, there is a need to form a gender and community science education corps. This corps could include community leaders and secondary and college and university students who have received training in ongoing, short term, participatory community science programs, such as career days, community science days, science and gardening programs, and soil and water testing activities. The community science corps should be equipped with low literacy, attractive materials; hands-on science packs; and audio and video science shows.
- Print and broadcast media staff should be provided with workshops on how to identify and develop their own community science radio shows, including news updates, talk shows, and science mystery programs. Radio and video are particularly useful in countries with little infrastructure and high illiteracy rates.
- Community science programs need to be evaluated and documented. Information is needed to help improve programs and to report on the impact of programs.
- In the interest of sustainable development, The World Bank and other donors should connect aid and loans to countries for female SMT education. For example, The World Bank's 1994 gender policy mandates that concern for gender inequities be integrated into the country assistance strategy.

It is clear from this study, as developing countries strengthen and scale-up their formal education systems, NGOs will have to play a major role in preparing both females and

males in science and technology. These groups are obviously an effective way to reach girls and women who may not have other educational opportunities. Since the strength of NGOs lies in their diversity, vitality, and ability to respond quickly and creatively to the community, they can be useful in advocating and, where appropriate, implementing quality community science programs.

Over the last 20 years, groups such as AAAS, IWTC, AWIS, and our other partnering organizations in OFAN have gained considerable knowledge and skills in mobilizing all types of communities for actions related to enhancing opportunities for girls and women in science and technology. In addition, through efforts such as Project 2061, AAAS has played a lead role in setting standards for the development of high quality science, mathematics, and technology content and instructional approaches.

Members of the OFAN coalition, such as FAWE, TWOWS, Ecowoman, and GASAT bring knowledge about both science and mathematics, and countries they live and work in. These NGO gender, science, and technology coalition efforts, like OFAN, need to be linked in a more structured way with UN and other agencies as they plan and implement both girls' and science education initiatives. If properly linked and coordinated, all of this knowledge and "know-how" can be a powerful force in jump-starting many of the country-specific educational planning initiatives.

## REFERENCES

1. United Nations Children's Fund (UNICEF). 1997. *The State of the World's Children*. New York, NY: UNICEF and United Nations Development Program. 1995. *Human Development Report*. New York, NY: United Nations Development Program.
2. Beaton, E., Martin, M., Mullis, I., Gonzalez, E., Smith, T., and Kelly, D. 1996. *Science Achievement in the Middle School Years*. Boston, MA and Beaton, E., Mullis, I., Martin, M., Gonzalez, E., Kelly, D., and Smith, T. 1996. *Mathematics Achievement in the Middle School Years*. Boston, MA: Center for the Study of Testing, Evaluation, and Educational Policy.
3. Female Education in Mathematics and Science in Africa (FEMSA). *FEMED Newsletter of the DAE Working Group on Participation in Education*. No. 6 (Oct. 1996).
4. United States Agency for International Development (USAID). Sept. 1996. *Girls' and Women's Education: A Conceptual Framework*. Washington DC: USAID.
5. International Development Research Center. 1995. *Missing Links: Gender Equity in Science and Technology Development*. New York, NY: United Nations Development Fund for Women.