

## THE SCIENCE EDUCATION FROM GENDER PERSPECTIVE

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### Sumar

*Analiza literaturii de specialitate demonstrează un parcurs gradual, deloc simplu, de valorificare a dimensiunii de gen în domeniul științei, inclusiv în STE. Începând cu sfârșitul anilor 70 și începutul anilor 80 ai secolului trecut apar primele lucrări, unde într-o formă sau alta, au fost abordate aspecte legate de diferențele de sex în calitate de variabilă corelată la capacitățile cognitive considerate critice pentru succesul în știință. Anii 1990 au adus alte accente pe știință în școală: utilizarea strategiilor de instruire mai "prietenoase fetelor", recunoașterea oficială a "genului" în calitate de aspect crucial în educația pentru știință [2]. Pe parcurs, implicațiile genului treptat au început să fie corelate cu alte variabile precum vârsta, rasa, clasa, limba, cultura, religia. Dincolo de tendințele pozitive în valorificarea subiectului, importanța problematicii egalității de gen în educația pentru știință rămîne extrem de importantă, în special în contextul transformărilor socio-economice, realizărilor tehnico-științifice, atît pe plan mondial cît și național.*

**Cuvinte cheie:** egalitate de gen, dimensiune de gen, discrepanțe de gen, strategii "prietenoase fetelor", "gender neutre", „gender sensibile”, stereotipuri de gen.

**Key words:** gender equality, gender dimension, gender gaps, a gender neutral, a female friendly and a gender sensitive approach, gender stereotypes.

### Introduction

Education (as process, as system) is a strong instrument to promote social values and to offer more opportunities to girls and boys, women and men, to develop and explore their potential and change the life, by avoiding the stereotypes about gender roles.

At the same time, despite of the significant progress on gender equality legislation and policies, international commitments and initiatives on the part of national governments,

gender stereotypes are a persistent feature of the education system in many European countries.

We would like to mention that Gender equality means equal visibility, empowerment,

responsibility and participation of both sexes in all spheres of public and private life. Achieving gender equality is central to the protection of human rights, the functioning of democracy, and respect for the rule of law, and economic growth and competitiveness [4].

The Committee of Ministers Recommendations on gender mainstreaming in education CM/Rec(2007)13) puts forward a set of comprehensive measures which member states need to put in place to ensure effective gender mainstreaming in education, including legal frameworks, school organization and school curricula. The recommendation also calls for regular monitoring of the implementation of the above measures [11].

Gender studies from several countries show that educational institutions are social entities deeply marked by gender rules and stereotypes, which makes gender patterns are very important for the formation and the integration of the individual in society [1; 3]. Traditional cultural models on femininity and masculinity, reproduced by the school through training/education, often put limits on the effective socialization of the young generation. Considering the above said, it is obvious that education, as a pedagogical phenomenon, and the education system in general, require a re-evaluation of the mentioned contradictions and an adjustment of concepts and methodology related to the introduction of the gender dimension in the school curriculum.

At the same time, we would like to reinforce the idea that teachers can become agents for the perpetuation of gender-based selection mechanisms or, on the contrary, for social change, and that it is essential to involve schools and the various participants in the education process in promoting gender equality [8].

Appreciating the importance of the theoretical and practical researches conducted, we can mention, however, that certain aspects of the problem remain still little explored. So, the problem of this research lies in the analysis of science education from a gender perspective as basis to improve the students' performance in the future.

Gender inequality in the fields of science, technology, engineering, and mathematics (STEM) has been ingrained into many societies since human civilization first began. While more and more women have gained access to education and expanded their professional career options, there is still a stigma against women in STEM fields arising from traditional gender roles and persisting stereotypes about women's competence [6]. Because technical and scientific innovations continue to drive the global economy, educators and scientists seek to promote students' interest and achievement in the STEM (Science, Technology, Engineering, and Mathematics) [5]. Many researchers have studied differences in male and female students' attitudes toward and performance in STEM courses and assessments.

While some research shows that gaps in male and female performance on STEM-related assessments have narrowed or even closed (Lindberg et al. 2010), other research continues to report gender differences in student affective dispositions (i.e., interest) toward mathematics and science, as well as differences in student performance in mathematics and science, especially in math-intensive science fields (Ceci et al. 2014; etc. [apud 5, p.1]).

Initiatives concerned with gender equity, some of which focus on access to or outcomes in technology and science, have become fairly common in recent years in number of countries.

This article includes general overview of the evolution of sciences education / sciences programs. We updated the theoretical framework that shows three different approaches to increase gender equity in science education proposed by A.Sinnes [10]. She used feminist critique of science as a point of departure to present the different understandings of how sex/gender impacts on pupils' approaches to science education. The framework shows how different understandings of how sex/gender impact on pupils' engagement in science education require distinct initiatives to increase gender equity, but also to address gender inequality in science education.

Using the term sex to represent biological sex and gender to represent social sex, two different visions can be explored as basic point. One of the visions refers that girls and boys have exactly the same abilities to succeed on equal terms in science subjects, and that gender inequities in these subjects are caused by discriminating attitudes towards one of the two sexes. Other vision might assume that girls and boys are different and that these differences need to be addressed and catered for in order to reduce the gender differences in science education. Although all visions reflect certain understandings of how girls and boys may differ and how these differences might impact on how they engage in science education, these understandings are seldom formulated explicitly by gender initiatives [10].

Based on different points of view on how sex/gender might impact on pupils' engagement in science education, we would like to mention the three alternative approaches that initiatives might choose to secure increased gender equity in science education; a *gender neutral*, a *female friendly* and a *gender sensitive approach*. These concepts are widely used within literature on gender issues in education, including science education.

A gender neutral science education removing all references to sex, apparently refer equally to the two sexes, but it can easily represent a false picture of reality. Most societies are not gender neutral, most societies are in reality strongly gendered. Particularly in traditional societies, males and females do have very distinct roles to play. Gender equity in science are influenced by social norms. It has also been criticized for not challenging the oppressive and discriminatory practices within scientific inquiry (Harding, 1992). As Howes (2002, p. 23) puts it: "This approach assumes that if women were to think, behave,

learn, and work more like male scientists, the problem of women in science would be solved” [Apud 10, p.81].

A female friendly science education is focused on women/ girls interest and needs. Brickhouse et al. (2000) accuse female friendly science education of reinforcing stereotyped images of females. An additional drawback to a female friendly science education could be the effect such an education might have on boys [apud 10].

Gender sensitive science education is based on the assumption that the variations between pupils of the same sex might be more important than differences between pupils with opposite sex. Such an education would acknowledge the existence of masculine and feminine pupils, but not take for granted that masculinity and femininity necessarily are determined by a person’s biological sex.

A science education that is designed in order to accommodate various interests and abilities without assuming that such varieties are a result of having different sex, was labeled as a “gender sensitive” science education (Sinnes, 2006 [10, p.267]). Science education reform programs operating under this understanding of gender and science might explore differences in interest found among pupils of the same sex and develop teaching materials to accommodate such a broad variety of interests. A teacher operating in a postmodern feminist classroom would be expected to be cautious about the varieties in interests and abilities that exist among pupils in the classroom without separating them into categories based on their sex. Groups should rather be developed based on the pupils’ individual interests and needs.

The suggested characteristics of a gender neutral, a female friendly and a gender sensitive science education are outlined in Table 1.

**Table 1. Approaches referring to science education (through gender prism)**

<b>App roaches</b>	<b>Curriculum</b>	<b>Educational Materials</b>	<b>Teacher’s Profile</b>
a “ <i>gender neutral</i> ” science education	Curriculumul a "gender neutral" not include express the interests of girls and boys; apparently it is addressed to both sexes without any difference. Gender neutrality may be a last resort a form of sexism.	- Abstract illustrations clearly predominant (no people). - There is a major gender discrepancy between successful models promoted. Textbooks abound with famous men. - Is induced gender segregation rather than collaboration etc.	- Pay apparently equal attention to girls and boys in the class without specifying gender- specific needs - View the traditional models in science (men), resulting in involuntary reproduction of prejudices and stereotypes etc..
a “ <i>female friendly</i> ” science education	Curriculumul: - Oriented specifically to women / with a focus on women	- Built on specific interests and experiences of girls	- It is responsive to the special interests of girls and sensitized about the manner in which girls learn science

	<ul style="list-style-type: none"> <li>- It includes the manner in which girls learn science</li> <li>- Responsive to feminist critique of science and incorporates the contributions of women and other oppressed groups etc.</li> </ul>	<ul style="list-style-type: none"> <li>- Incorporating scientific knowledge developed by women</li> <li>- Presents models of women in science etc.</li> </ul>	<ul style="list-style-type: none"> <li>- Teach in small groups / separating girls and boys</li> <li>- Creates a non-competitive environment in science class</li> <li>- Connection between science education and girls' experience outside the school etc.</li> </ul>
a "gender sensitive" science education	<p>Curriculumul:</p> <ul style="list-style-type: none"> <li>- Adjusted to the wide range of interests of girls and boys</li> <li>- Reflects the social, political and psychological aspects of science</li> <li>- Incorporate other systems of knowledge etc.</li> </ul>	<ul style="list-style-type: none"> <li>- Reflects the differences in interest for science</li> <li>- View the relationships between science and society and the impact of social and political factor on science</li> <li>- Include sciences developed by minorities and viewing other cultures and differences between different types of scientific research / Promote gender collaboration etc.</li> </ul>	<ul style="list-style-type: none"> <li>- Based on the experiences of boys and girls/apply constructivist teaching methods / equal opportunities for g / b in laboratory</li> <li>- Specifies that scientific knowledge are constructed by humans and therefore influenced by its creators women and men</li> <li>- Introduce questions about gender, race, class, when relevant etc.</li> </ul>

Because gender bias pervades societies throughout the world, we can expect to find gender bias influencing girls' choices in many ways. As Vasilios Makrakis put it, "a gender biased society teaches girls to have gender-stereotyped interests." [apud Sanders, 9, p. 5], including in sciences and technology.

Reflecting the origins of technology&sciences, most research has focused on female deficits: their lower experience levels, less positive attitudes, and failure to persist and perform well in educational programs, as compared with males. Research on gender and mathematics, science and engineering, further along than technology, repeatedly points to the value of including 'different' people — women, people of color, people with disabilities, and others —to expand the scope of the questions asked and paths followed. We support the ideas to re-imagine technology [9, p.23] and sciences, to shift it from what it can do to what it can serve, and in so doing to free ourselves from the conceptual constraints posed by business as usual according to the male model. At the same time, the issue for education is to remove the barriers that are interfering with girls' access to sciences and technology and success in it.

As science and technology develops, the world economy needs qualified workforce. Developing skills in women/girls will expand the reserve of human resources available to perform these tasks. Moreover, environmental concerns lead to the development of so-

called ecological jobs, many of which will require a solid educational background in science or technology. "Quality education" means: taking account of the following three elements [8]:

- Matching performance to expectations (fitness for purpose);
- Self-improvement and transformation (focus on processes);
- Empowerment, motivation and participation (focus on learners);

All mentioned above points are closely connected to gender equality perspective in education. From our point of view, *gender sensitive education in science represents the process of ensuring equal access of girls and boys to science, of opportunities for development of personal potential by applying methods of encouragement and eliminating gender stereotypes from the curriculum, teaching materials, and from the whole study process.*

In order to verify the hypothesis that states that the connection between "new program in sciences", gender and teaching strategies is an important factor, namely: learning motivation in science for girls and boys; diminishing gender stereotypes in learning science and technology disciplines; career guidance for girls and boys, developing methodology that will contribute to achieve the highest academic results/ girls and boys advancement in science and technology, the experimental research was conducted in Israel.

As important tools, there were: the Constructivist approach to learning, Instructional Model to encourage girls students in science and technology, a Profile of excellent teacher who is gender-sensitive, a Instructive Model for parents, developed by us. We reiterate that those models have been developed and applied within the activities as a teacher, teaching instructor/trainer and supervisor in training courses for teachers. These models, which include concrete work strategies, were complementary instruments to ensure ultimately a more effective implementation of the new program in science and technology.

Referring to the formative background, in the context of the presentation/achievement of strategies from previously mentioned models, gender awareness of reference groups was used [7]. Amongst *the topics addressed during the students training* were: Promoting the importance of secondary education in science and technology; the importance of involving girls and boys in science and technology; Modalities of cooperation between girls and boys in school and social activities; Gender stereotypes; developing self-efficacy; Defining professional aspirations beyond gender stereotypes; Life and career strategies. The discussion of topics was combined with study visits to various research institutions in science and technology, meetings and debates with scientists. We note that, regarding girls, special attention was paid to the topic of self-confidence and strategies to strengthen them.

Among *the topics discussed during the experiment with teachers* were: Gender equality and science/technology; Promoting the importance of secondary education in science and technology; The importance of involving girls and boys in science and

technology; Modalities of cooperation between girls and boys in school and social activities; Gender stereotypes in teaching, assessment and teaching material; Defining professional aspirations beyond gender stereotypes; Life and career strategies.

*Among the topics discussed with parents of students of reserve classes in science and technology were:* Cooperation between parents and children; Images of scientists women and men in science/technology; Promoting the importance of secondary education in science and technology; The importance of involving girls and boys in science and technology; Modalities of cooperation between girls and boys in school and social activities; Gender stereotypes and their impact; Gender-sensitive career guidance: Defining professional aspirations beyond gender stereotypes; Life and career strategies.

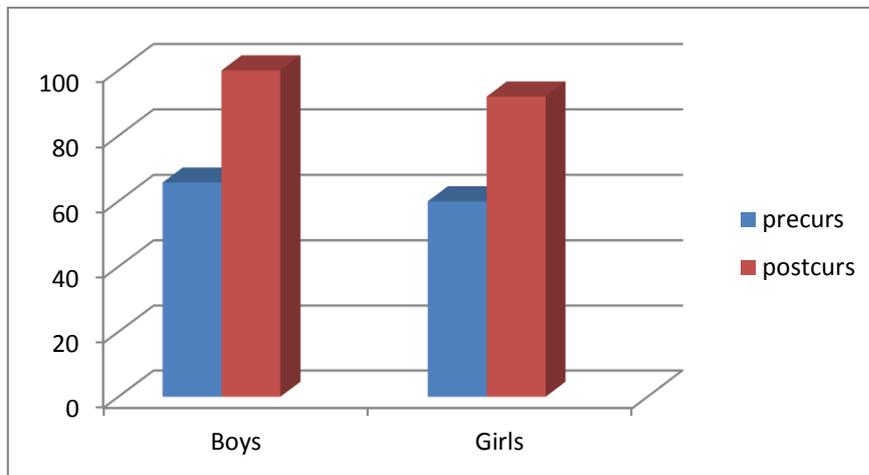
We note that organizing multiples gender awareness activities for the girls students, teachers and parents contributed to the creation of a unique favorable environment (gender friendly), motivating, especially girls, to study science.

We reiterate the fact that in this research, as a starting point, served the problem of gender stereotypes and prejudices' persistence in society, leading to discrepancies between the motivation of boys and girls in choosing physics as a subject and advanced discipline (with a gap in favour of boys), affecting their performance. Through the carried out experiment, opportunities were presented for prevention/transformation of stereotypes, faced by boys and girls, especially those who want to embrace science after three years of studies in science and technology reserve class. Based on the study results we conclude that the stereotypes and prejudices related to boys and girls, men and women working in science persist despite scientific and technical progress. Stereotypes are reproduced by the media, the educational system, traditional daily practices. They can be prevented and eliminated by replicating the positive obtained practices, including the ones from the present research.

The research results have confirmed that motivating girls and boys for sciences and technologies discipline can be achieved through gender sensitive strategies that are effective, paradigmatically addressed from a pedagogical and social perspective and based on the interdependence of educational activities focused on students and gender awareness of teachers, and also parents.

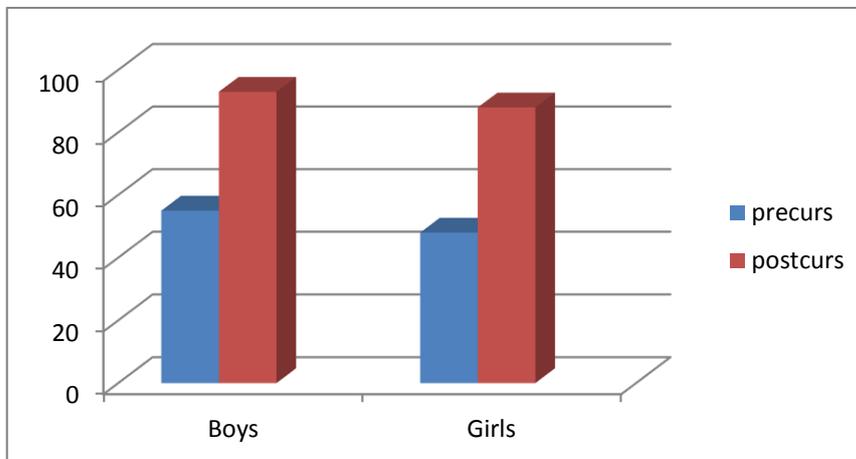
Thus, we conclude that the teaching experiment, which included the steps of finding and training, involved students (boys and girls), teachers, and parents, confirmed the relevance of the implemented strategies.

Among significant results from the mentioned interventions, we note the increased interest in science of boys and girls. Thus, if before applying the strategies only 65.72% of boys (1st place) and 60% of girls (2nd place) from reserve class have shown interest in science, after carrying out the activities - the score grew to 100% of boys and 92% of the girls which showed interest in science (Figure 1).



**Figure 1. Interest in science of students (by sex), %**

As a result of the activities, the students' attitude towards the advancement of science in future changed. Thus, if before training activities only 55% of boys (1st place) and 48% of girls (2nd place) from reserve class have confirmed *the decision of students' advancement in science in future*, after carrying out the activities - the score increased of 93% for boys and 88% for girls that have indicated the decision of students' advancement in science in future (Figure 2).



**Figure 2. The decision of students' advancement in science in future**

We acknowledge that the gender dimension in science and technology education is a formative-educational approach targeting a series of actions, which are based on considering influences specifics on the formation of boys and girls from the educational instructive process context, oriented to prevent and overcome gender stereotypes, attracting girls and boys in science and technology by encouraging and exploring their potential.

## Conclusions

As we have shown the three approaches (a “gender neutral”, a “female friendly” and a “gender sensitive” science education) that are described can be seen to represent quite different types of initiatives to increase gender equity in science education. All the three approaches do, however, have their strong and weaknesses. It can be mentioned that actions

that are recommended as suited to increase gender equity should be analyzed according to what perception they reflect of what role gender/sex plays for pupils engagement in science education.

Clarifying and describing the characteristics of the different ideal types might, however, enable initiatives to become more conscious about their own perception of how girls and boys engage in science education and thereby enable such initiatives to plan more consistent actions to increase gender equity in science education.

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