

Inclusion of women in science and technology

Actions aimed on basic education

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Abstract. The inclusion of Women in Science and Technology is an institutional extension project of the Federal University of São João Del Rei — UFSJ (Alto Paraopeba Campus — CAP) which encourages young girls from 11 to 18 years-old to pursue careers in the areas of Science, Technology, Engineering, and Mathematics. This project aims to show to young women the innumerable possibilities of careers in any area of knowledge both in Brazil and abroad, valuing the woman and her untapped potential. In the long run, this initiative aims to contribute to increasing the number of women in careers who are predominantly male and to better exploit the worldwide intellectual capacity of women, which is currently wasted. This project is developed in the Minas Gerais State (Alto Paraopeba region), more precisely in Ouro Branco and Congonhas historical towns, and has the cooperation of the international NGO, Greenlight for Girls — G4G (Brussels, Belgium) since 2011. The actions comprise scientific visits of the project members in public and private schools and the international annual event called *Greenlight for Girls in Brazil*, organized in partnership with the Greenlight for Girls NGO. As a result of this project, it was observed that 25% of participants girls like to study exact sciences in school, and less than 20% pretend to follow careers in science and technology areas. The testimonials of the participants evidenced that there is still resistance by family members and teachers at schools in the entry of women in popularly male areas/careers.

Resumo. Inclusão das Mulheres nas Ciência e Tecnologia é um projeto de extensão da Universidade Federal de São João Del Rei — UFSJ (Campus Alto Paraopeba — CAP) que incentiva jovens de 11 a 18 anos a seguirem carreiras nas áreas de Ciência, Tecnologia, Engenharia e Matemática. Este projeto visa mostrar às jovens as inúmeras possibilidades de carreira em qualquer área de conhecimento tanto no Brasil quanto no exterior, valorizando a mulher e seu potencial inexplorado. A longo prazo, esta iniciativa visa contribuir para o aumento do número de mulheres em carreiras que são predominantemente do sexo masculino e melhor aproveitamento intelectual mundial, atualmente desperdiçado. Este projeto é desenvolvido no Estado de Minas Gerais (Região do Alto Paraopeba), mais precisamente nas cidades históricas de Ouro Branco e Congonhas, em cooperação com a ONG internacional Greenlight for Girls — G4G (Bruxelas, Bélgica) desde 2011. As ações compreendem visitas científicas dos membros do projeto em escolas públicas e privadas e o evento anual internacional chamado *Greenlight for Girls in Brazil*, organizado em parceria com a ONG Greenlight for Girls. Como resultado deste projeto, observou-se que 25% das meninas participantes gostam de estudar ciências na escola, e menos de 20% pretendem seguir carreira em áreas das ciências e tecnologia. Os depoimentos das participantes evidenciaram que ainda há resistência por parte de membros da família e professores em escolas no que se refere à entrada de mulheres em áreas/carreiras popularmente masculinas.

Keywords. Teaching of Astronomy

1. Introduction

The representativeness of women in academic courses of computing has been decreasing since 2001 (Oliveira, Moro & Prates 2014). According to the latest report released by the Brazilian Computer Society (SBC), it can be observed that in 2015, in computer courses, 14.65% of those registered are women, of which 16% finished their studies. In an attempt to increase the proportion of women in the STEM areas, including Information Technology, there is a concern in several universities, development institutions, and companies to create incentive measures that promote the increase of the women representation in these areas. Experts in the study of Gender and Science claim that the factors which cause this reality are complex, but the most relevant causes are the prejudice and discrimination subtly embedded in the cultural conditioning of our premature society.

From the earliest years of schooling, girls are directed to the care and human areas and are little encouraged to enjoy science, which causes less concentration of women in scientific careers and jobs (Olinto 2011; Oliveira & Salva 2010). Prejudice about the lack of cognitive abilities for scientific performance is one of the most common arguments to justify women's withdrawal from scientific careers. The scarcity of appropriate role mod-

els prejudice over women's intellectual abilities appears early in childhood. According to Bian, Leslie & Cimpian (2017), girls learn to underestimate their gender from the age of six when they begin to associate people described as *particularly intelligent* or *exceptional* to males. Other studies point out that the social stereotype that men are better at math than women actually detracts from performance and undermines their (women) interest in Science, Technology, Engineering, and Mathematics areas (STEM).

These ideas accompany girls throughout elementary and high school, as well as in the crucial phase of career decision. This panorama makes many of them ending up opting for courses traditionally associated with a socially constructed feminine vocation (caring and teaching) because it remains the idea that women are not fit for careers in exact sciences. This has negative consequences, encouraging the systematic devaluation of the highly feminine professions in the labor market (Olinto 2011).

According to Klame, Whitney & Simard (2009), initiatives undertaken for pre-undergraduate studies, involving activities which enable contact with successful women in the computing careers and technology, overturn myths and stereotypes associated with them. Besides, it can provide accurate information

about these areas for people who exert great influence on girls (eg parents and teachers), it uses the potential of technology impact as a form of motivation, and promotes the engagement of female academic students and university teachers in works with elementary and high schools.

In view of the above, this proposal intends to contribute with actions beamed at increasing the number of women in the STEM, from the contact of young girls with graduates female students of the Campus Alto Paraopeba (CAP - UFSJ) engineering courses, teachers and professionals from Brazilian universities. It is also to show promising young women the innumerable career possibilities in any area of knowledge in Brazil and abroad, valuing the woman, her latent potential and discussing the difficulties of associating family, maternity and work in the present day. The objective is also to attenuate the cultural conditioning and enable access to information by all social classes, especially those less favored economically. Assisting and working together with the school (Education) to change the social reality of women (Society) is our goal. Education and society are about cause and consequences bound because one is dependent on the other.

Our efforts are to perform the Convention on the Elimination of All Forms of Discrimination against Women (written in 1979 and coordinated after 2008 by the Office of the High Commissioner for Human Rights in Geneva): (1) elimination of any concept stereotyping of male and female roles at all levels and forms of education; (2) assisting to eliminate discrimination against women by ensuring equal rights to freely choose their profession and employment; (3) the right to equal remuneration; (4) the right to the same employment opportunities, as well as the same evaluation criteria; (5) the right to equal treatment in the workplace.

2. Methodology

An important component of our actions is the availability of female models (public and private sector professionals, undergraduates female students of the CAP Engineering course) to give a successful career perspective within the STEM areas for young girls and their families (who will receive from their daughters examples of successful citizens in their careers, especially those in which the number of women is still small).

Thus, this project propose activities only for girls, which provides an atmosphere of confidence in themselves and with the project's members. Scientific topics inherent in each area of knowledge as well as women's human rights and their intersections of social class and generation will be addressed.

The young girls are placed in a direct contact with female undergraduate's students of the CAP Engineering courses. This contact provides (a) knowledge of the Sciences, Engineering, Mathematics and Technologies recently developed by the teachers/researchers members of this team; (b) understand the symbiosis between basic research (Science and Mathematics) and applied research (Engineering and Technologies). (c) knowledge of government programs to support overseas scholarship students and foreign programs for emerging countries; (d) exchange of information on the Brazilian and foreign labor market in the STEM areas (e) discussions about the relationship between family, work and maternity, highlighting the experiences of each speaker in this regard; (f) the importance of knowledge of a language as a channel for opening up possibilities of work and enrichment. (g) and exchange of personal experiences.

The actions consist of (a) 3 scientific visit at participating schools, with themes involving the STEM areas, women's human rights, family, career, and motherhood aimed at young



FIGURE 1. Scientific visit at school. Source: authors



FIGURE 2. IV *Greenlight for Girls in Brazil* event.

women from schools of Ouro Branco and Congonhas - MG, informing and encouraging them, in a fun and attractive way to pursue a career in areas where there is a lack of women. Workshops will be prepared by the UFSJ's undergraduates female students; (b) activities developed at the CAP during the *Greenlight for Girls in Brazil* event. The lectures and workshops will be taught by public and private sector professionals and foreign lecturers (members of the international NGO *Greenlight for Girls*).

Each participating school will be able to elect an coordinating teacher, that will be part of the project team, with the mission to support the girls during the school year, informing the families of the work done by the women, contributing to eliminate the cultural conditioning, prejudices, and discriminations. The coordinating teacher will be a facilitator and an important link of communication between the UFSJ and the school. We chose to include the possibility of a coordinating student since we observed that few teachers adhere to this proposal and we felt it was extremely necessary to have a project collaborator within a school.

3. Results

After five years of activity, (2012, 2013, 2016, 2017 and 2018), the project assisted 1111 girls, 23 female teachers, 13 schools at Ouro Branco and Congonhas towns (where 10 were public schools and 3 private schools). Besides, it counted on the collaboration of more than 20 undergraduate students of the UFSJ/CAP and 23 women researchers of federal universities in Brazil and 3 foreign lecturers, members of the international NGO *Greenlight for Girls*.

Fig. 1 shows a scientific visit at one of the participating school and Fig. 2 shows a picture taken during the IV *Greenlight for Girls in Brazil*, held at CAP/UFSJ in november 2017.

From questionnaires filled by students during the first scientific visit, it was possible to map their preferencing areas/careers.

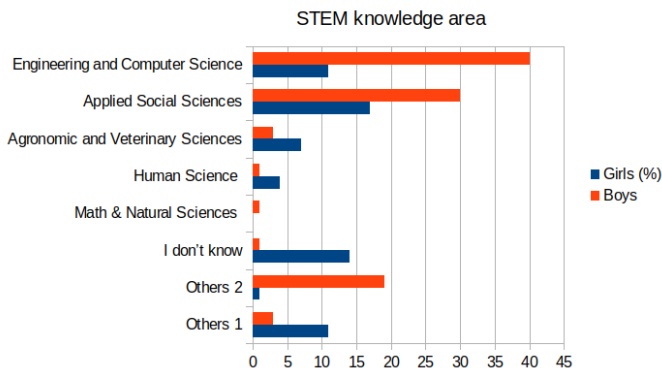


FIGURE 3. Preferred professions (by area of knowledge) by boys and girls of schools participating in the project during 2017. Maths and Natural Science: physics, chemistry, math, and astronomy; Human Science: physiology and pedagogy; Agronomic and Veterinary Sciences: veterinary medicine and agronomy; Applied Social Sciences: administration, architecture, law, design, economics, and advertisement; Health Sciences: nursing, medicine, nutrition, and dentistry; Others 1: fashion designer, actress, fashion model, photography, performing arts, gastronomy, dancer. Others 2: soccer player and a policeman. Source: IMCT project data, obtained by a questionnaire answered by students of both sexes.

Based on our results in 2016, it was observed that 25% of participating girls enjoy studying exact sciences, and less than 20% wants to pursue careers in Science and Technology areas. Besides, 77% believe there are few women in those areas due to lack of information, fewer opportunities in the labor market, and to consider themselves less capable than men (Torres et al 2017).

Fig. 3 shows the results obtained by the project regarding their preference for careers between boys and girls of participating schools in 2017. Our results are in agreement with those provided by correlated literature (Soares 2001; Torres et al 2017). In this survey, only 11% of the participating girls preferred engineering and computer science as a career. No girls choose careers in math and natural science, while 35% of them claimed professions in biological areas. Moreover, it was noticed a lack of incentive or support to study exact sciences in the fundamental and high school. It consequently affects their learning, as well as make them feel disinterested and insecure in choosing a career in that area, stating that the exact courses are "very difficult and possible only to very smart people". These results evidence a typical case of gender segregation in career choice (Fig. 3).

The girl's drawings required during the first school visit in 2016 evidenced gender stereotypes in career choice. For someone who performs an engineering work, 82% of the participating girls drew men figures, attributing them characteristics such as "good in making calculus, like mathematics, clever, smart, and intelligent". For medicine, the participants attributed the same feminine characteristics, but they drew men doctors. Personalities related to the care, patience, and gently, which are behaviors popularly associated with women, were present in 89% of the characteristics of persons exercising a nursing profession. Testimonials of the participants evidenced that there is still resistance by family members and teachers to accept women in male careers (Torres et al 2017).



FIGURE 4. Participants' drawings (2016) for someone who performs the nursing profession (top panel), medicine (middle panel) and engineering (bottom panel). Source:(Torres et al 2017)

4. Conclusion

The actions proposed in this extension program have provided a paradigm change for girls and the community contributing to the reduction of the cultural conditioning of the society regarding the choice of the career by women. This work evidenced that girls are influenced by the gender stereotypes of our society (family, school, and community), making it difficult to focus on subjects of the exact sciences and professional future in these areas.

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