https://doi.org/10.1590/198053149301_en

WOMEN IN STEM: A BRAZILIAN STUDY IN THE *DIÁRIO OFICIAL DA UNIÃO*[1]

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Abstract

The United Nations (UN) advocates the inclusion of women in Science, Technology, Engineering and Mathematics (STEM) as a pillar for the fifth Sustainable Development Goal (gender equality). Although women have, on average, reached a higher level of education than men, they still earn less in the labor market. The organization also reports that most women are in non-STEM careers, with traditionally lower pay. This study seeks to analyze Brazilian publications involving women in STEM in the *Diário Oficial da União*, in order to verify whether national and international guidelines are being carried out in the institution of public policies.

WOMEN • STEM • SCIENCES • TECHNOLOGIES

MULHERES NAS STEM: UM ESTUDO BRASILEIRO NO *DIÁRIO OFICIAL DA UNIÃO*

Resumo

A Organização das Nações Unidas (ONU) defende a inclusão de mulheres nas Ciências, Tecnologias, Engenharias e Matemática (STEM) como um pilar para o quinto Objetivo de Desenvolvimento Sustentável (igualdade de gênero). Apesar de as mulheres terem alcançado, na média mundial, uma maior escolaridade que os homens, ainda auferem menor remuneração no mercado de trabalho. A organização relata ainda que a maior parte das mulheres está em carreiras fora das STEM, com remunerações tradicionalmente inferiores. Este estudo busca levantar as publicações brasileiras envolvendo mulheres nas STEM no *Diário Oficial da União*, de forma a verificar se as diretrizes nacionais e internacionais estão sendo levadas a cabo na instituição de políticas públicas.

MULHERES • STEM • CIÊNCIAS • TECNOLOGIAS

1 The English version was provided by the author.

MUJERES EN STEM: UN ESTUDIO EN EL *DIÁRIO OFICIAL DA UNIÃO*

Resumen

La Organización de las Naciones Unidas (ONU) aboga por la inclusión de las mujeres en la Ciencia, la Tecnología, la Ingeniería y las Matemáticas (STEM) como pilar del quinto Objetivo de Desarrollo Sostenible (igualdad de género). Aunque las mujeres lograron, en promedio mundial, una educación superior a la de los hombres, siguen recibiendo salarios más bajos en el mercado laboral. La organización también informa que la mayoría de las mujeres están en carreras fuera de las STEM, con salarios tradicionalmente más bajos. Este estudio busca analisar publicaciones brasileñas que aborden a mujeres en las STEM en el *Diário Oficial da União*, con el fin de verificar se estén llevando a cabo lineamientos nacionales e internacionales en la institución de políticas públicas.

MUJERES • STEM • CIENCIAS • TECNOLOGÍAS

LES FEMMES DANS LES STEM: UNE ÉTUDE BRÉSILIENNE SUR LE *DIÁRIO OFICIAL DA UNIÃO*

Resumé

L'égalité de genre étant l'un des piliers du cinquième Objectif du Développement Durable, l'Organisation des Nations Unies (ONU) recommande l'inclusion des femmes dans les domaines des Sciences, des Technologies, de l'Ingénierie et des Mathématiques (STEM). Bien que les femmes aient atteint un niveau d'instruction plus élevé que celui des hommes dans la moyenne mondiale, leur rémunération sur le marché du travail reste inférieure. L'organisation signale en effet que la plupart des femmes suivent des carrières dont les salaires sont traditionnellement plus bas et en dehors du champ des STEM. Cette étude vise à examiner les publications brésiliennes, rélatives aux femmes dans les STEM répertoriées dans le *Diário Oficial da União*, afin de vérifier si les directives nationales et internationales sont appliquées dans la mise en place de politiques publiques.

FEMMES • STEM • SCIENCES • TECHNOLOGIES

Received on: JANUARY 31, 2022 | **Approved for publication on:** MARCH 21, 2022

IN GENERAL TERMS, BARROS AND MOURÃO (2020) CONSIDER THAT THE FEMALE PRESENCE was incipient and unwanted in universities until the beginning of the 20th century. Currently, according to the United Nations Educational, Scientific and Cultural Organization (Unesco, 2019), women make up 29.3% of scientists in the world. In Brazil, a total of 42% of *stricto sensu* graduate professors are women (Barros & Mourão, 2020).

In the field of Science, Technology, Engineering and Mathematics (STEM), there is a minority of women, despite significant efforts in terms of public, private and civil society initiatives to reduce gender inequality (Keune et al., 2019). In Latin America, 45.1% of STEM workers are women (Unesco, 2019), but this is not the case in Brazil. In this country, although 47% of all workers are women, only 24% work in STEM careers (*Fernandes*, 2021).

An example of this minority situation was presented in an interview with the professor of Universidade de São Paulo (USP, located in Brazil) Liedi Bernucci, which is part of the study by Nunes and Wanderer (2021). At USP, when she was a freshman in the engineering course, she heard from a professor that "women should not go into engineering, because what they want is to get married and they end up stealing a man's place" (p. 6). She is currently director of the Escola Politécnica da Universidade de São Paulo (Poli-USP), becoming the institution's first female director in 124 years. Similarly, Barros and Mourão (2020) report that one of the interviewed scientists was discredited by one of her colleagues when she said that she would apply for a full professorship. Similarly, BBC News (2018) reported that women selected to study medicine at nine universities in Tokyo were fraudulently removed from the approved list, due to the belief at the management of those institutions that they would withdraw from the labor market as soon as they were married and had children, thus curbing unnecessarily the development of men in the medicine labor market.

As a way of tackling inequities in income and opportunities, often due to cultural rather than economic issues, the inclusion of women in STEM constitutes one of the pillars for Sustainable Development Goal number 5 (gender equality) of the United Nations (UN). One of the reasons is that, despite the fact that women have reached, on the world average, a higher level of education than men, they still receive lower remuneration in the labor market. According to Unesco (2019), this is due to the fact that most women are in careers outside STEM, with traditionally lower pay. To make matters worse, the same research shows that even when they enter STEM careers, women are paid less than men for the same role.

In terms of theoretical framework, the following section seeks to point out the best national and international practices to promote the inclusion of women in STEM. As an objective, this article seeks to point out the publications on women in STEM existing in the *Diário Oficial da União* (DOU), the main official publication site for Brazilian legislation.

Women in STEM: a hope for equity

Specifically in STEM, women start careers from a "call" (Kemp et al., 2020, p. 169), when they realize that they can contribute to the advancement of science or society using their facility with the hard sciences. Loch et al. (2021) also report that the family environment with access to science fiction and relatives linked to the exact sciences contributes to the choice of courses in the area of engineering.

In addition, there is a common sense that women do not have the aptitude or skills for the hard sciences (mainly in the areas of physics, computer science, engineering and mathematics), as reported by Alfred et al. (2019). This generates the effect of self-fulfilling prophecy, in which teachers do not invest their efforts in teaching exact sciences for girls because they have an opinion

that their efforts would not be rewarded by an improvement in the performance of them (Talsma et al., 2019).

Furthermore, Alfred et al. (2019) report that, specifically in the case of black students, there is institutional discrimination throughout their lives, more disciplinary punishments, lower grades and, consequently, eventual dropouts throughout their academic life. Additionally, there is the recent phenomenon of attacks and cancellations perpetrated through social media against vulnerable groups, such as black women and the LGBTQIA+ community (Lima & Oliveira, 2020). In response to this type of attack, Zaragoza-Cano and Akhmatova (2018) stated in their "Manifiesto por algoritmias hackfeministas":

> . . . we wish to rewrite our own forms of intervention and resistance from a hackfeminist political stance: we want to resist against any infrastructure that allows and reproduces oppression, discrimination and misogyny, through our bodies-territories-algorithms in whatever space we inhabit within the Internet world.

In this sense, Natansohn and Reis (2020) also warn about the lack of diversity of gender, ethnicity and social class in STEM, which makes this field a fruitful space to be occupied by subalternized groups, such as black, indigenous and LGBTQIA+ women. Wilkins-Yel et al. (2022) warn of the hegemonic stereotype of STEM workers, white, heterosexual, upper-class men, which leads women, especially the non-white ones, to face mental health problems throughout their training and in the labor market inside STEM.

Despite this visible and concrete effect on the daily lives of educational institutions in general, a study by the Organization for Economic Co-operation and Development (OECD, 2019) on the Programme for International Student Assessment (Pisa) test found that there are 47 countries with higher overall female than male performance in mathematics, among which those with the greatest performance gap are, in descending order: Brunei, Finland, Iceland, Indonesia, Malaysia, Malta, North Macedonia, Norway, Philippines, Qatar, Saudi Arabia, Thailand and United Arab Emirates (UAE). The Pisa test is administered in 79 countries, encompassing reading, math and science skills, involving 15 years old students.

On average, overall female performance on the Pisa science test was also significantly higher, with the prevalence being observed in 34 countries. The biggest differences in science performance, comparing the two genders, in favor of girls, were in the following countries: Qatar, Jordan, Saudi Arabia and the UAE. Male performance was higher in science only in the following countries: Argentina, China, Colombia, Costa Rica, Mexico and Peru.

Girls can be seen to have the skills needed for STEM careers as the Pisa test is taken at age 15 in all participating countries. However, socialization and labor market restrictions end up discouraging them from continuing to study and work in these careers (Alfred et al., 2019; Loch et al., 2021).

According to Wijayawardena et al. (2017), some of these market restrictions are in the design of the work to be performed, salary determination, distribution of decision-making and supervisory power, physical design of the workplace, as well as in the implicit and explicit rules of the work environment. In terms of study, teachers believe that boys have more curiosity and ability for STEM than girls, which is linked to the self-fulfilling prophecy syndrome mentioned earlier.

In this sense, Kemp et al. (2020) identified, in the UAE, communities of women in STEM that provide support to the few female peers who have chosen these careers. In this community, there were expatriates from countries that are less safe for working women, such as Pakistan. Patterson et al. (2020) also reported that it is common in Arab countries for women to have to emigrate to other countries due to the lack of job positions for STEM women in their countries of origin.

Thus, even though universities are environments that promote gender equality in Arab countries, the local labor market does not absorb this form of qualified worker, generating the female exodus. The authors report that there is legislation prohibiting discrimination and wage differentiation in several Arab countries; but, in practice, they have no effect on female inclusion.

Returning to the UAE, women make up 70% of graduates, 46% in the STEM fields, but there is still an exodus due to exclusion from the labor market. There is legislation mandating female participation in the management boards of public and private organizations, which is consistent with the country's position as the first place in gender equality among the countries of the Gulf Cooperation Council, formed by the countries bordering the Persian Gulf. However, participation does not have a defined minimum percentage, as in most developed countries, such as the OECD components.

In the case of Brazil, Serafim and Amaral (2021) report that women are the majority of professors in postgraduate studies and at the beginning of their teaching career in higher education, especially in the areas of biological sciences, health and humanities. In the opposite side, they are a minority in engineering. Loch et al. (2021) report, on the other hand, that the dropout rate and graduation completion time for women are significantly lower than for men in engineering courses.

However, Grossi et al. (2016) report that they still do not reach in Brazil the majority of senior university management positions or the positions of full professors. In global terms, the Unesco International Institute for Higher Education in Latin America and the Caribbean (Unesco-Iesalc, 2021) points out that only 30% of university researchers are women. This means that there is still a long way to go at the higher education and in university management positions.

Sorority in the academic and high-business environment is consistent with the findings of Dubow and Kaminsky (2019), in which young support networks for women undergoing training in STEM areas, such as academic centers and the like, act in a beneficial way, mainly in contexts of scarcity of female examples representative of vulnerable groups, in an intersectional way. Another form of support presented by the authors is via digital social media, in which users organize themselves into communities of support, advice and professional referrals for inclusion and progression in STEM. In Brazil, the support networks Marialab, Programaria, Girls in Tech, Mulheres na Computação and Think Olga stand out (Lima & Oliveira, 2020).

Supporting women in STEM in cases of belonging to vulnerable groups is fundamental for inclusion, especially in the case of black women, as argued by Alfred et al. (2019). Successful black women in STEM report strong personal sacrifice and high study and workloads to overcome prejudices in the professional and academic environment, using exacerbated demonstration of their superior performance relative to their male and white peers. This strategy of super-demonstration of performance as a way to resolve prejudice is used by several vulnerable groups, such as black, latina, LGBTQIA+, people with disabilities, among others. Part of the successful black women seek to pave the way for their disciples, and another part incurs in the "queen bee" phenomenon (Grangeiro & Esnard, 2021).

Grangeiro and Esnard (2021) point out that "queen bees" occur mainly in organizations where most of the leadership is male, generating experiences of discrimination against female managers in their process of professional advancement. When the professionals reach the management position, they sabotage the process of ascension of their female subordinates so as not to be replaced by them. Another factor that influences the occurrence of this behavior is the sisterhood or not of the managers.

In terms of survival strategies in STEM, women in Sri Lanka use different means: (1) being caregivers; (2) sacrifices for high training and performance; and (3) masculinization and assertiveness (Wijayawardena et al., 2017). Some of the interviewees sought to become the caregivers of their IT team (strategy 1), in order to be less criticized by their peers due to their lack of femininity.

In some cases, as in strategy 2, there are reports of unpaid overtime, with safety risks due to lack of transport on the way home. The interviewees in general are of predominantly urban origin, due to the lack of access to IT in rural regions of the country. In terms of stereotypes, they are the ones who most challenge the culturally established roles in their country, which generates criticism by their co-workers due to their non-femininity or softness. In terms of personal life, they are criticized by their families for not giving enough attention to their children, according to the cultural standards established in the country.

Rigg and Sparrow (1994) demonstrate that the strategy of masculinization, focus on tasks and high performance (strategy 3) has a better professional result than the adaptation to the female gender roles expected in organizations. However, this strategy, according to Bird and Rhoton (2021), provokes criticism from male peers of women in executive positions, due to the need for assertiveness, that is, masculinity, in higher STEM positions. According to Wijayawardena et al. (2017), the respondents who performed worse were those who chose to be passive and have a neutral voice inside their teams (strategy 1).

As a way of supporting women in STEM in Canada, Woodwark et al. (2021) presented women's networks to support entrepreneurship as ways to encourage women's access and permanence in STEM. In this way, female entrepreneurs are supported in terms of training, counseling, therapy and financial support for the development of start-ups. Consequently, they can continue the venture autonomously, or get even more resources from mixed gender networks to support start-up companies. Similarly, Bird & Rhoton (2021) report that women professors from different STEM courses informally constituted a support network apart from their respective collegiate, in order to provide sisterhood to professors who were the only women in their respective courses.

These forms of reception seek to balance the opportunities for access to STEM between genders, in a professional context strongly marked by the belief in superficial meritocracy, which does not consider the differences in access to training opportunities at the beginning of life. Due to the lack of consideration of these differences, the authors report the impostor syndrome as a recurring problem, that is, when students do not consider their position achieved in STEM deserved.

There are also additional factors that influence the permanence of women in STEM: the balance between work and family, flexible working hours and the stereotypes associated with women in their place of residence as adults, and where they had their basic education (Jiang, 2021). The author, through quantitative methods, found that, although there is equity in the grades in exact sciences in basic education and in higher education, women do not remain in STEM not due to differences in proficiency, but due to their life choices. Statistically explaining this phenomenon, Starr (2018) found that women who associate STEM with the male stereotype are less inclined to pursue STEM careers, due to fears of being labeled as masculine, socially inept, or relationally incapable.

Xu (2016), in the same line of reasoning, reported that women from vulnerable groups, low-income families and married, even if they have managed to complete undergraduate courses in STEM areas, do not continue in graduate schools. Other variables with a negative impact were the low level of education of the parents of college students and the undergraduate student's grades. The author argued that, in this demographic context, women do not have expectations of salary gains by improving their educational profile. The opposite occurs in individuals within the hegemonic pattern of STEM, composed of white men, coming from middle or upper class families, often not being the first of their families to follow in higher education and graduate studies.

In the case of Sri Lanka, a developing country (HDI 0.658), there is a prevailing expectation that IT workers will be men. In the country, a strong misogynistic component of socialization with the bias of "respectable femininity" is common among their ethnicities, which leads women to situations of subservience and supporting roles in organizations (Wijayawardena et al., 2017).

According to the authors, the country invests heavily in IT, due to a national technological anchor project for global reach. The country has also made heavy investments in education and health since its independence from the United Kingdom in 1948.

Another means of advancing in this predominantly male market, according to Keune et al. (2019), are the workshops proposed by the maker culture. In these workshops, users have access to equipment and supplies in order to invent new applications that solve everyday individual and collective problems. According to the authors, this type of environment promotes access to new technologies for vulnerable groups, such as women, LGBTQIA+, black, latina, indigenous, among others, additionally contributing to community development through makers for their communities of origin.

Maker culture has as its greatest Brazilian exponent the teacher Débora Garofalo (2019), who promoted robotics workshops using recyclable materials and was nominated for the Global Teacher Prize, being among the ten best educators in the world in 2019. In terms of black feminism, the greatest Brazilian maker expression is PretaLab, which promotes workshops on inclusion and digital appropriation of black women, emphasizing the culture of experimentation (Lima & Oliveira, 2020). In these workshops, robotics, artificial intelligence, electronics content are addressed at the same time as the traditional and analogical knowledge of the communities involved.

Speaking now of the difficulties faced by women in STEM, according to Saxena et al. (2019), women working in STEM experience more incivility in the workplace than others, due to the male hegemonic presence in these professional areas. According to the authors (p. 589), incivility is "the deviant behavior with ambiguous intent to harm the target". One of the forms of incivility is hostility, defined as "the active pursuit of worsening the working environment for women in STEM" (p. 590). Both forms of aggression are carried out by colleagues, clients and superiors, leading, in the long term, to resignations, absenteeism and burnout syndrome.

Another form of aggression is social exclusion, when social events outside work are organized in such a way as to exclude women, implying lower chances of inclusion in projects and professional progression. In these cases, the idea of a prototypical threat may still be present, when members of the hegemonic group organize themselves collectively to repel the threat of a newly arrived individual or group.

According to Saxena et al. (2019), an explicit zero-tolerance rule in organizations is necessary, so that employees understand what constitutes acceptable behavior or not. As an example, training and dismissal for just cause can be promoted as a way of civilizing behavior within organizations. Another beneficial policy is the promotion of institutional social support for women in STEM, as a way of actively combating the effects of exclusive events organized by men.

Rodrigues and Guimarães (2016) also list as beneficial actions for women within organizations: flexible working hours, maternity leave for researchers and day care centers to support mothers with young children. For instance, they report that, in Sweden and Denmark, there are spaces for scientists' children in congresses and organizations.

In accordance with Russell (2017), support for women can also take place on an individual level, in the form of academic mentorships or in the workplace. This avoids the queen bee phenomenon, in which women who have reached managerial positions avoid the advancement of others for fear of losing their own positions. In the specific case reported by Russell, the Massachusetts Institute of Technology (MIT) encourages the inclusion of women and vulnerable groups in STEM mainly through mentoring guided by women and representatives of vulnerable groups.

Another example is the three-month Leadership Lab training course created at the Weatherhead School of Management (Case Western Reserve University, Cleveland, Ohio, United States) (Van Oosten et al., 2017). In this course, there are mentorships in STEM, so that aspirants

can look up to and be inspired by someone for their professional progression. In addition, there is training in terms of knowledge, skills and connections, so that participants can catalyze gender-positive change in their respective organizations, as well as balance professional and personal lives.

It was observed in the theoretical framework on women in STEM that STEM-positive practices are based on intersectional strategies of inclusion and maintenance of women in the areas, considering their diversity of gender and ethnicity. In the following section, the procedures for the search inside the *Diário Oficial da União* will be outlined, considering the subject in question.

Methodology

In the case of Brazil, federal legislation that addresses the inclusion of citizens in general in STEM is scarce, and, in the case of the inclusion of women in the areas, extremely rare. Two searches were carried out in December 2021 in the domain "in.gov.br" using the Google search portal. The keywords used were: (1) "*mulheres STEM*" (meaning "women STEM" in Portuguese), and (2) "*mulheres tecnologias*" (meaning "*women technologies*", in Portuguese). For the first search, 5 results were found. For the second, 94,500 results were found.

In the second search, as a way of limiting and specifying the search to encompass only the scope of this article (women in STEM), only publications available on the Google portal were included, making a total of 218 publications. Publications appear in descending order of relevance, according to the frequency of keywords and the number of accesses to each document. Additionally, the documents relating to nomination, transference and the like in terms of personnel were not analyzed.

The legislation related to the following areas was also not analyzed, as they do not contain specific content related to the scope of this article: health and women in a situation of deprivation of liberty and egresses from the prison system, information security, law of bidding and administrative contracts, Covid-19, Brazilian Space Program and Ministério da Defesa [Ministry of Defense].

Analysis of the *Diário Oficial da União*

The search results were listed in chronological order in Table 1, as follows.

Table 1
Brazilian legislation for inclusion in STEM

Legislation	General content	Specific content: women + (STEM or technologies)
Portaria MWREHR/GM n. 58, de 1º de fevereiro de 2016 [Ordinance /GM No. 58, February 1, 2016]	Establishes the Information Technology Committee – ITC within the scope of the Ministry of Women, Racial Equality and Human Rights – MWREHR.	Art. 2 – It is incumbent upon the Information Technology Committee: I – deliberate and approve IT strategies, policies, guidelines and plans; II – to deliberate, approve and monitor the execution of the Information Technology Master Plan – ITMP and its revisions; III – establish and monitor the Investment Plan for the IT area, including hardware and software acquisitions; IV – prioritize ITMP's portfolios, projects and actions; V – promote the integration of IT strategies with the strategic instruments of the Ministry. Art. 3 – The ITC will be composed by the following members: . . . III – Representative of the Secretariat of Policy for Women.
Portaria MDH/SE n. 397, de 3 de setembro de 2018 [Ordinance MHR/SE No. 397, September 3, 2018]	Provides for the inclusion of the National Secretariat for Policies for Women among the organizational units of the Information and Communication Technology Governance Committee – ICTGC.	Art. 1 – The annex of Ordinance MHR No. 33, March 13, 2017, amended by Ordinance MHR No. 152, May 23, 2018, becomes effective with the following wording: . . . IV – a representative of the National Secretariat of Policies for Women and . . . VIII – the Director of Information Technology.

(To be continued)

(Continuation)

Legislation	General content	Specific content: women + (STEM or technologies)
Decreto n. 9.673, de 2 de janeiro de 2019 [Decree No. 9,673, January 2, 2019]	Approves the Regimental Structure and the Demonstration Chart of Positions in Commission and Trusted Functions of the Ministry of Women, Family and Human Rights, relocates positions in commission, Commissioned Functions of the Executive and Remunerated Functions, transforms positions into group commission – Superior Management and Advice – SMA and replaces commissioned positions in the Group – Superior Management and Advice – SMA by Commissioned Functions of the Executive Career – CFEC.	Art. 18. The Board of Social Challenges in the Family Area is responsible for: I – promote and coordinate actions aimed at combating violence in families, abandonment, pedophilia and pornography and II – promote and coordinate actions to combat addictions and negative impacts of the immoderate use of new technologies . . . . Art. 30. The National Secretariat for the Rights of Persons with Disabilities is responsible for: . . . XV – to encourage the development and production of assistive technologies.
Portaria MMFDH n. 21, de 11 de fevereiro de 2019 [Ordinance MWFHR No. 21, February 11, 2019]	Establishes the Information and Communication Technology Governance Committee of the Ministry of Women, Family and Human Rights – ICTGC/MWFHR	Art. 2 The ICTGC/MWFHD aims to deliberate on the planning, budgeting, investments, prioritization and risk management of the entire Information and Communication Technology Policy of the Ministry of Women, Family and Human Rights – MWFHR, in addition to promoting internally implementation of the Digital Governance Policy. Art. 3 It is incumbent upon the ICTGC/MWFHR: I – to deliberate on the strategies, policies, norms and plans of Information and Communication Technology – ICT; II – propose, execute, formulate, implement, monitor and evaluate the ICT strategies of the MWFHR policies, norms and plans, through an integrated plan of actions, materialized in the Information and Communication Technology Master Plan – ICTMP, considering the Institutional Strategic Planning and the policies and guidelines of the Federal Government; III – establish prioritization criteria for the formulation and execution of actions, projects and contracting of ICT solutions and IV – establish parameters for the performance of the Information and Communication Security Management Committee.
Portaria MCTIC/GM n. 3.459, de 26 de julho de 2019 [Ordinance MSTIC No. 3,459, July 26, 2019]	Establishes the Brazilian Nanotechnology Initiative – BNI, as the main strategic program to encourage nanotechnology in the country.	Art. 2 The BNI aims to: . . . III – encourage the joint development of new technologies and the transfer of knowledge and technologies, associated with nanotechnology, from academia to the public and private sectors, with a view to generating wealth, employment and national growth; . . . Art. 10. The BNI will be periodically evaluated and revised based on the performance indicators chosen in the Science, Technology and Innovation Action Plan for Converging and Enabling Technologies 2018-2022.
Decreto presidencial n. 10.094, de 6 de novembro de 2019 [Presidential decree No. 10,094, November 6, 2019]	Provides for the Interministerial Committee on Assistive Technology.	Art. 4 The Assistive Technology Interministerial Committee is composed of representatives of the following bodies: . . . V – Ministry of Women, Family and Human Rights.
Decreto n. 10.160, de 9 de dezembro de 2019 [Decree No. 10,160, December 9, 2019]	Establishes the National Open Government Policy and the Open Government Interministerial Committee.	Art. 1 The National Open Government Policy is established, within the scope of the federal Executive Power, which will be operationalized through action plans consisting of initiatives, actions, projects, programs and public policies that increase transparency, access to information, improvement in delivery of public services and the strengthening of integrity. Art. 2 The guidelines of the National Open Government Policy are: . . . III – encouraging the use of new technologies that foster innovation, strengthening public governance and increasing transparency and social participation in the management and provision of public and IV – increase in transparency processes, access to information and the use of technologies that subsidize these processes. Art. 5 The Open Government Interministerial Committee will be composed of representatives of the following bodies: . . . XII – Ministry of Women, Family and Human Rights.

(To be continued)

(Continuation)

Legislation	General content	Specific content: women + (STEM or technologies)
Decreto n. 10.174, de 13 de dezembro de 2019 (revogado pelo Decreto n. 10.883, de 2021) [Decree No. 10,174, December 13, 2019 (revoked by Decree No. 10,883, 2021)]	Approves the Regimental Structure and the Demonstration Chart of Positions in Commission and Trusted Functions of the Ministry of Women, Family and Human Rights, relocates positions in commission and trust functions and transforms positions in the Group's commission – Superior Management and Advice – SMA and Commissioned Functions of the Executive Career – CFEC.	Art. 20. The Department of Social Challenges in the Family Area is responsible for: . . . I – promote and coordinate actions aimed at combating violence in families, abandonment, pedophilia and pornography and II – promote and coordinate actions to combat addictions and negative impacts of the immoderate use of new technologies. . . . Art. 33. The National Secretariat for the Rights of Persons with Disabilities is responsible for: . . . XV – promote the development and production of assistive technologies. The Decree No. 10,883/2021, which replaces Decree No. 10,174/2019, does not have relevant content for the inclusion of women in STEM.
Portaria MMFDH/GM n. 3.136, de 26 de dezembro de 2019 [Ordinance MWFHR/GM No. 3,136, December 26, 2019]	Approves the Internal Regulations of the Ministry of Women, Family and Human Rights.	Art. 146. The Department of Social Challenges in the Family Area – DSCFA – is responsible for: . . . II – promote and coordinate actions to combat addictions and negative impacts of the immoderate use of new technologies. Art. 149. The General Coordination for Combating Addictions and Negative Impacts of the Immoderate Use of New Technologies – GCNT is responsible for: I - assist the National Secretary in matters relating to vices and negative impacts of the immoderate use of new technologies; II - formulate, implement, monitor and evaluate public policies related to the vices and negative impacts of the immoderate use of new technologies; . . . V – propose, coordinate and articulate transversal, inter-institutional, inter-federal actions and with civil society organizations on the issues of vices and negative impacts of the immoderate use of new technologies; . . . Art. 150. It is incumbent upon the Coordination to Combat Addictions and Negative Impacts of the Immoderate Use of New Technologies – CCTEC: I – support the holder of the General Coordination for Combating Addictions and Negative Impacts of the Immoderate Use of New Technologies – GCNT in the execution of their attributions.
Portaria MMFDH/SE n. 137, de 4 de março de 2020 [Ordinance MWFHR/SE No. 137, March 4, 2020]	Makes public the Information and Communication Technology Master Plan of the Ministry of Women, Family and Human Rights – ICTMP/MWFHR.	Art. 1 To make public the Master Plan for Information and Communication Technology of the Ministry of Women, Family and Human Rights – ICTMP/MWFHR for the biennium 2020-2021. Art. 2 The document is available on the portal www.mdh.gov.br
Edital MCTIC/Finep. Seleção Finep Startup. Programa de investimento em startups inovadoras. 11 de março de 2020 [MSTIC/SPFI Notice. SPFI Startup Selection. Innovative start-up investment program. March 11, 2020]	Public support to encourage start-ups led by women, in order to contribute to the increase of female representation in the national entrepreneurial scene.	The Study and Projects Financing Institution – SPFI makes public the launch of the first call for Innovative Women Award – Innovative Women Program, the result of a technical cooperation agreement signed between the Ministry of Science, Technology, Innovations and Telecommunications (MSTIT), the Study and Projects Financing Institution (SPFI) and the city hall of the city of São Paulo, aiming at public support to stimulate startups led by women, in order to contribute to the increase of female representation in the national entrepreneurial scenario. This action will take place through the training and recognition of entrepreneurs who can favor the increase of Brazilian competitiveness.

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Legislation	General content	Specific content: women + (STEM or technologies)
Portaria MC/SEDS/SNAS n. 86, de 1º de junho de 2020 [Ordinance MC No. 86, June 1, 2020]	Approves general recommendations for the care of women in situations of domestic and family violence in the social assistance network of the Unified Social Assistance System – USAS in the context of the pandemic of the new coronavirus, Covid-19.	5. Guidelines for the performance of teams of the protection service and specialized assistance to families and individuals (PSAFI) for the assistance in CREAS of women in situations of domestic and family violence . . . 5.9. Regarding remote psychosocial care for women in situations of domestic and family violence, it is recommended that professionals: . . . d) Prioritize individual face-to-face care in situations where the aggressor is cohabiting with the woman and the user reports the precariousness of Information and Communication Technologies (ICTs) and/or situations of seriousness and complexity that justify the preferential use of this type of service, through careful professional evaluation; 5.10. If there is demand in the territory and availability of institutional and professional means of communication, CREAS will be able to provide emergency telephone numbers or WhatsApp to which women can call after the closing of the face-to-face service hours, working on duty. (pp. 9-10).
Decreto n. 10.531, de 26 de outubro de 2020 [Decree No. 10,531, October 26, 2020]	Establishes the Federal Development Strategy for Brazil in the period from 2020 to 2031.	1.3.2. Challenge: increase the productivity of the Brazilian economy: . . . improve and intensify investments in education, for the improvement of human capital, especially through the teaching of science, technology, engineering and mathematics – STEM in the Country. (p. 6).
Decreto n. 10.645, de 11 de março de 2021 [Decree No. 10,645, March 11, 2021]	Regulates art. 75 of Lei n. 13.146, de 6 de julho de 2015 [Law No. 13,146, July 6, 2015], to provide for the guidelines, objectives and axes of the National Plan for Assistive Technology.	Art. 2 For the purposes of this Decree, it is considered: I – assistive technology or technical assistance – products, equipment, devices, resources, methodologies, strategies, practices and services that aim to promote functionality, related to the activity and participation of people with disabilities or mobility reduced, with a view to their autonomy, independence, quality of life and social inclusion; . . . Art. 8 The implementation and monitoring of the National Assistive Technology Plan will be carried out by the following federal government agencies: . . . V – Ministry of Women, Family and Human Rights.
Portaria GM/MCTI n. 4.617, de 6 de abril de 2021 [Ordinance GM/MSTI No. 4,617, April 6, 2021]	Establishes the Brazilian Artificial Intelligence Strategy and its thematic axes.	Strategic Actions: . . . - Create mechanisms to broaden the interest of Brazilians in STEM subjects (mathematics, science, technology and engineering) at school age, with a special focus on gender and race inclusion programs in these areas. (p. 17).
Resolução n. 205, de 17 de maio de 2021 [Resolution No. 205, May 17, 2021]	Approves the Internal Regulations of the Assistive Technology Interministerial Committee, established by means of Decreto n. 10.094, de 6 de novembro de 2019 [Decree No. 10,094, November 6, 2019].	Art. 1 The Interministerial Committee on Assistive Technology, established by Decree No. 10,094, November 6, 2019, is a body intended to advise on the structuring, formulation, articulation, implementation and monitoring of the assistive technology plan, with a view to guarantee people with disabilities and rare diseases access to products, resources, strategies, practices, processes and services that maximize their autonomy, personal mobility and quality of life. . . . Art. 3 The Interministerial Committee on Assistive Technology is composed of representatives of the following bodies: . . . II – a representative of the Ministry of Women, Family and Human Rights. . . . § 4 In the absence or impediment of the representative, titular and alternate, of the Ministry of Science, Technology and Innovations, the Coordination will be exercised by the representative of the Ministry of Women, Family and Human Rights.
Portaria MMFDH/GM n. 1.980 de 24 de junho de 2021 [Ordinance MWFHR/GM No. 1,980, June 24, 2021]	Establishes the Personal Data Protection Management Committee at the Ministry of Women, Family and Human Rights.	Art. 2 The Personal Data Protection Management Committee is a consultative, advisory, study and articulation body of the Ministry of Women, Family and Human Rights, aimed at formulating proposals on: I – the evaluation of data processing and protection mechanisms existing personnel.
Portaria MCTI n. 4.979, de 13 de julho de 2021 [Ordinance MSTI No. 4,979, July 13, 2021]	Amends the Annex of Portaria MCTI n. 4.617, de 6 de abril de 2021 [Ordinance MSTI No. 4,617, April 6, 2021], which establishes the Brazilian Strategy for Artificial Intelligence and its thematic axes.	Strategic Actions: . . . – Create mechanisms to broaden the interest of Brazilians in STEM subjects (mathematics, science, technology and engineering) at school age, with a special focus on gender and race inclusion programs in these areas.

(To be continued)

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Legislation	General content	Specific content: women + (STEM or technologies)
Resolução MCTI/CI n. 1, de 23 de julho de 2021 [Resolution MSTI/CI No. 1, July 23, 2021]	Approves the National Innovation Strategy and Action Plans for the Development Axes, Technological Base, Culture of Innovation, Market for Innovative Products and Services and Educational Systems.	Axis C488: Strengthen and articulate national programs to encourage the creation, development and validation of ideas with innovation potential. Title: 7857 – Promote the 2nd edition of the Innovative Women program Description: The Innovative Women Program is an initiative by Finep and the Ministry of Science, Technology and Innovation (MSTI) to encourage start-ups led by women, in order to contribute to the increase of female representation in the national entrepreneurial scenario, through training and recognition of enterprises that may favor the increase of Brazilian competitiveness. Target Audience: Start-ups led by women Start Date: 12/17/2020 End Date: 12/31/2022 Budget 2021/2022 (R$): 1,000,000.00 Main source of funds: Public development bank Responsible Body: Ministry of Science, Technology and Innovations and SPFI . . . Action: Promote the call "Girls in Exact Sciences, Engineering and Computing". Description: The Program aims to encourage the training of women for careers in exact sciences, engineering and computing in Brazil. This initiative also aims to combat the dropout of female students from undergraduate courses in these areas, as well as bringing public schools closer to Basic Education and Higher Education Institutions. Target Audience: Basic Education Students (Elementary School from the 6th year and High School) linked to public and private schools; Undergraduate students of engineering, exact sciences and computing courses; IHE professors and ICT researchers, linked to a Department, Faculty or Institute responsible for undergraduate courses in exact sciences, engineering and computing, and ICT researchers; Teachers of Basic Education from public or private schools in the areas of exact sciences, mathematics, computing, robotics. Start Date: 01/02/2018 End Date: 06/30/2022 Budget 2021/2022 (R$): 9,000,000.00 Main source of funds: Agency budget Responsible Body: NCSTD – National Council for Scientific and Technological Development. (p. 28).
Portaria ME/GM n. 683, de 27 de agosto de 2021 [Ordinance ME/GM No. 683, August 27, 2021]	Amends the Annex of ME Ordinance No. 784, September 30, 2020, which publishes a complete list of normative acts below the decree in force within the scope of the Ministry of Education.	ME Ordinance No. 1,015, July 21, 2011 – Establishes the Thousand Women National Program that aims at professional and technological training articulated with an increase in schooling for women in situations of social vulnerability. . . . Ordinance No. 4, January 23, 2012 – Establishes the National Committee and the National Executive Committee of the National Thousand Women Program.

Source: Author's elaboration with research data.

It can be seen that there is only concern about the inclusion of women in STEM by the Ministério da Ciência, Tecnologia e Inovações [Ministry of Science, Technology and Innovation] (MCTI), among other publications from MCTI focused on generalized social inclusion in STEM, without a focus on women.

There are no ordinances to that effect by the Ministério da Mulher, Família e Direitos Humanos [Ministry of Women, Family and Human Rights] (MMFDH), in charge of promoting women's rights in the national territory. On the other hand, it is possible to observe, in Table 1, the existence of several ordinances that aim to protect women against pornography and the immoderate use of the internet. According to Rivera and Rojas (2021), the best way to protect women and vulnerable people from inappropriate use of the internet is precisely technological education, promoting the appropriation of technologies by these social groups. This contradicts what is recommended in the publications of MMFDH, which are biased in order to frighten women, blocking their access to these technologies.

Another important observation is the scarcity of concrete actions in the DOU implementing actions for women's inclusion in STEM, with a budget forecast, schedule and specific personnel. It can be seen, in the previous table, that the rare exceptions come from the MCTI.

In the case of the MMFDH, the Information and Communication Technology Governance Committee was created in 2019. However, its scope of action is mainly related to the safety of women in the digital environment and with the digital public governance of information about women. This type of action is contrary to what is recommended by the UN (2021), in relation to Sustainable Development Goal number 5, gender equality, associated with the 2030 Agenda for Sustainable Development. According to the entity, one of the actions to promote gender equality is the inclusion of women in STEM, as these are areas that generate greater individual remuneration and infrastructure for the economic development of countries.

Final considerations

Throughout this article, we sought to report the best national and international practices for the inclusion of women in STEM, in order to verify if they occurred to some degree in national public policies made official in the *Diário Oficial da União*. As verified in the results of this article, there are rare public policies for the inclusion of women in STEM at the federal level in Brazil.

This scenario generates a forecast of low development in the coming years in Brazil, as the inclusion of everyone in STEM, especially women, a traditionally excluded group, generates economic and social development at the national level. According to Lee (2010), the democratization of education, with the consequent inclusion of women in STEM, was a preponderant vector for the development of South Korea from the 1960s onwards. In Brazil, the gender pay gap between genders in the formal market is 35% (Yahmed, 2018), which reveals the potential for GDP growth if wages were the same for the same functions.

As a limitation of this study, agents for the inclusion of women in STEM were not interviewed, due to the scope of the article. Alternatively, we sought to include as many publications from the *Diário Oficial da União* as possible, in order to fill this gap.

In terms of the research agenda, public policies for the inclusion of women in STEM can be found in similar official publications in Latin America and around the world. Another aspect can be the reporting of best practices in this regard by international organizations, such as UN, Unesco, United Nations Children's International Emergency Fund (Unicef), World Bank, OECD, among others.

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gratificadas, transforma cargos em comissão do grupo-direção e assessoramento superiores – das e substitui cargos em comissão do grupo-direção e assessoramento superiores – das por funções comissionadas do poder executivo – FCPE. Presidência da República.

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Data availability statement

The data underlying the research text are reported in the article.

How to cite this article

Iwamoto, H. M. (2022). Women in STEM: A Brazilian study in the *Diário Oficial da União*. *Cadernos de Pesquisa*, *52*, Article e09301. https://doi.org/10.1590/198053149301_en