

Overcoming the Gender Gap in Math, Science and Technology: A 21st Century View *

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Distinguished Ladies and Gentlemen

Any country wishing to be an integral part of the 21st century financial, academic, and social community needs to reach full participation of women in science and *technology at all learning stages and all advanced positions. When this is not the situation, 50% of the work force is not fully contributing to the modern world, which is in a constant need for more highly qualified professionals. Participation of young girls in math and science classes, as well as in computer competence, has already been improved in many countries that started studying the problem of under-presentation of females in so-called "masculine" areas. In many more countries young females excel in math, science and technology in high school and college (e.g. the United Kingdom, The United States, Israel). Other countries invest a lot of effort in order to reach equity in achievements of girls and boys (e.g. the Scandinavian countries), but in spite of their affirmative action regarding many aspects of public life, and their laws helping to reach gender equity in the private arena, gender gaps in educational achievements still exist. On the other hand, in the ex-USSR new republics there has been a long tradition of full participation of women in all professions, and without any special intervention areas such as medicine and engineering have been equally divided between males and females for many decades. In this lecture I am to present the situation regarding gender inequity in math, science and technology at all educational and professional levels and to suggest effective ways to close existing gender gaps in school, university and "real life".

Introduction

Nigeria has proceeded far beyond the "raising of awareness of gender equity" stage in many life aspects. In the last 20 years literacy has increased in Nigeria substantially in general and among women in particular (Eze, 2010; Jaulmes, 2007). Here is the list of the main institutions that have contributed to dealing with the gender issue both in education and employment in Nigeria:

- I. Committee on the Elimination of Discrimination against Women (2004a, 2004b, 2007);
- II. UNICEF: launch Girls' Education Initiative in Nigeria (Jaulmes, 2007; UNICEF, 2008, 2011);
- III. Nigerian Association of University Women (2009). A group of graduate women interested in improving the mental, social, and physical lives of women and girls in Nigeria. Its main activity: empowering women to excel in life;

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- IV. The Center for Development and population activities (2011);
- V. Business and Professional Women – Nigeria (2011).

In addition, education and employment of women in Nigeria, as well as the women's situation, are discussed in many newspapers on a regular basis. For example: Eze's (2010) article or the *Afrique en langue* article ([Education-Nigeria: Ensuring education for girls, women, 2011](#)). More extensive, scientifically-based reports have been published in journal articles about this issue. For example: Ukpore (2009) wrote about "Sustainable development in Nigeria: Roles of women and strategies for their improvement", and Ojobo (2008) wrote about "*Education: A catalyst for women empowerment*". Let us cite Ojobo's abstract, as it both summarizes the problem of gender gaps in education in Nigeria and offers a way to solve it:

The article] examines the place of education as a catalyst for women empowerment in Nigeria. The paper, using primary and secondary sources of data, has shown that in spite of all the laudable goals and objectives of education, Nigerian women still suffer a lot of constraints and inhibitions which militate against their personal and national development. The paper therefore recommends, among others, the involvement of women in educational policy formulation, extensive enlightenment campaigns, the discarding of stereotypical division of work into men's and women's job, and women must organize themselves to meet the challenges of a positive and meaningful role in the struggle for personal and national emancipation, development and progress (ibid, p. 75).

Personal Versus National Need for High Quality Professionals in Science, Engineering and Technology

A modern country needs as many students as possible specializing in math, science, and technology in order to compete with the world economics, supply work places for the less educated or contribute to the national economics by attracting foreign investments and increasing exported goods. This is one of the main reasons for encouraging more women to be a part of the high-level professional work-force (Eidelman, 2006). This obviously contributes to national strength; there is high positive correlation between participation of females in the work force and the wealth of the country. Nigeria scores no. 32 in the world in its Purchasing Power Parity (*The World Factbook 2010*), which means it has a potential of becoming a rich country with a much higher life quality for all its citizens when more women take part in developing its economics and turning its natural treasures into financial advantages. At the same time, education and high prestige positions also contribute to the well-being of females as individuals and as a group.

Women have proved themselves to be able to "make it" in all influential areas, even at the highest possible levels, such as politics, business or science. It can thus be concluded that we are far beyond the stage of proving that "it is possible". The aim of each county must now be increase dramatically the percentage of these women, a target that is to be achieved only by intensive intervention for the benefit of large sub-populations of women who have not yet reached the point where they advance relying only on their merit; they still need some external help. Let us describe some potential ways of helping the less privileged women.

One such group is underprivileged university students. This is the majority of the female population, who neither take part in the educational opportunities offered nor participate in the upper level of the work market, namely, in occupations that are neither manual nor clerical, and have but very limited progress opportunities; women from the economic, ethnic, and geographical periphery.

One such intervention that has already proven to be of great help for underprivileged talented, ambitious and diligent women is a mentoring program tailored especially for them.

Mentoring Programs: Background and Review

At the turn of the 21st century a substantial reform has occurred in the structure of higher education: learning in academic institutions has become more accessible to larger sub-populations, as more academic and communal colleges have opened their gates to students from underprivileged backgrounds. Girls living in the periphery, minority girls, girls from immigrant families, as well as girls from traditional families have mostly benefited from this "educational revolution".

However, for many high ability female college students the opportunity to get a higher degree does not reflect their true potential. In many cases the teaching staff in the college is still young and inexperienced in nurturing gifted, talented students, or consists of retired university professors who teach part-time and dedicate most of their resources to research. In addition, many of these excellent students, coming from a traditional background, are not used to attracting special attention and care, especially from male instructors.

For such a student the mentoring option, especially by a female mentor, might be of great help both as a part of the teaching and learning process and for helping design the student's professional future.

Mentoring of each of the sub-groups of talented students has the potential to make a change, the result of which is extending the educational as well as the career limits of underprivileged female students.

Mentoring programs have been developed in many EU member countries during the 90s in the academia as well as in the industry. The European Commission has sponsored a "Mentoring for Women in Europe" program, and there are already positive results in three European countries – Germany, Finland, and Sweden. The percentage of women leadership positions in these countries has increased since the funding of this project. The "Mellow – Life Long Mentoring Of Women in and/or towards technical jobs", which is also sponsored by the European Community, is a part of the "Leonardo-da-Vinci" program in the Netherlands, England, Ireland, and Germany. In addition, there are training programs in the fields of engineering, which take place in Greece, Spain and Finland. For schoolgirls summer camps have been offered, and for female university students – special summer university courses.

Engineering associations, industrial companies, universities, the government and other organizations have been giving constant support to the British project: "Women into science and engineering [WISE]" (WISE, 2010). The WISE Annual Awards are given in recognition of companies and individuals who have actively addressed the issue of promoting Science, Engineering and Construction to girls and young women. Among the WISE awards are: The WISE Excellence Award; WISE Partnership Award; WISE Outreach Award, and WISE Special Judges Award. *Trish Goodchild*, the winner of the 2010 WISE Outreach Award, said that "The Outreach Award in particular is given to a University who has implemented and is determined to sustain a set of successful outreach strategies to support and encourage more female students into STEM subjects". However, the success of this program has also to do with the fact that the effort to reach females who are to be a part of this British program starts already in primary school (ibid). Indeed, it is much easier to succeed when starting early, but it is never too late to start.

Coaching and mentoring women has been carried out in Switzerland both by Swiss universities and by The Swiss Association for Women Engineers [SVIN] (SVIN, 2010). Here is the organization's credo:

The Swiss Association of Women Engineers (SVIN) is a not-for-profit, professional organization for individuals with an interest in engineering. The members of our national organization are engineers from various branches and allied fields, corporations and persons interested in supporting the aims of SVIN. SVIN is dedicated to the advancement of women in engineering fields, business, education and industry and strives to motivate young women to pursue a career in engineering.

In addition to the activities aimed at older females, *the Swiss Association of Women Engineers* has initiated the "KIDSInfo" setup for children, focusing on young girls (KIDSInfo, 2010). Its latest activity has been the 2nd festival for children "*Hérisson sous gazon*", on June 19, 2010, at Charrat, Valais. Girls participating in the festival had an opportunity to experience "everyday electricity", such as building electrical circuits, understanding how everyday tools work, and most importantly – breaking the male stereotype of

dealing with machines and instruments and fixing them when necessary. Mentoring programs have been taking place in industrial institutions throughout Europe. For example: Telekom has established a mentoring program of its own. Activities like "A girls' technology day" have been organized in many industrial research centers in England, Germany, Austria, Finland, and Sweden.

How Can a Mentoring Program Help?

Mentoring as means of under-represented populations to gain participation in the main-stream education system and reach higher levels of employment has been known for many decades. A mentor for underprivileged female college students has many tasks, educational, psychological, and social. Here are the main ones.

I. Identifying the high abilities of the mentees at the earliest possible educational stage and making plans for their fulfillment. Let us start with an [is "example" the word that's missing here?]. If the mentor discovers that her mentee has a special gift for languages, she should encourage her to develop this gift in order to acquire proficiency in a few languages before getting the degree. This will enable the student to continue her studies in one of the linguistics departments, in an MA translators track or in a literature department where her languages knowledge will be considered an asset. It will also give her more possibilities in the market place, allowing her to choose to become a literary, technical or legal translator, or perhaps to prefer simultaneous translation. In any case – being proficient in a few languages will increase both her opportunities and her potential salary.

II. Raising the awareness of the students of their real educational and professional situation. many underprivileged young women do not even know that there are huge differences between university and college education, that an academic degree does not necessarily mean getting a job where education will be taken into consideration that most first degrees are not professional degrees and that different higher education institutions are valued differently with regard to their quality. The first task of the mentor working with a BA college student or with a female university student whose expectations do not go far beyond getting a degree in a non-scientific subject should be helping her to know these simple facts. The mentor should be very clear in explaining that a first degree from a second rate college is usually sufficient just for clerical, administrative jobs, while a good university could serve as an "open ticket" for a better education and a wealthier future.

III. Being role-models for the students. Role-models must not necessarily be of the same gender, ethnic group or religion, but it is preferred that they be similar in as many components as possible to their mentees. For example: a female older woman from a traditional background who is a wife and a mother, in addition to being a successful academic, can be a living example to a young woman from a traditional family, where the main task of women is perceived as raising a family.

IV. When possible, meeting the student's family member who might hinder her aspirations in order to "soften" their objection gradually. It is highly recommended, especially for students from a rural background, that the female mentor visit the mentee's parents. In that case the resistance to leaving home, acquiring a high-prestige family, or the delaying of marriage, which usually accompany higher education, might lessen, making the student's life easier.

A Practical Issue: Cost and Benefits of a Mentoring Program

In many existing mentoring programs, aimed to raise the participation of girls and young women in math, science and technology, the mentors have volunteered to their task without any payment (CyberMentor, 2009; MentorING, 2008; Mentoring an der TUM, n.d.; Schneiderdorfer et al., 2003). In all these programs the mentees contribute to the mentors as they are all good students willing to participate in science and engineering studies at the earliest possible stage. Thus the cost of the mentoring program will be minimal. A

young diligent female student who is happy to get all the advantages an older professional can give will be eager to help the mentor in any possible way. The mentor, on the other hand, will be obligated both to the high education institution where she works and to the future advancement of good students in the various fields of knowledge.

Summary

A mentoring program is just one idea for helping young underprivileged high ability women to reach the full extent of their potential. As many other mentoring programs have been successful both abroad and in Israel, it is time for that special effort to be invested in a large population that has been underprivileged in spite of their proven abilities and high motivation. The program is based on the good will and willingness to invest in the next generation of young women who are both intelligent and diligent, and as such can be enriching not only to the mentees but to their mentors as well.

Gender and Education

The State of the Art in Math and Science

Participation of women in high prestige occupations, especially in the areas of technology and "hard" science, has been low in spite of efforts made by many concerned countries. The under-representation of women has focused in the areas of mathematics, technology, physics and engineering (*Amancio, 2005; Braithwaite & Tacitus, 2001; Frauen in der Informations Gesellschaft, 2000*). The main obstacle to learning high level science and technology has been a lack of mathematics knowledge (e.g. Hassi et. al, 2010).

Gender Differences in Participation and Achievements in Math, Computers and Technology, and Science

Math and science are the keys to technology. Therefore it is crucial to bridge existing gender gaps in these two areas in order to maintain access to underrepresented groups to technology-related occupations.

Gender Differences in International Examinations in Grades 4 and 8 Math and Science

Findings from international examinations.

In Mathematics

In 2007 36 countries participated in The Trends in International Mathematics and Science Study (TIMSS) at grade 4, and 48 participated at grade 8. Among 4th grade students, significant gender differences favoring boys were found in 12 countries; gender differences favoring girls were found in 8 (Mullis et al., 2008, Exhibit 1.5). In grade 8 significant gender differences favoring boys were found in 8 countries, favoring girls – among 16 (ibid, Exhibit 1.5).

More careful analysis of TIMSS 2007 reveals that in regard to the actual results, gender differences have been reduced in the last two decades substantially, and in many countries their direction has turned over and girls score significantly higher than boys. However, if we look at the "Self confidence in learning mathematics" result (ibid, Exhibit 4.11) we shall see that among high self confidence math students, substantial gender differences favoring boys have been discovered in most countries participating in the TIMSS 2007. Only in 4 countries, Kazakhstan, Kuwait, Qatar and Tunisia, more girls than boys belonged to this category, while in 22 countries, including countries where the actual achievements of girls were higher than those of boys, boys

scored higher regarding self confidence in math learning.

A similar picture has been revealed among 8 grade math students: only in Bahrain, Cyprus, Qatar and Saudi Arabia girls were the majority among "high self confidence in math learning" students, while in no less than 26 countries there was a significant difference favoring boys in "high self confidence in math learning" (ibid, ibid). This could have been understood had boys scored higher in math in these countries, but that was not the case. Of the 26 countries with boys having a majority among high self-confidence students in math learning, in most cases there was no actual reason for this high self confidence, as only in 8 countries boys scored better than girls (ibid, Exhibit 1.5).

We can conclude that girls' self confidence in math learning must be improved even when they actually do very well in school. It has been proved that belief in one's own math ability is the single component influencing more than any other the actual achievements among junior high school students (David, 2009). Thus girls who do not believe in their math ability have worse prospects to go on learning it than those who believe in their ability to improve and develop in this area.

In Science

Of the 36 countries participating in the science part of the TIMSS 2007 at grade 4, significant gender differences favoring boys were found in 8 countries; gender differences favoring girls were found in 6 (Martin et al., 2008, Exhibit 1.5).

It is of special importance to note that the advantage of boys in math, even at an early stage – grade 4, is highly correlated with advantage in science. Of the 8 countries, where significant gender differences favoring boys were found among grade 4 science students, 7 were also in the 12-country list with significant gender differences in mathematics. The eighth, El-Salvador, which had also significant gender differences favoring boys in science, had also quite large gender differences in math among grade 4 students (9 points), though this difference was non-significant (Mullis et al., 2008, Exhibit 5.1; Martin et al., 2008, Exhibit 1.5).

Of the 6 countries where girls scored higher than boys in science in grade 4, 4 – Armenia, Qatar, Tunisia and Kuwait – also had gender differences favoring girls among 4th graders in mathematics (ibid).

In grade 8 significant gender differences favoring boys were found in 8 countries, those favoring girls – in 16 (Martin et al., Exhibit 1.5).

Conclusion

1. Islamic Countries Have Higher Gender Differences Favoring Females in Math and Science. in Actual Achievements

Grade 4 science: Of the 6 countries, where gender differences favoring girls were found, 4 were Muslim: Algeria, Qatar, Tunisia and Kuwait; 2 are mainly Christian, with other influencing religions: Georgia with about 10% of Muslims, and Armenia with a variety of minorities, including Kurds who practice [Sunni Islam](#) (ibid);

Grade 4 math: gender differences favoring girls were found in 8 countries, 5 of which were Muslim: Tunisia, Kuwait, Qatar and Yemen (Mullis et al., Exhibit 1.5).

Grade 8 science: gender differences favoring girls were found in 16 countries, 8 of which were Muslim: Egypt, Jordan, The Palestinian Authority, Saudi Arabia, Kuwait, Oman, Bahrain, and Qatar (Martin et al., Exhibit 1.5).

Grade 8 math: gender differences favoring girls were found in 16 countries, 7 of which were Muslim: Jordan, Kuwait, Saudi Arabia, Bahrain, The Palestinian Authority, Qatar and Oman (Mullis et al., Exhibit 1.5).

In self-confidence

Grade 4 math

Among high self-confidence grade 4 students, significant gender differences favoring girls were found in the

TIMSS 2007 only in 4 countries – all Muslim: Kazakhstan, Kuwait, Qatar and Tunisia (Mullis et al., 2008, Exhibit 4.11).

Grade 8 math: significant gender differences favoring girls regarding high self-confidence in math were found in 4 countries, 3 of which were Muslim: Bahrain, Qatar and Saudi Arabia (ibid).

Grade 4 science: Among high self-confidence grade 4 students, significant gender differences favoring girls were found in the TIMSS 2007 in 10 countries – 5 of which were Muslim: Algeria, Kazakhstan, Kuwait, Qatar and Tunisia (Martin et al., Exhibit 4.11).

Grade 8 science: Among high self-confidence grade 8 students, significant gender differences favoring girls were found in the TIMSS 2007 only in 4 countries – all Muslim: Bahrain, Kuwait, Qatar and Turkey (ibid)

2. Gender Differences Favoring Boys are not Necessarily Larger in Countries Where Achievements are Higher

There has been found no correlation between gaps in achievements and the achievements themselves. Let us see some of the findings.

Grade 4 mathematics:

Of the 8 countries with gender differences favoring girls in grade 4, four had scored much higher than the international mean (Singapore Russian Federation, Kazakhstan and Armenia); the other 4 – all Arab countries – scored under it (Mullis et al., 2008, Exhibit 1.5).

Grade 8 mathematics:

- The country which scored the highest in the world in the TIMSS 2007 – Singapore – had a significant gender difference of 15 points favoring girls.
- Of the 16 countries with significant gender differences favoring girls, 5 scored above the international mean and one, Thailand, scored exactly at the international mean – 453 (ibid). On the other hand, of the 8 countries with significant gender differences favoring grade 8 boys only one – Australia – had achievements higher than the international mean. It can thus conclude that in most cases increasing the level of girls has a contribution to the country's mean, and in well-educated countries an increase in girls' achievements is accompanied by an increase in boys' achievements.

Grade 4 science:

Of the 6 countries with gender differences favoring girls in grade 4 one –Armenia – had scored well above the international mean (Martin et al., 2008, Exhibit 1.5).

Grade 8 science:

Of the 14 countries with gender differences favoring girls in grade 8 two had scored well above the international mean and who more just a little under it (ibid). It seems, thus, that while the correlation between gender differences favoring girls and the actual scores is negligible in math, it is a little higher in science.

3. Something is Rotten in Denmark: Being "Western" Does not Necessarily Mean Having Small Gender Differences in Educational Achievements

The TIMSS 2007 show that only non-Western countries had overcome the gender gap favoring boys in grade 4 and 8, both in math and in science. Let us examine the results in detail.

Grade 4 mathematics

Of the 8 countries where gender differences favoring girls have been found among 4 grade students there was not even one western country: of the 6 Muslim countries 4 were Arab (Tunisia, Yemen, Qatar and Kuwait); the other two were both ex-USSR countries (Kazakhstan and Armenia), Kazakhstan is also Muslim. The remaining two countries were Singapore and the Russian Federation (Mullis et al., 2008, Exhibit 1.5).

Grade 8 mathematics:

Of the 16 countries where significant gender differences were found, there was not even one Western

country (ibid).

Grade 4 science:

Of the 6 countries where significant gender differences were found, there was not even one Western country (Martin et al., Exhibit 1.5).

Grade 8 science:

Of the 14 countries where significant gender differences were found, there was not even one Western country (ibid).

4. Do Gender Differences Increase with Age? Will Gender Differences in Achievements, Favoring Boys, in Grade 4 Predict Similar or Even Larger Differences in Grade 8?

In 2007, gender differences favoring boys were found in 12 countries among 4 grade students in mathematics, but only in 8 countries among 8 grade students (Mullis et al., exhibit 1.5). A somewhat different picture was found in the science part of the TIMSS 2007: in 8 countries gender differences favoring boys were found among 4 grade students; in grade 8 the number increased to 11 (Martin et al., 2008, Exhibit 1.5).

It is of special importance to note, that most countries where gender differences favoring boys existed in grade 4 did not prove to be able to close them in grade 8 (ibid). Furthermore, in most cases these gender differences became larger in grade 8 (ibid).

Summary

*Unlike what we have all been taught to believe, high achievements do not necessarily result in widening gender differences in math and science achievements. In many more cases increased achievements have been shown in countries where gender differences have been decreased.

* Trying to decode the mystery of the reasons for gender differences in achievements by finding common characteristics of countries where gender differences favor girls requires is far beyond the scope of this work, if at all possible.

* As most studies about gender differences in general and educational gender differences in particular are conducted and published in the US, it is possible – maybe even likely – that these studies do not reflect the situation in other countries.

* In spite of the fact that there is no simple correlation between gender differences in math and science at grade 4 and those at grade 8, the connection between them should not be ignored. From an educational point of view it means that preventing gender differences or closing them when they already appear at the earliest possible age helps to avoid such differences at a later stage.

The Main Objective: Improving the Education and Employment of Women in IT Society

A straight line can be drawn along the path from early education to future occupation in the areas of science and technology. When we look at the global picture, the data is far from being satisfactory. Let us look first at the European situation. Europe can be divided according to participation of women in technology and science, both in industry and in the academia, into three main groups: 1. The German-Flemish Group, which includes Germany, Austria, Switzerland, Belgium, The Netherlands, and to some extent Denmark. This group scored the worst regarding female achievements in high school in science and technology, female participation in "typically male" academic areas and female participation in high prestige careers in these fields. 2. The Southern countries – Greece, Turkey, Portugal, Spain, and to some extent Italy. They have scored the best in all abovementioned educational and occupational stages. 3. France and Scandinavia – except for Denmark (to some extent except for Norway as well) – they have average scores regarding female education and occupation level. England, Scotland, and Ireland belong to this group as well – they are characterized by

mixed results, namely high level of gender differences in some areas, low level of such differences in others, and average gender differences in the remaining fields. Let us see what happens in these three groups at all educational levels, with some examples of particular countries within each educational and occupational level.

There is an accepted assumption, which we have already shown to be true when discussing gender differences in math and science at age 10, that until the age of 12 girls do at least as well as boys in all subjects, including mathematics and science. According to this assumption, at age 12, because of social-cultural pressures, girls, particularly the more talented, start to underachieve in mathematics (e.g. Arnot, et al., 1998; Bailey, et al., 1997; Boaler, 1997; Campbell, & Sanders, 1997; Lundenberg, 1997; Wilgosh, 1998; Zorman & David, 2000). As a result, the percentage of girls studying enough mathematics to enable their further education in prestigious professions is smaller than that of boys. Let us see what has already been done to improve this situation at the various stages of education.

School Programs

Because of the necessity to encourage girls – at the youngest possible age – to participate in extra-curricular math and science activities, a number of programs have been developed in Europe for primary and junior high school girls. Let us survey them briefly.

Teaching single-sex classes. The National Association for Single Sex Public education (NASSPE) has recently reported that

In March 2002, when NASSPE was founded, only about a dozen public schools offered single-gender classrooms. As of January 2011, there are at least 524 public schools in the United States offering single-sex educational opportunities. Most of those schools are COED schools which offer single-sex CLASSROOMS, but which retain at least some coed activities (NASSPE, 2011).

The program was developed in the US for primary and junior high school girls. Its aims: to raise the level of self-esteem among girls; to raise the assertiveness level of girls; to improve cooperative work among boys.

Gender-Responsive Pedagogy (GRP)

The Forum for African Women Educators – FAWE – developed the Gender-Responsive Pedagogy (GRP) model to address the quality of teaching in African schools. The model trains teachers to be more gender-aware and equips them with the skills to understand and address the specific learning needs of both sexes. It develops teaching practices that propagate equal treatment and participation of girls and boys in the classroom and in the wider school community.

The credo and main objectives of the program are as follows:

The GRP model trains teachers in the design and use of gender-responsive:

- Teaching and learning materials.
- Lesson plans.
- Language in the classroom.
- Classroom interaction.
- Classroom set-up.
- Strategies to eliminate sexual harassment.
- Management of sexual maturation.
- School management systems.
- Monitoring and evaluation.

Gender-Responsive Pedagogy was initiated in 2005 and has been introduced in Burkina Faso, Chad, Ethiopia, The Gambia, Guinea, Kenya, Malawi, Namibia, Rwanda, Senegal, Tanzania, Uganda and Zambia.

Impact of FAWE's GRP Model

- Improvement in girls' retention and performance.
- Greater participation of girls' in the classroom.
- Improved gender relations within schools.

Over 6,600 teachers have benefited from FAWE's GRP training since 2005 (Gender-Responsive Pedagogy, 2005).

A whole school policy approach to gender reform. Different aspects of the program were developed in England (Acker, 1988; Arnot et al., 1998; Ruddock, 1994) and in Norway (Imsen, 1996; Undheim et al., 1995). Its main objectives are establishing a school policy that focuses on equity at all functioning levels. Wilson (2003) had presented her program for overcoming the shortage of women in computer science. Her program consists of two main parts: 1. Improve the recruitment for potential computer scientists 2. Encourage college students to take computer studies as a major. According to her, the first part is the more important one; when it is not done on time it is usually too late to correct it later. It includes:

- Programs concentrated on working with girls in elementary and middle schools to teach computer skills and thus to bolster confidence in computer competence,
- Programs directed toward role modeling and mentoring for middle and high school girls showing successful women in the field of computers.
- Summer programs directed at reducing the male "stereotyping" of computer problem-solving activities by involving girls in an "all-girl" computer camp.

Some of the efforts purported to reduce the attrition of women in college computer courses are:

- Formation of peer support groups among the women studying computer science, with "upper-classwomen" mentoring "under-classwomen",
- Use of cooperative learning techniques rather than the competitive/individualistic approach to writing computer programs,
- Offering supplemental class sessions for those with lesser computer experience,
- Making connections with other disciplines to have more practicality in computing assignments.

A program for attributional retraining to improve the performance of talented girls in math, physics, and chemistry (Heller, 1998, Ziegler, Dresel, & Schober 2000) was developed in Germany. The "Assessing women in engineering" organization (2005, n.d.) has dealt with most of the important issues regarding encouragement of girls, adolescent females and young women to study math, engineering and technological issues. The organization supplies written materials on the following topics:

1. Attribution Theory
2. Career Development Theory for Women in Engineering
3. Cooperative Learning
4. Family Influence on Engineering Students
5. Gender Differences in Math Performance
6. Gender Differences in Science Achievement
7. Mentoring and Women in Engineering
8. Psychological Sense of Community for Women in Engineering
9. Self-Efficacy and Women in Engineering
10. Psychological Sense of Community for Women in Engineering
11. Self-Efficacy and Women in Engineering
12. Visual Spatial Skills

Ort to the 21st century (Rom, 1996) was developed in Israel. Its aims: to educate more girls and boys towards a degree in engineering, and to advance girls in hi-tech. The program functions successfully up to now; the percentage of girls participating in math and science in Ort schools is not smaller than that of boys (Loten,

2005).

Computers: A Necessity to the It World Starting as Early as Possible

Improving the employment situation of women in the IT society is one of the main objectives of each developing as well as developed society. Therefore, let us first look at the already existing European programs aimed at supporting and encouraging young girls and professional women at the various stages of their schooling and career. These programs are to serve as models to be fully or partially adopted.

A popular way to enhance maximal exposure of all students – with a special focus on girls – to educational and recreational web-sites, is to be up-to-date and to supply the information about available web-sites to the students. For example – a short list of those that might be interesting for girls: There is evidence that while being exposed to the Internet decreases reading ability among boys, that is not the case among girls (DeBelle & Chapman, 2006; Vigdor & Ladd, 2010). Girls benefit from computer games as much as boys do, while preparing themselves to have better future occupations, to serve in higher level positions, and to improve their financial situation. In countries where computers are comparatively expensive, and schools do not offer free use of them, here is some advice that might increase participation of girls in computer use.

Support girls who want to indulge in computer games by ensuring they get equal time to that of the boys. That can be done by allotting half of the available computers to girls (Furger, 1998), by forming – when students need to work with a partner – only girls' or boys' pairs, so that the boys wouldn't take control of the computer while letting the girls watch them, and by encouraging girls to deal with the more technical parts of the work with the computer, e.g. installing new programs, preparing floppy disks for the entire group, and especially learning new programming languages.

In addition to these means, all teachers, headmasters and counselors should participate in special gender-equity in-service training, as the positive attitude of the school's staff towards science education at the primary education stage is crucial for the success of such a program.

Summary

The way to gender equity in math, science, computers and technology, at all educational and occupational levels, is still long. Only when a country adopts a national program aimed to decrease the gap, only when all girls, adolescent females, young women and older women have access to the program most suitable for them – only then will the prospects to bridge the gap increase. Without the talent, diligence, ambition and motivation of 50% of the population no education, cultural or financial system can flourish. Thus, it is the task of the educators to persuade all authorities involved that while better education for females is indeed expensive, the benefits to come from it are much higher and long-lasting than any other investment.

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