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THE ARTICULATION OF NETWORKS AT THE 1ST INTERNATIONAL WOMEN IN STEAM CONGRESS [1]

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Abstract: This article presents the case study of the 1st International Women in STEAM Congress (I CIMESTEAM). The congress aimed to expand connections and integration between academia, industry and political agents, in order to strengthen regional, national and international cooperation so that they can assist in the formulation, implementation and evaluation of ST&I guidelines and policies that integrate the current panorama. of Women in STEAM (acronym in English to designate the areas of Science, Technology, Engineering, Arts and Mathematics). The Congress included lectures by women with recognized performance and reference in the area, round tables with representatives of successful projects, technical sessions and poster presentations with the work being developed, in addition to workshops and plenary sessions to discuss actions for the future. In this context, the I CIMESTEAM strategy was to debate the systemic barriers that impede the interest of young women and women in STEAM areas. This sought to better understand how large-scale transformations, such as industrialization, globalization, education and public policies, shaped class, race and gender inequalities in Brazil in the event's theme. More than a methodology, STEAM education can be used as a teaching development strategy focusing on active learning and motivation of teachers and students.
Keywords: Network, Women in STEAM, Academia, government and industry.

INTRODUCTION

Despite Brazil having structures and organizations aimed at training and training professionals in the field of education, it has not achieved good results in the performance of its students. The need to attract talented students and professionals in academia and industry has motivated and driven in-depth research into issues related to basic education, higher education and continuing education, particularly in the STEAM areas (Ortiz-Revilla, 2018). STEAM is an acronym for Science, Technology, Engineering, Arts and Mathematics. Critical studies indicate how technology, used intentionally, can contribute to effective student learning and improve diversity, equity and inclusion (DEI) in organizations (ELSEVIER, 2022; WEF, 2021).

According to the Global Parity Alliance (2021), the market for DEI has been estimated at US$7.5 billion and is projected to more than double to US$15.4 billion by 2026 (Global Industry Analysts, 2021). In fact, the global DEI market will increase in the coming years. According to the Mckinsey and Co (2019) report, addressing existing underrepresentation can boost regional technological growth and innovation, as well as being an economic necessity. The Association of Information and Communication Technology and Digital Technologies Companies (Brasscom) points out that by 2025 Brazil will have a deficit of tens of thousands of professionals in the STEAM areas, which could hinder the further development of the national economy (BRASSCOM, 2022).

In this context, the strategy of the 1st International Women in STEAM Congress (I CIMESTEAM) was to debate the systemic barriers that impede the interest of young women and women in STEAM areas. This sought to better understand how large-scale transformations, such as industrialization, globalization, education and public policies, shaped class, race and gender inequalities in Brazil in the event's theme. More than a methodology, STEAM education can be used as a teaching development strategy focusing on active learning and motivation of teachers and students (UNESCO, 2018; IPEA, 2018).

The purpose of this work is to present a report on the extension activities developed at

I CIMESTEAM, exposing the main challenges of this implementation, especially those resulting from the post-Covid-19 pandemic. Several studies have shown that the time spent on unpaid care and domestic work during the COVID-19 pandemic has made the situation even more challenging for girls and women in Brazil (TATAGIBA, CUSTÓDIO, 2022; BARROSO, 2020). Indeed, the world continues to grapple with the pandemic and other critical issues, and as such, women's equal participation and leadership in science, technology, engineering, arts and mathematics (STEAM) is more important than ever.

This article presents the case study of the I CIMESTEAM and was structured with the aim of presenting, in sections 1 and 2, the introduction and context of the congress, presenting the partnership between the Brazilian Network of Women Scientists (RBMC) and the Innovation Laboratory from ITA, more specifically with the researchers from the Education in STEAM project. In section 3, the methodology and activities developed at I CIMESTEAM will be presented. Then, in section 4, final considerations will be presented.

THE CONTEXT OF I CIMESTEAM

The I CIMESTEAM was an initiative by researchers from InovaLab in collaboration with researchers from the Brazilian Network of Women Scientists (RBMC). The congress focused on disseminating ESG (Environmental, Social and Governance) principles and encouraging undergraduate and postgraduate students and professionals to remain in the STEAM areas. The event took place on October 21st and 22nd, 2022, at the São José dos Campos Technological Park/SP, and had the support of several universities, non-governmental organizations, companies, among which Embraer, Dassault Systèmes, EmbraerX, Flex, among others.

Since 2020, InovaLab researchers have brought the discussion about diversity, inclusion and equity as a transversal axis of their extension activities, in order to highlight the plural contributions of initiatives and guest groups from different regions of the country. Sharing experiences and realities has been fundamental for a critical reflection on the performance of extension projects, the expansion of their scope and action in regional development strategies.

RBMC is a social movement of teachers and researchers created during the Covid-19 global health crisis in 2020. RBMC currently has 4,000 members in various areas of knowledge. The Network established strategic themes for the coming years: i. Health; ii. Violence; iii. Education; 4. Social Assistance and Food Security; v. Work and Employment and saw. Housing and Mobility. These strategic themes supported the planning of the I CIMESTEAM. Firstly, because the Network's activities work on projects that emphasize the importance of the diversity of workers available for STEAM. Secondly, because several RBMC researchers work in public schools and universities providing training and professional training to women in poor areas of Brazil who do not have access to quality education.

The congress activities were planned to publicize teaching and extension projects and initiatives in the STEAM areas, through panels, round tables, workshops, teaching materials and communication channels using educational and information technologies (social networks) and bringing companies together - with an emphasis on entrepreneurial education approaches and transversal methodologies. The congress included two structuring axes, namely:

AXIS 1: Equality, Diversity and Inclusion. In this axis the objectives were: i. map technical and transversal skills development programs to attract and retain the best female

technical talent in the country; ii support local productive arrangements articulated with institutes and technological vocational centers with the aim of generating income and employment, iii. value and support historically underrepresented populations in the innovation and entrepreneurship ecosystem.

AXIS 2: Entry and support for Women's Career Progression in STEAM areas. This axis consisted of presenting research to participants, providing data on the job market with a gender and race focus. The objectives of this axis were: i. stimulate access to careers in STEAM areas, ii. support women in understanding career planning and development through activities with national and foreign partners, iii. give visibility to the activities of women researchers, teachers, high school students and postgraduates to support development and career progression in STEAM and iv. facilitate the exchange of experiences and mutual support.

To achieve the objectives defined in the structuring axes above, several activities were carried out. Table 1 presents a summary of the activities of the I CIMESTEAM.

Research has shown that the rapprochement and interaction between actors in the innovation and entrepreneurship ecosystem have been fundamental for women's professional trajectories (ELSEVIER, 2022, IPEA, 2018). Furthermore, the experience gained through activities and collaboration with other institutions enabled the participants involved to become more qualified as they were introduced to new teaching techniques and tools based on interdisciplinary approaches, active methodologies and ESG principles.

METHODOLOGY

This section presents a description of the 1st International Women in STEAM Congress, its objectives, methodologies, and, mainly, the challenges of implementing the network of extension projects in the areas of STEAM, highlighting the planning and development stages of the 1st CIMESTEAM.

The general purpose of the congress was to develop several actions aimed at seeking greater inclusion of girls and women in the areas of science, technology, engineering, arts and mathematics. To this end, the event was structured into different activities, subdivided into: organizational management, networking, marketing, events, production of texts for the press, panels, workshops, technical sessions and poster sessions. Each front was responsible for developing specific and interdependent objectives. Organizational Management was focused on operationalizing broad planning and developing integration activities among the members of the organizing committee.

The congress sought to create an environment that stimulates quality education and active learning innovation in STEAM areas, highlighting Sustainable Development Goals numbers 3, 4, 5 and 11. First, addressing gender equality and empowering women and young people (objective 5). Secondly, seeking to highlight decent work and economic development strategies (Goal 10). The event encouraged interdisciplinary cooperation between several universities, institutes and organizations working in STEAM areas to improve diversity, equity and inclusion (DEI) in organizations.

The activities provided diverse interactions between institutions, managers, teachers and students, companies and technology parks in the country. In this context, several methodologies were presented, among which agile methodologies and maker culture stood out as they involve cultural, technical and scientific aspects aimed at innovative solutions with high potential for replication and multiplication for public primary and secondary education networks.

The event created stimulating environments that had direct action in the chosen school communities, in order to directly impact teaching-learning relationships in public secondary and elementary schools.

Since 2021, the I CIMESTEAM began to be defined and planned by a national organizing committee. Some researchers who participated in the organization of the 1st Women in STEM Symposium, at ITA, carried out a survey of interests by topic, carried out via a form (google forms) sent to the symposium participants, the topics classified as "very relevant" are presented in the Table 2, in order of interest.

Based on the analyzes and trends observed, it was possible to align the themes and learning strategies that would be addressed at the congress, in addition to the best times and days for engagement, target audience, providing support for better planning of the event's actions and greater coordination of networks that work in extension activities.

NETWORKING AND ARTICULATION OF NETWORKS

The main objective of the event was to create opportunities for young people and women to be inspired by STEAM careers in order to identify the challenges and needs of the job market in the area. Additionally, employers had access to a diverse talent pipeline to meet their recruiting needs and help them advertise their vacancies. By promoting a multidisciplinary and integrated approach, the emphasis sought to provide participants with quality interdisciplinary STEAM learning experiences to solve problems in the contemporary world.

In Brazil, according to the Higher Education Census (2017), 36% of women marry before the age of 18. The study highlights the direct correlation between child marriage and school dropout and, consequently, impact on these women's adult income, in addition to increasing the risk of domestic violence and maternal and child mortality. Currently, fewer girls complete high school compared to boys. Due to this scenario, the CIMESTEAM organizing committee articulated several actions with the aim of encouraging the insertion of women in science in order to encourage the implementation of innovative solutions that would contribute to improving science teaching and learning; in addition to encouraging the use of new educational technologies and new science teaching methods in order to expand access to training and strengthen interaction between basic education schools, higher education institutions, science spaces and other institutions. To achieve the objectives described above in the thematic axes, the congress adopted some integrated and networked actions.

In this context, counting on the participation of researchers from the Brazilian Network of Women Scientists (RBMC) was essential for institutions to understand their ESG implementation challenges, and consider the need to encourage people with protected characteristics, such as gender and race, pregnancy and maternity, to participate in the labor market or other activities in which their participation is low. In fact, the RBMC partnership allowed the event to connect national and international networks to create new models and methodologies based on collaborative work with representatives from the administrative, industrial, educational and technological sectors. To this extent, the event planning strategy involved first bringing together groups of women researchers from Brazil and directing their work towards practical applications within the thematic axes of the event and then connecting with international networks, as was the case with the Women in computer Science and

Activities	Number
Pannels	4
Work in groups	5
Workshops	2
Workshops	6
Oral Work Presentation	39
Poster Presentation	38
Future Actions Plenary	1

Table 1: Summary of activities of the I CIMESTEAM

Source: Education in STEAM- InovaLab project file.

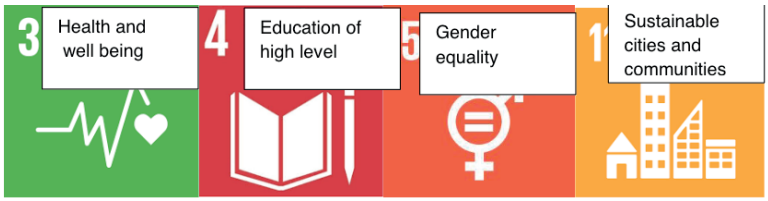

Figure 1: Sustainable Development Goals guiding the congress

Source: ONU

Thematic axis	**Percentage**
Women and the job market	79,6%
New teaching, research and extension methodologies aimed at encouraging girls and women in the STEM area	59,2%
Female leaders in the private sector	57,1%
Violence, violations and gender rights	57,7%

Table 2. Description of topics of greatest interest to the I CIMSTEAM

Source: Authors' archive.

Figure 2 – Innovation and entrepreneurship ecosystem panel

Source: Education in STEAM- InovaLab project file.

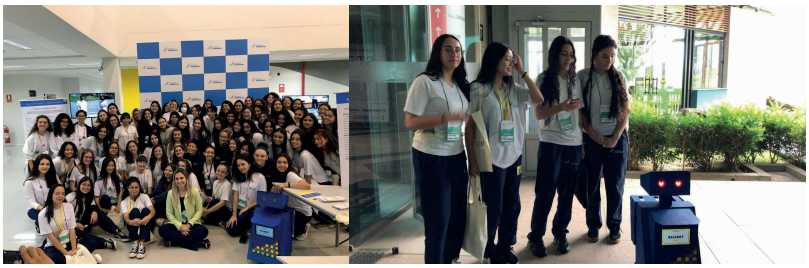

Figure 3 – STEAM Education Workshop

Source: Education in STEAM- InovaLab project file.

engineering Workshop: from bits to gigabytes with the participation of the University of Essex, in the United Kingdom, and with the support of the British Council.

ACTIVITIES CARRIED OUT AT THE 1ST INTERNATIONAL WOMEN IN STEAM CONGRESS

The event established a design in which it identified and incorporated external factors (socio-economic and cultural aspects and resources of the school and the locality) and internal factors (infrastructure, pedagogical project, management tools, teacher training, school trajectory and student interests). Although the family or socioeconomic context contributes to reducing access to opportunities for needy students, they were not prioritized in the debates and activities of the congress.

The panel discussions dealt with work and business opportunities, addressing initiatives and good practices for universal access to goods generated by scientific and technological development in the STEAM areas. In addition, they discussed career training and workforce training to provide the graduate profile with knowledge and skills to meet society's demands for highly qualified professionals in these areas.

A total of 4 workshops were organized, namely: i. STEAM Education Workshop, ii. Workshop Engineering of the future, iii Workshop Women in computer Science and engineering: from bits to gigabytes and iv. Self-knowledge is Empowerment! Measuring and managing emotional intelligence.

The objective of the activities carried out in the workshops was to present innovative solutions that contributed to the improvement of science teaching and learning. These activities were developed in collaboration with school teachers and their managers, introducing new contextualized ways to develop science teaching in these teaching environments. Thus, the use of new educational technologies and new science teaching methods allowed better learning for the participants.

The Education in STEAM workshop was held on both days and was concerned with scientific literacy and the defense and dissemination of science and its methods. The work of high school students from Colégios Alpha Lumen, Embraer, social and assistive technology extension projects produced by undergraduate students from various states were presented, highlighting work from the State of Bahia and Rio de Janeiro.

On the first day of the Education in STEAM workshop, we had the participation of one hundred (100) high school students and students from Colégio Embraer presented works to promote science and robotics.

The Alpha Lumen booth created a technology immersion environment with robot #1860 and other robotics themes. The Girls in Technology project was also presented.

The spaces created stimulated the development of technical and social skills among high school students; and developed communication channels with society to encourage an increase in the number of women in the STEAM areas, disseminating teaching materials, social networks for popularization, dissemination of science produced by participating institutions and, above all, highlighting the areas and training expected of professionals of the future.

The Figures above show examples of the "STEAM in educational environments" strategy, in addition to active learning pedagogical practices "STEAM with replication in schools", where workshops were carried out to highlight how schools can apply technological teaching in a makerspace for female engineers, technologists and professionals prepared for the new digital

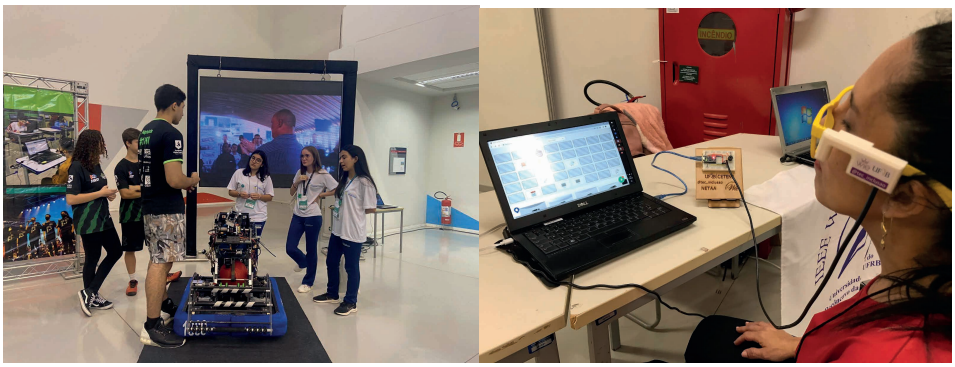

Figure 4 – STEAM Education Workshop

Source: Education in STEAM- InovaLab project file.

Figure 5 – Future Engineering Workshop

Source: Education in STEAM- InovaLab project file.

Works	Total
Participants	701
Universities, institutes and research centers	89
Lecturer	60
Companies	10

Table 3. Summary of participation in the I CIMESTEAM.

Source: STEAM Education project file – InovaLab.

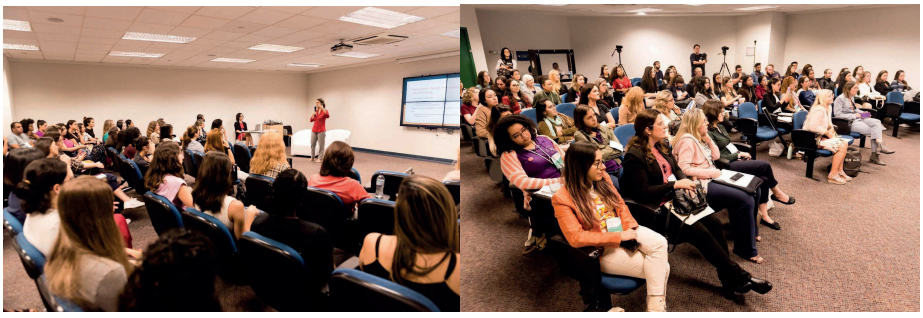

Figure 6 – Workshop Women in computer Science and engineering: from bits to gigabytes

Source: STEAM Education project file – InovaLab

reality. With these spaces, students were able to apply theories and technologies learned in science projects, consolidating knowledge with practice and improving their science and technology skills.

RESULTS AND DISCUSSION ABOUT THE 1ST INTERNATIONAL WOMEN IN STEAM CONGRESS

The organizing committee sought to engage the target audience on social media, with the production of digital content, surveying issues related to the event's interests with the aim of greater integration of the Brazilian Women in STEAM Network. The aim was to define communication strategies, at a national and regional level, in addition to producing lives, workshops and online events, open to all audiences, broadcast on the YouTube channel of partner channels.

The congress had a considerable number of participants. In order to highlight the scope of the activities, Table 3 shows the number of participants from different regions of the country, which allows us to see a significant scope that the congress activities had, which implies stating that this format has proven to be relevant for face-to-face activities. Table 3 presents a summary of participation in the congress.

The panels, round tables, workshops together with technical sessions and poster sessions debated the importance of science for the formulation, execution, monitoring and evaluation of public policies for the S&T area.

The text production group took care, in itself, of the organization of oral scientific works and posters, in addition to supporting the press office with notes to be published in other academic events and other international and national means of dissemination, contributing to the actions of the event were disseminated in different areas of knowledge and regions.

Organized by professors from the Technological Institute of Aeronautics (ITA), researchers from RBMC and PqTec, the event was sponsored by companies (Embraer-X, Embraer, Dassault Systèmes and Flex), and institutional support from several organizations (MIT Brazil, Porto Digital, CNPEM, Inova Unicamp, CETENE, ABES, ANPEI, RME, Plug and Play Brazil) and educational institutions (Alpha Lumen, Instituto Embraer, Unicamp, UFPA, UnB, UFSCar, UNESP; IFSP, USP, UFBA, UFRGS among others).

The impact of the event was very positive with wide publicity in different regions of the country such as the FAPESP website, the website of the Union of Engineers in the State of Paraná (Senge-PR), the website of the postgraduate program in Industrial Engineering at ``Universidade Federal da Bahia`` - PEI UFBA, Portal Trânsito Aberto, newspaper O Vale, newspaper Dia a Dia, publicity on the SP Rio+ portal, interview broadcast on the SP Rio portal, CBN and open regional radio and TV channels, among others.

FINAL CONSIDERATIONS

Based on a general overview of the specific and interdependent actions of the subgroups organized within the scope of the I CIMESTEAM, this work aimed to present the main challenges experienced by the event's organizing committee. The choice of presenting the congress as a case study was due, above all, to the participation of a large number of extension networks integrated in actions that affect, to a greater extent, companies, secondary education institutions and higher education institutions involved in the congress, as organizers or participants.

As evidenced, the various activities at the congress aimed to develop practical activities, through workshops and

workshops, in order to foster the interest and curiosity of young girls in these areas. The workshops and workshops took place through the development of four face-to-face methodological strategies, namely, "STEAM and female leaders", which consisted of receiving speakers with recognized careers in the areas of the event; "STEAM in educational environments", aimed at immersing scientific and practical experiences for people who visited the congress spaces at PqTec in São José dos Campos; "STEAM and dissemination of sciences", with presentation of extension activities related to the congress themes in order to implement workshop activities and enable their subsequent replication by the teaching staff of the educational institution; and "STEAM and public policies" with debates on the importance of science for the formulation, execution, monitoring and evaluation of public policies for the S&T area.

The São José dos Campos Technological Park (PqTec) was the ideal place to hold the event, which was not only academic, but also focused on technological innovation in companies. Furthermore, the large concentration of people in urban environments, coupled with environmental, economic and social issues, has brought to light the need to compose an agenda focused on the implementation of sustainability policies, with the aim of making cities and human settlements inclusive, safe, resilient and sustainable, being one of the great challenges of the United Nations 2030 Agenda for Sustainable Development.

At the event it was possible to share experiences, create a relationship network between projects and initiatives, learn about ongoing programs, analyze the current panorama of Women in STEAM, expanding connections and integration between groups, in order to strengthen regional cooperation, national and international so that it is possible to formulate, implement, evaluate and propose ST&I guidelines and policies for the areas.

Finally, it can be stated that a considerable part of the activities designed by the I CIMESTEAM organizing committee were possible to be carried out, even amid the challenge of connecting academia, government and industry. The developments and new activities that can be created have the prospect of becoming permanent as long as there is greater coordination and presence of extension networks, but above all with the resumption of investments in the S&IT area.

THANKS

We would like to thank the members of the Education in STEAM project: civil servants, students and undergraduate and postgraduate students for their contribution to the activities developed, the teachers and researchers associated with InovaLab and the Brazilian Network of Women Scientists. We thank the Instituto Tecnológico de Aeronáutica for the infrastructure and for enabling the implementation of the project. We would especially like to thank the companies and organizations that provided financial support for the I CIMESTEAM, especially ITAEx.

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