



DEVELOPMENT OF THE EXTENSION PROJECT WOMEN IN EXACT SCIENCES IN BRAZIL

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Resumo: *This work describes the development of the extension project Women in Exact Sciences, developed in a federal university in Brazil. The project involves the development of different activities for disseminating gender equality information, access to technology and education to students from universities and public schools in the region. During the extension activities, some university students gave courses spreading their knowledge. In addition, they learned about the real social needs related to science and computing, through extracurricular activities, such as contact with external speakers and students from public schools. This way, both students from university and schools expanded their knowledge regarding various social issues, including gender equality.*

Palavras-chave: *Extension Project; STEM; Exact Science; Gender equality*



DEVELOPMENT OF THE EXTENSION PROJECT "MULHERES NAS EXATAS" IN BRAZIL

1 INTRODUCTION

Many universities have reported low female participation in exact sciences courses. For example, at Stanford University the percentage of women in computing in 2015 represented only 30% of students at that university. In the United States, about 18% of computer graduates are women (Meyer, 2015; Catalyst, 2019). According to estimates by the United Nations Educational, Scientific and Cultural Organization - UNESCO Institute for Statistics, women in STEM (Science, Technology, Engineering, and Mathematics) represent less than 30% of the research and experimental development workforce worldwide (Unesco, 2017).

The UNESCO report points out that gender differences in STEM education become more visible at higher levels of education, especially at the Ph.D. level and in research professions (Unesco, 2017). This report shows a proportion of 53% women X 47% men in Bachelor's level; a proportion of 55% women X 45% men in Master's level; a proportion of 44% women X 56% men in Doctoral level and a proportion of 29% women X 71% men working as researchers. In general, we have more women who graduated, however, we lose them during the transition to the research workforce.

This leads to a diversity crisis in the area of Information Technology (IT), with regard to gender. According to data from the report presented by the AI Now Institute (AI NOW, 2020), women represent only 18% of the authors of articles published in renowned conferences in Artificial Intelligence (AI). In the industry, only 17% of women work in the area. Companies like Facebook Research have about 15% women in their employees and Google has 10% in their employees.

In Brazil, the National Institute of Educational Studies and Research Anísio Teixeira (in Portuguese Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira - INEP), an agency of the Ministry of Education, released the census of higher education in 2015. In this report, 70% of women were studying education and health while 30% were studying science, mathematics, and engineering (Inep, 2015). Moreover, from 300 thousand professionals registered at the Federal Council of Engineering and Agronomy of Sao Paulo (in Portuguese Conselho Federal de Engenharia e Agronomia - CREA-SP), only 40 thousand are women (Crea, 2019). These numbers show us the importance of actions that seek gender equality and encourage the participation of women in STEM.

The Institute of Science and Technology - Federal University of Sao Paulo, where this project was developed has seven courses in exact sciences: Science and Technology,

Biotechnology, Computer Science, Biomedical Engineering, Computer Engineering, Materials Engineering, and Computational Mathematics. The campus was founded in 2007 and since the beginning, the number of female students was lower than the male students, as presented by Figure 1. The number of female professors is also lower than the male, as shown in Figure 2. Following international and national estimates, our campus also has a low female representation.

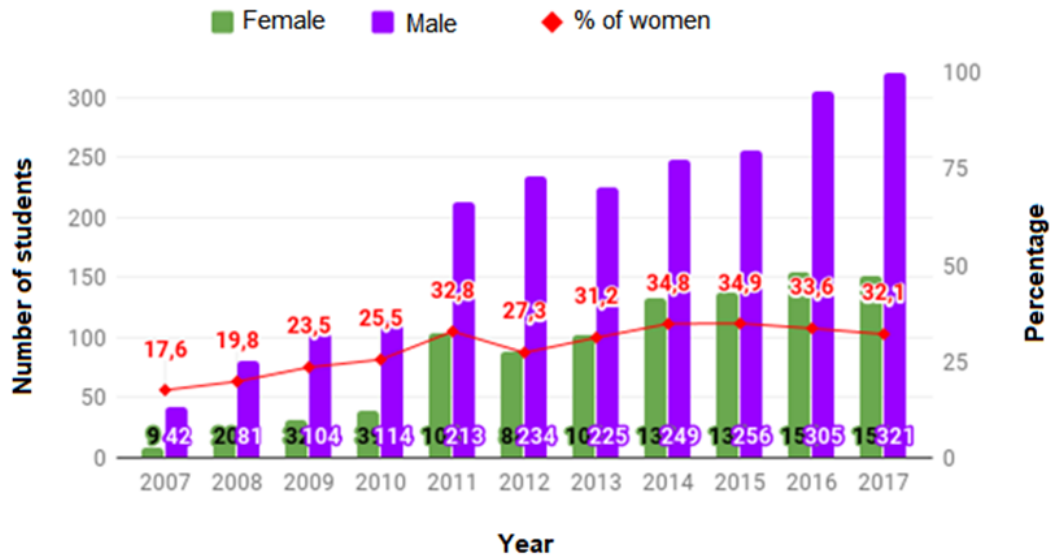


Figure 1: Number of female and male new students in the university from 2007 to 2017.

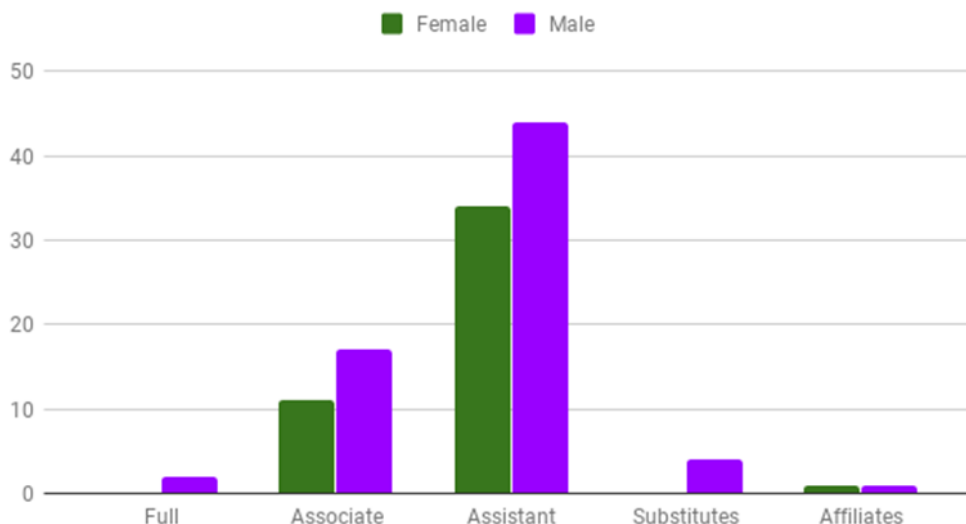


Figure 2: Number of female and male professors in the university in 2020.

The extension project "Mulheres nas Exatas" was founded in 2018 at this university in order to start a group that encourages gender equality and the participation of women in the area of STEM promoting collaboration between professors, professionals in the field and students. It is also noteworthy that the project is aligned with two sustainable development objectives promoted by the United Nations (UN), namely, "Goal 04 - Quality education: ensuring inclusive, equitable and quality education, and promoting opportunities for lifelong learning of life for all"; and "Goal 05 - Gender equality: achieve gender equality and empower all women and girls".

This paper aims to present the activities developed by this extension project to help other ongoing projects and encourage the creation of new groups. We would like to expand the connections among regional and national STEM groups, to share ideas and plans that integrate a gender perspective.

Next, in Section 2 the activities developed in the project are presented. In Section 3 some evaluations made by questionnaires and applied to the participants are shown. Finally, in section 4 the conclusions and future works are highlighted.

2 DEVELOPED ACTIVITIES

This section presents the main activities developed by the extension project "Mulheres nas Exatas". Figure 3 summarizes the three approaches developed by the project encompassing: 1) internal activities for undergraduate students; 2) external activities for students from public schools; 3) participation in events that debate about women in STEM. Following the activities face-to-face developed in 2019 and the online activities developed in 2020 are described in more detail.

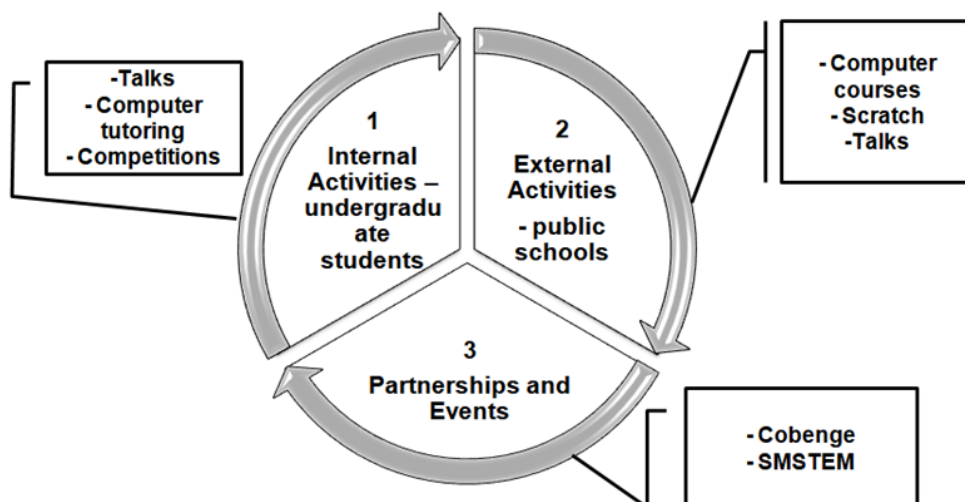


Figure 3: Activities developed in the extension project "Mulheres nas Exatas".

2.1 Internal activities - undergraduate students

The project promotes talks in the university to collaborate in the process of empowering women and to encourage more girls into STEM careers. The lectures were attended by students and professionals who already work in the area, sharing their experiences. The following lectures were given:

1) "The most important women in the history of computer science": This talk was held on Ada Lovelace Day, which is an international celebration of the achievements of women in STEM that happens every year on the second Tuesday of October. It was given by the project coordinating professor and five students from the university. Each one briefly presented the biography of the main women who contributed to Computer Science.

2) "Leaders: the female presence in the National Institutes of Science and Technology": This talk was held on 2019 international women's day by a professor from the university who presented several Brazilian women researchers who contributed to Brazilian science in different fields.

3) "Freshmen Reception 2019: Female Representation in the Exact Sciences": This talk was conducted by the project coordinating professor, two collaborating professors and four female students. They presented the extension project for freshmen and the importance of women following STEM careers. The professors and students shared their experience in the university and which were the main difficulties and motivations they had.

4) "Pyladies": This group was brought to Brazil in 2014 with the purpose of instigating more women to enter the technological area. A lecture was given by two members from Pyladies, who spoke about the Python language and the international movement created to encourage women in computer science.

Besides the talks, the project also offered monitoring and support in competition for undergraduate students:

1) "Monitoring in Programming Logic discipline": Monitoring was also carried out for freshmen. Many students after entering a graduation course find different types of difficulties and end up frustrated. Offering tutoring and programs that help and motivate these students would be interesting options to avoid dropouts. The discipline Programming Logic has a history of high failure rate and the objective was to offer extra-class support for students.

2) "Brazilian Informatics Olympiad" (in Portuguese Olimpíada Brasileira de Informática - OBI 2019). The project coordinating professor was representing OBI in the university and motivated the freshmen to participate. Seven freshmen got to the final stage

of the competition. A female student was the best placed in the university obtaining the rank 52 among 1991 Brazilian participants.

3) "Local programming competition": Every year during the week of science and technology, events are promoted for students, including a programming competition. The project coordinator assists in the competition and encourages the participation of girls whose number is very limited. In 2019 a team with two girls reached third place in the competition. It was the first time that a team of girls was among the three placed.

2.2 External activities - public schools

It is believed that introducing science and technology for children and teenagers can also help demystify and attract more women to exact sciences. The present project believes that programming is increasingly important to understand the functioning of computers and other electronic devices, as well as providing job opportunities in the field of Information Technology (IT). Programming also helps to develop concentration, interactively exercise creativity, logical and mathematical reasoning, providing pleasurable moments of creation and authorship. The domain of programming is about using imagination and creativity to guide the computer to do new things using the best languages and tools.

In 2019, the following tutoring and courses were offered for students from public school:

1) "Scratch programming course for children of the Decolar Project". Decolar serves 6th-grade elementary school students in the city, considered talented and with a high intelligence quotient. We offered a Scratch course and logic games for children during two semesters. The courses had an hour and a half of weekly activity. In each class, different programming commands were taught to children, for example, how to declare variables, conditional structures, repetition loops, Boolean and arithmetic operators. Scratch allows the creation of different characters and scenarios, facilitating the visualization of programming commands.

2) "How to enter into a public university and the importance of women in the exact sciences": The project gave this talk at the Helio Augusto de Souza Foundation (FUNDHAS), which serves young people in social vulnerability. It was carried out by the project coordinating professor and four students from the university. The main public universities in the region were presented and how to enter through National High School Exam (in Portuguese Exame Nacional do Ensino Médio - ENEM) and Unified Selection System (in Portuguese Sistema de Seleção Unificada - SISU). Moreover, we mentioned the importance of women studying higher education.

3) "Scratch programming course for teenagers from the Hélio Augusto de Souza Foundation (FUNDHAS)". The Scratch course was also offered for the students from

FUNDHAS, during one semester, to encourage them to keep their studies and course in a technological or computer science area.

In 2020 and 2021, with the Covid-19 pandemic, we offered online courses for students from public schools. We used free tools like Google Classroom and Google meet to contact the students and realize the online courses, and online frameworks to practice the content of each course. The courses had an hour and a half of weekly activity during three months. The following courses were offered:

1) "Scratch Programming Logic": Scratch is a technological graphical programming tool that offers a simple programming language in which it is possible to create interactive stories, animations, games, and more. We used the Scratch site to develop practical activities and introduce the basic concepts of programming logic.

2) "Arduino": Arduino is a free hardware, single-board electronic prototyping platform. The aim of the project is to create tools that are accessible, inexpensive, flexible and easy to use for both beginners and professionals. We used the site Tinkercad to practice the concepts.

3) "Office tools": Office has become an essential tool that manages the demand of several professionals. There are different programs that assist in the work of creating and editing articles, creating a database, financial tables, visual presentations and managing e-mails. We used Google documents to edit documents, spreadsheets and presentations.

4) "Advanced C programming": The C language is one of the best known in the world. Like human languages, programming languages are used to communicate. This communication involves both the programmer and the machine, as well as with other programmers, who will read the code and modify it eventually. It is very important for a programmer to know this language. We used online C compilers to practice the commands.

2.3 Partnerships and events

The coordinator of the project "Mulheres nas Exatas" participated in events related to women in STEM and education in exact sciences. This is an opportunity to share experiences and create a network between projects and initiatives.

1) "XLVII Brazilian Congress of Engineering Education 2019" (in Portuguese XLVII Congresso Brasileiro de Educação em Engenharia – COBENGE) is the most important discussion forum in Engineering in Brazil. This is an annual event that has been held by Brazilian Engineering Education Association (in Portuguese Associação Brasileira de Educação em Engenharia - ABENGE) since 1973, and its mission is to produce changes to improve the quality of undergraduate and postgraduate education in engineering and

technology in Brazil, contributing to the formation of professionals who bring development and technology to all parts of the country. This event happened from September, 17 to 20, 2019.

2) "The Brazilian Symposium Women in STEM 2020" (in Portuguese I Simpósio Brasileiro de Mulheres em STEM - SMSTEM) aims to bring together representatives and participants of projects and initiatives with the purpose of attracting young girls and keeping young students and professionals in the STEM areas, as well as people interested in women's issues in the labor market, challenges to be faced and actions to overcome them. This event happened on March, 13 and 14, 2020.

3 EVALUATION

During the realization of the project, questionnaires were applied to the participants to evaluate the developed activities. The questions and graphs with answers are presented below. It is noted that, in general, the project has been well received and the participants are motivated with the activities.

Figure 4 presents the grade attributed by the undergraduate students from the university regarding how monitoring helps them. Notice that in all the questions they give grades 4 or 5 indicating they are very satisfied regarding learning new concepts and the C language, doing exercise, keeping motivated in the course, improving their logical thinking.

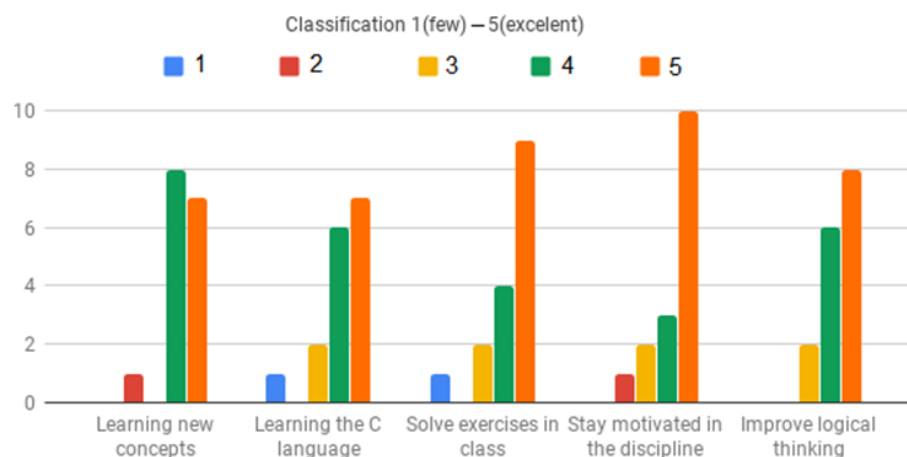


Figure 4: Evaluation made by students participating in the Programming Logic monitoring offered by the Project "Mulheres nas Exatas". This graphic shows the grade attributed by undergraduate students regarding how the monitoring helps them.



Figure 5 and 6 presents the evaluation by the students from public school enrolled in Decolar and FUNDHAS, respectively. Decolar students point all the options as personal development, but they learned most Scratch and programming, while FUNDHAS students point most they learned Scratch and improved their creativity. Both students liked the activities given grades 4 and 5 for the course as presented in Figure 7. We could consider that the children loved more than the teenagers since Scratch is a playful tool.

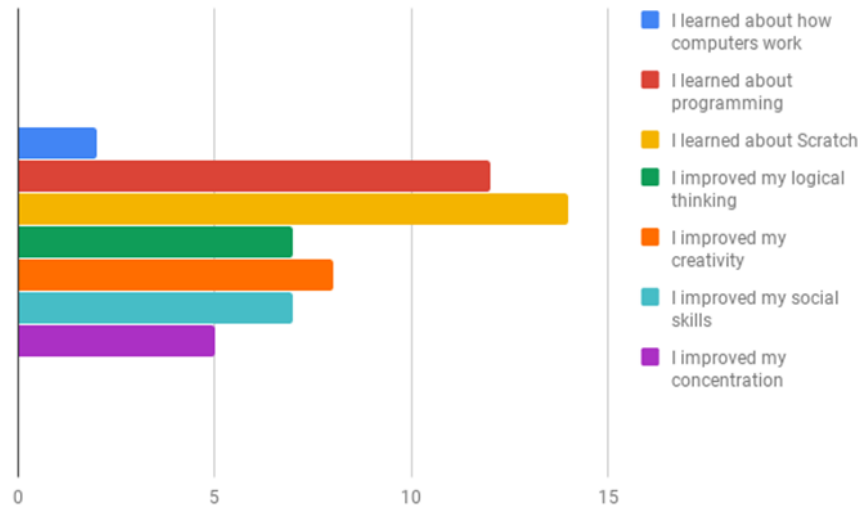


Figure 5: Evaluation made by Decolar students participating in the Scratch course offered by the Project "Mulheres nas Exatas". This graphic shows the students' answers about what aspects the course contributed to their academic and personal development.

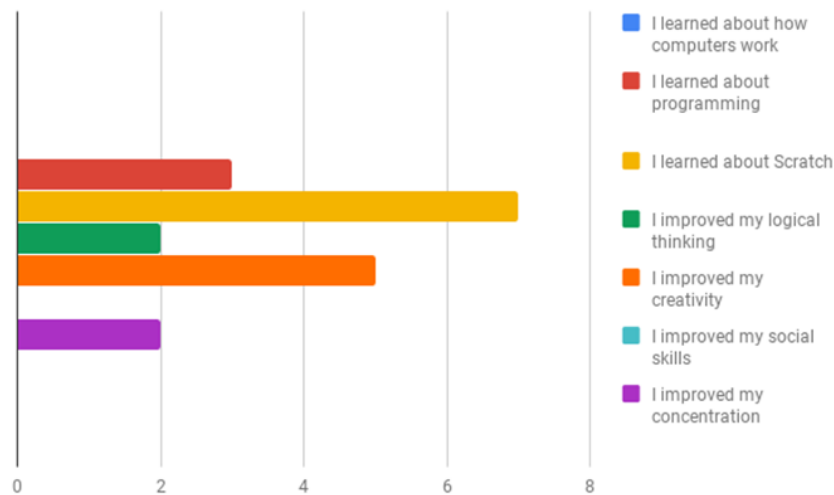


Figure 6: Evaluation made by FUNDHAS students participating in the Scratch course offered by the Project "Mulheres nas Exatas". This graphic shows the students' answers about what aspects the course contributed to their academic and personal development.



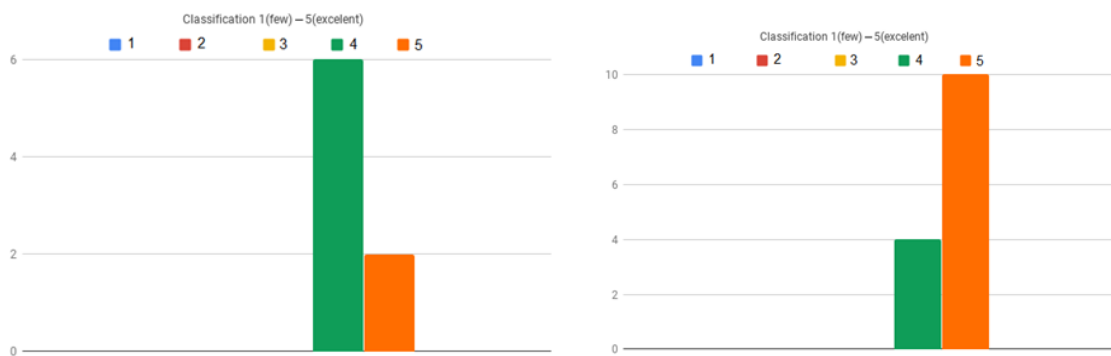


Figure 7: Evaluation made by FUNDHAS (left) and Decolar (right) students participating in the Scratch course offered by the Project "Mulheres nas Exatas". This graphic shows the students' answers about how much they liked the activities developed in the course.

After the closing of the Freshmen Reception in 2019, a form was released by the Student Support Center (in Portuguese Núcleo de Apoio ao Estudante - NAE) to collect information about it. The project "Mulheres nas Exatas" had 27 evaluations and received a score of 4.07 out of 5.

4 FINAL CONSIDERATIONS

The project has motivated undergraduate students from Federal University of Sao Paulo through real examples and motivational lectures, where we presented international and national women working in science and technology. Moreover, we support women's participation in local and national competitions, as a result, we had young women students reaching good positions and feeling motivated.

The project aims to encourage students from public schools to pursue STEM careers, through the development of logical and creative thinking by our computational courses. In our course, we develop activities that teach students to program using Scratch. It is a free programming environment and ideal for beginners, where blocks of code with colorful commands and cartoons are connected to create programs. This software is used by almost 12 million people in 150 countries and is available in 40 languages. Scratch allows the abstraction of complex concepts and facilitates learning through games and interactive activities. It is a simple tool that should be used whenever possible among children, teenagers, and young people who are starting their contact with programming.

As future work, we would like to expand the number of schools to receive our Scratch course. We also want to expand our collaborations with other STEM groups in the country to promote the insertion of female students in the STEM area.

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