The Brazilian professional, scientific, and technological education system as an instrument for promoting gender equality in computing

Sara Luiz de Farias[1], Maria Isabela Silva Nunes[2], Natália do Carmo Louzada[1], Thalia Santos de Santana[1], Ramayane Bonacin Braga[1] and Adriano Honorato Braga[1]

[1] *Instituto Federal Goiano - Campus Ceres, GO-154, Km 218 - Zona Rural, Ceres, Goiás, Brazil*
[2] *Universidade Tecnológica Federal do Paraná - Campus Pato Branco, Via do Conhecimento, s/n - Km 01 - Fraron, Pato Branco, Paraná, Brazil*

Abstract

The field of computing faces a persistent and significant challenge regarding women's representation. Despite technological and social advances, the female presence in this field remains substantially low. This study explores the *Meninas Digitais* (Digital Girls) program, which aims to stimulate young women to pursue a technology-related career, focusing on projects related to the program – referred to as "sister projects" – and developed within the Brazilian national professional, scientific, and technological education system (national EPT system). The research identifies how these projects have worked on the comprehensive training of students, especially at the high school level, assessing their impact on reducing gender inequality in computing and highlighting the performance of the project *Meninas Digitais no Cerrado*. In addition, the study offers a quantitative overview of sister projects within the national system, categorized by the project location, year of creation, and similarity of objectives, aiming to assess the impact of institutions such as the Brazilian Federal Institutes of Education on the entry and permanence of girls in tech careers.

Keywords [1]

gender diversity, technical education, digitais girl program

1. Introduction

The gender gap in computing has been studied and discussed in various contexts [9][25]. The lack of female representation in technology-related careers is a global issue, impacting industry progress, innovation, and equity in society, particularly in academic and professional realms. In Brazil, research conducted by Santos et al. [25] highlighted that women attribute this underrepresentation to a hostile environment and a lack of interest, exacerbated by cultural factors that directly influence their career choices. One of the key findings is that young women in high school are often encouraged to pursue other fields of knowledge, such as humanities, due to the prevailing societal perception that computing is a male-dominated profession. Therefore, understanding the strategies designed to promote STEM

Proceedings XV Congress of Latin American Women in Computing 2023, October 16–20, 2023, La Paz, Bolivia
EMAIL: sara.luiz@estudante.ifgoiano.edu.br (S. L. de Farias); mariaisabela@alunos.utfpr.edu.br (M. I. S. Nunes); natalia.louzada@ifgoiano.edu.br (N. C. Louzada); thaliassantana15@gmail.com (T. S. de Santana); ramayane.santos@ifgoiano.edu.br (R. B. Braga); adriano.braga@ifgoiano.edu.br (A. H. Braga).
ORCID: 0009-0007-8821-196X (S. L. de Farias); 0009-0009-6673-4684 (M. I. S. Nunes); 0000-0002-6138-0495 (N. C. Louzada); 0000-0003-1899-4819 (T. S. de Santana); 0000-0002-2543-4011 (Ramayane B. Braga); 0000-0002-1729-4039 (Adriano H. Braga).

careers at the high school level can be a crucial approach to increasing the participation of women in computing and, consequently, fostering greater gender diversity in tech careers.

The Brazilian *Rede Federal de Educação Profissional, Científica e Tecnológica* [2], or the national professional, scientific, and technological education system (referred to as the "national EPT system" in this article), aims to provide public and tuition-free professional and technological education for all. This system offers technical education together with preparatory school from high school to graduate level. However, as observed in the Brazilian regular education system, the national EPT system is marked by gender inequality, particularly in STEM careers, where gender stereotypes significantly influence students' career choices [12].

Some historical reflections are worth highlighting when discussing the issue of EPT in Brazil. These reflections encompass the discrepancies between the provision of technical education on one hand and vocational education on the other. It is a discussion about technical education provided to the working class and the humanistic/scientific training developed for the nation's elites. While the number of women engaged in EPT has increased, the specific contributions of this education to reducing gender inequalities in the field of computing, both in the academic and professional domains, remain largely unknown.

In this sense, this work aims to contribute to these reflections by analyzing projects, commonly referred to as "sister projects," associated with the *Meninas Digitais* or Digital Girls Program (PMD) [20], which is a part of the national EPT system. The unique aspect of this study is mapping PMD's sister projects within the national EPT system while discussing the system's significance in promoting comprehensive education with a focus on gender issues.

This article is structured into six sections, starting with this introduction. The following section delves into the history of EPT in Brazil, followed by a third section that presents gender issues within EPT, with a specific focus on the computing field. The fourth section examines the *Meninas Digitais no Cerrado* project in the context of technical education and preparatory school. The subsequent section discusses and provides quantitative data regarding the PMD's sister projects, which are related to the national EPT system. Finally, the last section presents concluding remarks and outlines directions for future research.

2. A brief history of EPT in Brazil

Brazilian professional education has had a dual character since its inception, which can be understood by examining the history of education in the country. Professional education, often with an instrumental function, was primarily targeted at the low-income population, while the elites received basic education with a preparatory nature [16].

The history of professional and technical education (EPT) in Brazil predates the emergence of the national EPT system. The first institutions dedicated to professional training were the *Liceus de Artes e Ofícios* (Schools of Arts and Occupations), established during the second half of the nineteenth century. Their primary goal was to "support and prepare poor, orphaned, and disadvantaged children for work" [27]. Subsequently, on September 23, 1909, President Nilo Peçanha issued Decree 7566, creating the *Escolas de Aprendizes e Artífices* (Schools for Apprentices and Craftsmen) [5]. These schools were under the purview of the Ministry of Agriculture, Industry, and Commerce and coordinated by the Technical Professional Education Inspector's Office. Nineteen such institutions were established in state capitals across the country, with a focus on providing professional education tailored to the needs of emerging agriculture and industry. They primarily catered to young individuals labeled as 'underprivileged,' typically between 10 and 13 years old [16][27].

The Schools of Apprentices and Craftsmen represented the government's response to the demand of national elites for a prepared workforce. The initiative was an attempt to facilitate the employment of a massive contingent of free workers approximately 21 years after the end of the slavery regime in Brazil [18]. The early development of Brazilian professional education was marred by negative and discriminatory representations associated with manual work. Similarly, the limited number of public secondary schools during the so-called "First Republic" era resulted in the commodification of this level

of education, often restricting access for women and excluding Black, Indigenous, and low-income populations from preparatory schools at the high school level [27]

During the presidencies of Getúlio Vargas in the 1930s and 1940s, Brazil experienced substantial political and economic transformations linked to urbanization and industrialization. In this context, there was a notable expansion of schools dedicated to technical education nationwide aimed at addressing the needs of the growing industrial sector. These changes were influenced by the rise of liberal economic ideology within Brazilian society [10].

In the same period, in 1930, Brazil established its first Ministry of Education, which was initially affiliated with the Ministry of Health. Subsequently, in 1934, the Technical Professional Education Inspector's Office underwent a name change and became the Superintendency of Professional Education. According to the 1937 Federal Constitution, this superintendency was entrusted with the education of the "less favored classes," a responsibility considered the state's primary duty [18].

During the Estado Novo period (1937-1945), Gustavo Capanema, who served as the Minister of Education and Health, introduced the Organic Laws of Teaching. These laws established a framework for industrial education and led to the creation of the National Industrial Learning Service (SENAI). They also guided reforms in professional training for commerce and restructured secondary education into two cycles: a four-year junior high cycle and a three-year high school cycle. This comprehensive set of laws, enacted between 1942 and 1946, is commonly referred to as the Reforma Capanema. It divided high school education into three branches: preparatory school and technical and regular education, with admission exams determining access to each branch [14].

From 1946 to 1961, technical education offered restricted access to university, limited to industrial and engineering programs. Regular education led to undergraduate programs offered by the Faculties of Philosophy, Sciences, and Language. Preparatory schools aimed to form "the country's leaders," offering an education that encompassed literature, science, and philosophy, as well as preparing students for their responsibility within society and the nation" [14].

The preparatory school enabled mobility between the other branches and ensured access to all higher education programs. As a result, these laws established a hierarchy among various types of secondary education, designating distinct paths for students from different social groups [14]. Consequently, even though legislation during this period marked the creation of Agricultural Education, the National Commercial Learning Service (SENAC), and the establishment of the Federal Technical Schools in 1959, education within preparatory schools remained predominantly limited to the country's economic elite.

Over time, the Organic Education Laws underwent a series of progressive modifications through a succession of decree-laws and ordinances. These changes aimed to address the conflicts arising from the expansion of both public and private secondary institutions. In 1961, the Brazilian Education Guidelines and Bases Law (LDB) was enacted, guided by the paradigm of providing public education to all citizens to establish "a common culture among all social classes" [14].

The Civil-Military Dictatorship (1964-1985) introduced a new education reform in 1971. Basic education was divided into primary and middle or secondary levels. The reform abolished admission exams, opening up access to secondary education for a previously excluded population. However, secondary education became vocational, creating a distinction between social groups enrolled in public schools and those who could afford private education. This division allowed for better conditions to access higher education but "maintained the lack of equity between students in terms of the cultural assets that the school could offer and the future paths they could choose" [14].

Significant changes in the Brazilian education system occurred in the 1990s, driven by efforts to reopen the political landscape after the dictatorship and democratize the provision of quality public education. The new LDB established in 1996 rejected the idea of compulsory vocational schools and the paradigm of technical education aimed at the working class [14]. This legislation dedicated a specific chapter to EPT, emphasizing the need to integrate technical and secondary education.

One of the key milestones in the consolidation of professional education in Brazil was the establishment of the *Rede Federal de Educação Profissional, Científica e Tecnológica* (the national professional, scientific, and technological education system, or national EPT system) in 2008, as stipulated by Law 11892 passed on December 29, 2008 [2]. Initially composed of the former Federal

Centers for Technological Education (Cefet)[2] and Agrotechnical Schools, the national EPT system underwent progressive diversification and expansion, extending its presence to various regions across the country. As of 2022, the system encompasses 678 units spread across 27 states, comprising 38 Federal Institutes of Education (IFs), 2 Cefets, the Federal Technological University of Paraná (UTFPR), 22 technical schools affiliated with Federal Universities, Colégio Pedro II, as well as local authorities with administrative, financial, and didactic-pedagogical autonomy [4].

According to Brazilian legislation [6], "instituted at the time of the creation of the Rede Federal, the institutes are legally obligated to reserve a minimum of 50% of their capacity for the provision of secondary-level technical courses, primarily in an integrated manner." The integrated modality, in turn, combines the technical curriculum with the regular curriculum, employing interdisciplinary methodologies and fostering initial research and extension experiences at the secondary level.

Therefore, within the context of the Federal Institutes, EPT aims to provide both technical and preparatory education. This educational approach emphasizes the integration of science, technology, and culture to stimulate the development of crucial skills for intellectual autonomy and the exercise of citizenship [17]. This approach seeks to bridge historical distinctions between educational training offered to elites and the working class in Brazil.

3. Gender relations in EPT for technology careers

EPT plays a significant role as one of the first career-related choices for teenagers. Even while still in basic education, young people decide to pursue a particular field of activity. This choice can lead to potential career opportunities in the job market or serve as a pathway to further education. Understanding social gender relations in the context of women pursuing careers in technology underscores the significance of EPT and related institutions. For many students, EPT represents their initial foray into programs related to computing [23], often serving as their first exposure to IT.

According to recent data [11], women are predominant in professional education across various age groups. When considering the number of students under 20 years of age enrolled in 2022 (reflecting the age range of students in secondary education involving professional training), over 55% of these students were women. However, when focusing on the percentage of female students in technical high schools related to information and communication technology (ICT), this figure drops to 43.34% in the same year, indicating that gender equality has not yet been achieved in this field. Nevertheless, an evolution is evident when examining the historical data series available on the Ministry of Education's website *Plataforma Nilo Peçanha*. In 2017, this percentage was notably lower at just 37% [3].

Research by Posser and Teixeira [19] has shown that completing a technical course significantly motivates women to pursue careers in the field. From this perspective, EPT is crucial in promoting equitable educational opportunities. According to the authors, students who complete technical courses better understand employment prospects and various career pathways within the sector. This becomes especially important considering that, as per data, less than 18% of enrollments in higher education computing programs are women [26]. EPT has consistently contributed to increasing this rate, playing a vital role in demystifying the field of computing and inspiring girls to pursue tech careers.

However, as reported by Ribeiro and Maciel [23], even though girls are included in professional courses related to IT, it is common for students to maintain a somewhat ambiguous perspective of this field. This view may be influenced by misinformation or misconceptions. Therefore, initiatives that provide support and help redefine the perception of the computing field are crucial in pursuing greater gender equality.

4. *Meninas Digitais no Cerrado* Project

In order to realize the integration between technical and preparatory education as outlined in the law that established the national EPT system, educators at the Instituto Federal Goiano – Campus Ceres

[2] From 1978 onward, the Federal Technical Schools were progressively transformed into Cefet.

recognized the importance of motivating female students to pursue professional careers in IT. Consequently, in 2016, they initiated an interdisciplinary project in collaboration with the Brazilian Computing Society (SBC), known as "*Meninas Digitais no Cerrado*".

This project was among the earliest initiatives in the state of Goiás to formally register as a sister project of the *Meninas Digitais* program (PMD), and its base of operations was situated at one of the campuses of the Instituto Federal Goiano, situated in the city of Ceres, located approximately 180 km from the capital, Goiânia. The Federal Institute of Goiano was established by merging the former Federal Agrotechnical Schools within the state, aiming to foster regional economic development by training skilled professionals in the agricultural sector. Following the introduction of the national professional, scientific, and technological education (EPT) system in 2008, the Ceres Campus expanded its course offerings, including information technology-related ones. These courses were offered from the technical level in an integrated modality through higher education. Before this expansion, the campus primarily offered courses in agricultural sciences, with student assistance policies primarily geared towards men, including a larger number of available spaces in student residences.

Initiated in the context of consolidating these courses, the *Meninas Digitais no Cerrado* project (MDC) is involved in teaching, research, and extension activities. The project secures funding to support the participation and success of female students who engage with the project, with the primary aim of reducing the dropout rates among women in computing programs and facilitating their vertical integration from secondary to graduate levels. Students who consistently engage in coordinating the project's activities remain involved throughout the program:

- Technological training: Offering short-term courses and workshops related to IT careers, enabling students to gain experience in teaching, research, or extension;
- Scientific production and dissemination: Forming study and research groups dedicated to the theme of gender inequality in the tech industry and the invisibility of female participation in fields historically considered "masculine." The project also produces articles for scientific events like Women in Information Technology (WIT) and the Congress of Latin American Women in Computing (LAWCC);
- Engagement in or organization of events: These activities are aimed at both the academic community and broader society and include technical visits, exhibitions, and fairs. The goal is to communicate science to the wider public, foster networking with partner institutions and projects, and expand the project's reach;
- Humanistic education with a preparatory role: Implemented through lectures, round tables, and discussion circles, these activities provide a space for critical reflection on gender relations in computing within the academic community. Their primary objective is to enhance students' self-confidence and deconstruct sexist stereotypes that influence social perception and practice within their professional field.

In a more qualitative perception, since the beginning of the project, it is common for students participating in the actions, especially those who formed a team in teaching, research, and/or extension opportunities, to pursue a professional career in IT, joining the higher education program in information systems at the same institution as the first group of graduates did. Four of the eight graduating students were girls, and all four graduated from the technical secondary education. These results are in line with other studies by Ribeiro and Maciel [22], who point out that female students who receive positive stimulus when attending secondary education with professional training in computing and IT-related courses are more likely to continue their studies in computing, increasing the number of women in this field.

Thus, in line with the proposal of Frigotto and Ciavatta [8], the MDC is designed to equip women with the technical skills required to enter the job market. Simultaneously, it aims to nurture citizens who can not only comprehend the dialectical processes within their historical and social context but also actively engage, through their praxis, in the construction of a more equitable reality.

5. *Programa Meninas Digitais* in the National EPT System

The *Meninas Digitais* program (PMD) originated in discussions conducted during the Women in Information Technology (WIT) event. Established in 2011, the program was initially coordinated by the SBC Regional Secretariat in Mato Grosso and officially endorsed by the SBC in 2015 [21]

The program's primary aim has been to foster an interest in computing and encourage girls attending high school and the upper grades of elementary school to pursue academic and professional endeavors in the field. The program has become a leading advocate for gender equality in information technology within Latin America. PMD's activities are replicated by other initiatives referred to as "sister projects," which propagate these principles within their respective educational institutions, both nationally and internationally [21].

The PMD Annual Report of Sister Projects for the period 2021-2022 comprises a survey encompassing 73 active projects. According to the report, 92% of these projects are involved in extension initiatives, 53% engage in research activities, and 45% participate in teaching-related endeavors such as organizing events, offering short-term courses, creating educational materials, conducting workshops, delivering lectures, and hosting and participating in competitions [20]. These statistics underscore the importance of the projects' extension work and their dedication to fostering a dialogical exchange between educational institutions and the community.

To evaluate the involvement of PMD's sister projects in the national EPT system, we compiled all available data from each of the 73 initiatives on the PMD's website. Additionally, we conducted research to gather specific information[3] not included in the report. This data collection process included acquiring project names, their operating state or region, the affiliated institution, and their primary objectives, and ascertaining whether they were developed by institutions members of the national EPT system.

In total, 26 sister projects (35.6%) were developed by institutions of the national EPT system (Table 1). Most of the projects (24 of them, or 32.9% of all PMD's sister projects) were established by the Federal Institutes of Education. Additionally, 2 projects (2.7% of all sister projects) were developed within the Federal University of Technology – Paraná (UTFPR).

Table 1
List of sister projects developed by institutions members of the national EPT system. Source: Elaborated by the authors (2023).

Name of the PMD's Sister Projects developed by Institutions Members of the *Rede Federal de Educação Profissional, Científica e Tecnológica* (National EPT System)	
Bit Rosa - Elas na Computação	Meninas Digitais - Regional Sergipe
Caliandras Digitais	Meninas Digitais - Rio Pomba
Corte de Lovelace	Meninas Digitais - IFMT
DAMAS - Disseminação e Apoio à participação de Mulheres em Áreas de STEM	Meninas Digitais do Sudoeste da Bahia
Developer Girls	Meninas Digitais - Regional Mato Grosso
Divas	Meninas Digitais no Cerrado
Elas Digitais	Meninas High Tech
Emili@s	Mermãs Digitais
ForGirls	Metabotix
Girls Power In Programming	Mulheres na computação IFSP Campus SP
Maia (Meninas Aprendendo Inteligência Artificial)	Paragobyte Girls
Meninas Cientistas	PS4W - Programa Sabará for Women
Meninas das Geotecnologias	TIChers

In a state-based analysis of the 26 PMD's sister projects developed by members of the national EPT

[3] Available at: https://bit.ly/pmd-rede-federal (in portuguese)

system, Goiás had the highest representation, with 4 projects (accounting for 15.4% of the 26 sister projects). Following closely, Minas Gerais and Paraná were responsible for 3 projects each (making up 11.5% each). Meanwhile, Mato Grosso, Mato Grosso do Sul, Pará, and Rio Grande do Sul each had 2 projects. The states of Bahia, Ceará, Espírito Santo, Maranhão, Paraíba, Santa Catarina, São Paulo, and Sergipe had one project each. Therefore, PMD's sister projects, carried out within the framework of the national EPT system, have a presence in all five regions of Brazil, with the Central-West region boasting the highest number of initiatives. These projects collectively span across 15 states (Figure 1).

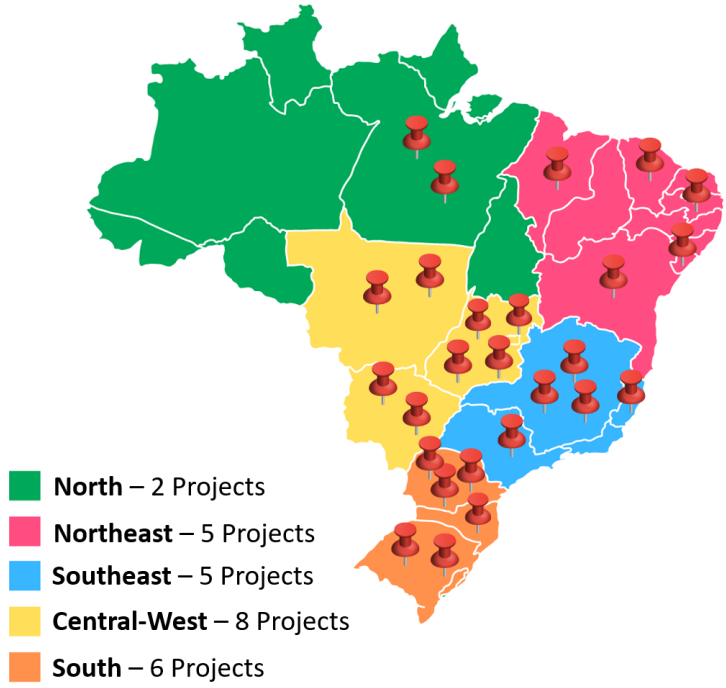

Figure 1: PMD's sister projects active in the national EPT system. Source: Elaborated by the authors (2023).

Figure 2 below illustrates the start years of PMD's sister projects initiated by members of the national EPT system. The data reveals that 2019 saw the highest number of new projects, accounting for 9 projects or 34.6%, followed by 2017 with 4 projects (15.4%). During the historical series encompassing the years 2013 to 2021, only 2014 had no project initiated. All 26 projects identified were initiated within this 8-year timeframe, from 2013 to 2021.

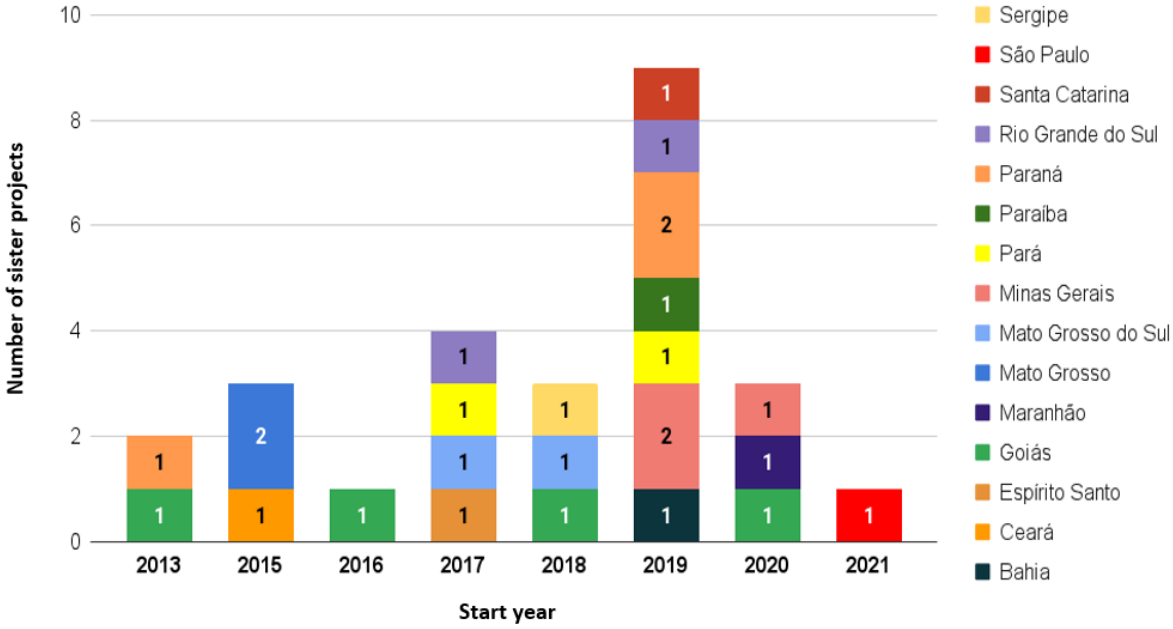

Figure 2. Start of PMD's sister projects developed by members of the national EPT system per year and per state. Source: Elaborated by the authors (2023).

Regarding the data extracted from the PMD website[4], some of the information collected focused on the objectives of the sister projects. An analysis was undertaken to assess whether projects affiliated with the national EPT system engage in activities aligning with EPT principles, which involve integrating different education levels and combining technical and preparatory education. This similarity analysis was conducted in a web format (Figure 3) using the Iramuteq[5] software, version 0.7 Alpha 2, widely used for analyzing textual data. The similarity analysis identified the most frequently used words (in Portuguese) among the selected texts and facilitated the construction of interconnected webs that depict relationships among the analyzed objectives. As a result, we acquired a visual representation of the rhizome, highlighting the most prevalent terms among the objectives. The visualization and grouping of these terms were influenced by their proximity or distance within the analysis.

This analysis revealed that sister projects operating within the framework of the EPT system can be categorized into four primary objective axes: i) Empowering women by cultivating an interest in the field of computing; ii) Encouraging girls to not only enter but also persist in the academic and professional realms of computing; iii) Promoting the dissemination of computing from elementary school onwards through courses and hands-on activities; iv) Fostering professional careers in technology among high school students. A notable coordination is observed across various education levels among the projects scrutinized. This coordination utilizes the realm of computing as a central element for activities aimed at imparting technical knowledge and fostering emancipatory education.

In this context, we showcase three PMD's sister projects developed by members of the national EPT system. These projects stood out in the similarity analysis, as they exhibited aligned objectives and demonstrated either complete or partial similarity in terms of their outcomes and alignment with EPT principles. The initiatives highlighted herein serve as concrete examples of how the EPT system can effectively contribute to addressing gender disparity in the field of computing.

[4] https://meninas.sbc.org.br/projetos/
[5] http://www.iramuteq.org/

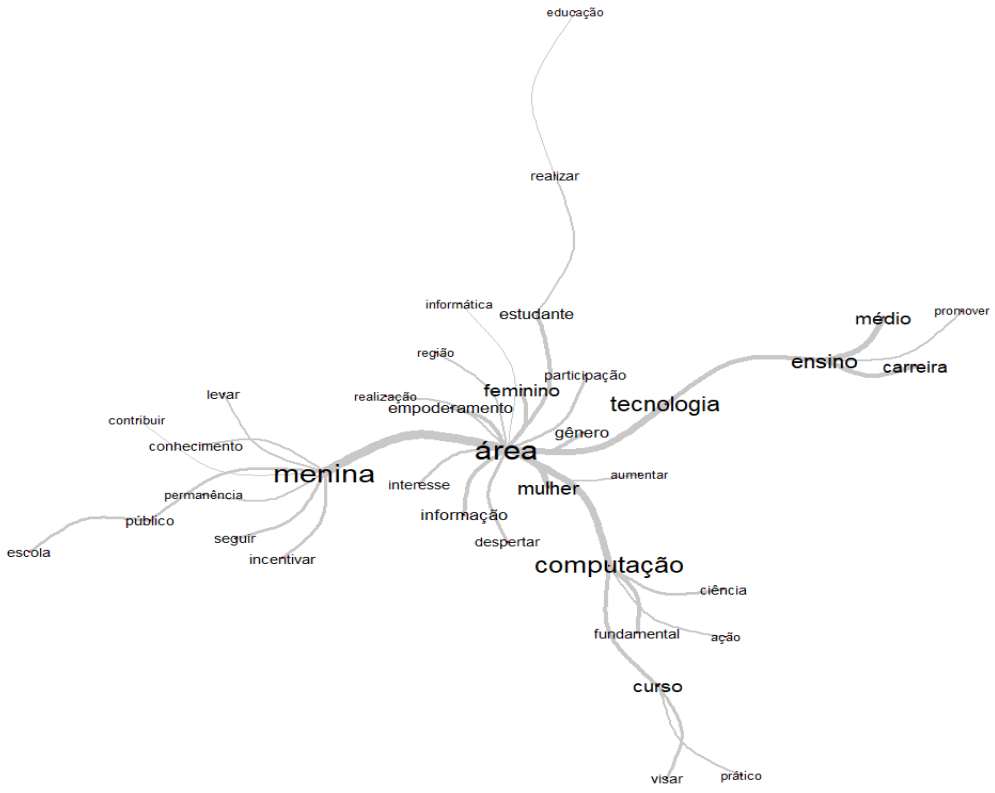

Figure 3. Similarity analysis of objectives of PMD's sister projects developed by members of the national EPT system (in Portuguese). Source: Elaborated by the authors (2023).

In their work, Bim et al. [1] introduce the *Emíli@s – Armação em Bits* project conducted at the UTFPR Curitiba campus. The project's primary objective is to introduce the field of computing to high school students from public schools in the capital of Paraná, with a particular focus on disseminating the various areas of professional activity in this domain, especially among girls. The project offered four technical workshops to students from a partner school, covering diverse themes, including Human-Computer Interaction, Database, Android Application Development, and Basic Web Design. Additionally, the project organized lectures for teachers to engage in discussions about gender relations and stress the significance of women's participation in IT. Furthermore, the project extended its efforts to secondary and higher education courses, specifically Information Systems and Computer Engineering, to promote integration among female students and encourage their persistence and success in these courses.

In their work, Louzada et al. [13] delve into the initiatives undertaken by the *Meninas Digitais no Cerrado* project, headquartered at the Instituto Federal Goiano – Campus Ceres, in the Brazilian state of Goiás. Their focus is on activities designed to empower women and encourage their continued engagement in IT courses. The authors shed light on the project's empowerment and training endeavors, which are offered as part of an extension project encompassing high school, technical, and higher education students. They also emphasize the preparatory activities centered on social-gender relations, imparting an interdisciplinary character to the project. This interdisciplinary approach fosters a cross-cutting connection between computing and other programs, including degrees offered by the institution.

Marquiori, Oliveira, and Nascimento [15] documented a computational thinking workshop conducted by the Corte de Lovelace project, which is affiliated with the Federal Institute of Espírito Santo. This initiative involved students from public schools in the 5th to 9th grades of elementary school and utilized everyday activities, such as makeup tutorials or outlining the sequence of steps from home to school, to teach algorithmic concepts. For the authors, the implementation of projects that encourage girls, even in their primary education years, to explore the academic and professional field of computing is closely linked to the potential contributions of professional and technical education (EPT) in addressing gender inequality within the computing field.

6. Final Considerations

In the perspective presented by Ciavatta and Ramos [7], integrated education signifies the fusion of work, science, and culture, with "work" as an educational principle rather than a strictly technical or professional. According to these authors, an illustrative integrative education model can be observed at the secondary level within Federal Institutes of Education. Through an integrated curriculum and the facilitation of interdisciplinary and integrative activities, these institutions fulfill the social responsibility of educating and empowering individuals, irrespective of their social class. This educational approach contributes to the development of counter-hegemonic education.

Within the framework of the national EPT system, a tangible endeavor exists to amalgamate basic and professional training institutions, representing an alternative to the traditional duality between technical public education, primarily intended for the working class, and preparatory education, traditionally reserved for elites [16]. Hence, it is imperative to recognize that EPT education must incorporate gender discussions to ensure a holistic education. Viewed from this perspective, empowerment projects executed within the national system can emerge as a potent tool for fostering gender equality through emancipatory education. Such initiatives empower women to actively engage in the social transformation of the IT professional landscape.

The results gleaned from the analysis of the PMD's sister projects developed by members of the national EPT system underscore a dedicated effort to transform societal realities to mitigate gender disparities in the field of computing. These projects span all regions of Brazil and reveal a significant number of initiatives affiliated with Federal Institutes (FIs), some dating back to 2013.

In this context, the integrated technical secondary education provided by the Federal Institutes of Education embodies a polytechnic education [24], which is comprehensive and emancipatory. It represents a microcosm of educational actions that, in our view, have the potential to contribute significantly to reducing gender inequalities in the computing sector. It plays a crucial role in fostering a more equitable society by nurturing individuals capable of professional practice in the realms of science and technology while fostering a deep awareness of the dialectical nature of the social relations in which they are embedded.

Future research endeavors could delve into assessing the impact of gender inequality reduction through the national EPT system. This might involve investigating the verticalization of education and examining how offering computing courses from high school through to graduate levels within the same institution has contributed to a shift in these indices. Additionally, it may be valuable to consider the perspectives of students who started their journey at the age of 12 and later decided to pursue careers in computing due to their technical training during high school.

7. Acknowledgements

We would like to extend our gratitude to Instituto Federal Goiano – Campus Ceres for providing institutional funding support.

8. References

[1] Bim, S., Amaral, M., Kozievitch, N., Emer, M., Setti, M., Pellison, L., & Merkle, L. (2016). Divulgar para Atrair, Motivar para Manter. In: *Anais do X Women in Information Technology*, (pp. 29-33). Porto Alegre: SBC. doi:10.5753/wit.2016.9695

[2] Brasil (2008). Lei Nº 11.892, de 29 de dezembro de 2008. *Institui a Rede Federal de Educação Profissional, Científica e Tecnológica, cria os Institutos Federais de Educação, Ciência e Tecnologia, e dá outras providências.* Brasília, DF. https://www .planalto.gov.br/ccivil_03/_ato2007-2010/2008/lei/l11892.htm, March 2023.

[3] Brasil (2018). Ministério da Educação. *Plataforma Nilo Peçanha*, http://portal.mec.gov.br/plataforma-nilo- pecanha, May 2023.

[4] Brasil (2022). Ministério da Educação. *Rede Federal.* https://www.gov.br/mec/pt-br /acesso-a-informacao/institucional/secretarias/secretaria-de-educacao-profissional/rede-federal, April 2023.
[5] Brasil (2023a). Ministério da Educação. *Histórico da EPT.* http://portal.mec.gov.br/ educacao-profissional-e-tecnologica-ept/historico-da-ept, March 2023.
[6] Brasil (2023b). Ministério da Educação. *Instituições da Rede Federal.* http://portal.mec.gov.br/rede-federal- inicial/instituicoes, March 2023.
[7] Ciavatta, M., & Ramos, M (2011). Ensino Médio e Educação Profissional no Brasil: dualidade e fragmentação. *Retratos da Escola*, v. 5, n. 8, p. 27-41.
[8] Frigotto, G., & Ciavatta, M. (2003). Educar o trabalhador cidadão produtivo ou o ser humano emancipado?. *Trabalho, Educação e Saúde*, 1, 45-60.
[9] Garcia-Holgado, A., Gonzalez-Gonzalez, C. S., Silveira, I. F., & Garcia-Penalvo, F. J. (2022). A Case Study in Brazil and Spain about the Students' Perception of the Gender Gap in Computing. *International Journal of Engineering Education (IJEE), 38*(3), 663-672.
[10] Guiraldelli Júnior, P. (2015). *História da Educação Brasileira.* São Paulo: Cortez. 5. ed.
[11] INEP, Censo Escolar (2022). *Censo Escolar da Educação Básica 2022: Resumo Técnico*, https://download.inep.gov.br/publicacoes/institucionais/estatisticas_e_indicadores/resumo_tecnico_censo_escolar_2022.pdf, May 2023.
[12] Lopes, S. F. P., & Quirino, R. (2017). Relações de gênero e sexismo na educação profissional e tecnológica. *Cadernos de gênero e tecnologia*, 10(36), 58-71.
[13] Louzada, N., Santana, T., Assis, I., Braga, R., & Braga, A. (2019). Agindo sobre a diferença: atividades de empoderamento feminino em prol da permanência de mulheres em cursos de Tecnologia da Informação. In: *Anais do XIII Women in Information Technology,* (pp. 69-78). Porto Alegre: SBC. doi:10.5753/wit.2019.6714
[14] Machado, A. R. A., & Toledo, M. R. A. (Org.) (2017). *Golpes na História e na Escola:* o Brasil e a América Latina nos Séculos XX e XXI. São Paulo: Cortez. 1. ed. ANPUH SP.
[15] Marquiori, V., Oliveira, M., & Nascimento, G. (2019). Letramento de Meninas em Programação através do Pensamento Computacional para Compreensão de Problemas. In: *Anais do XIII Women in Information Technology,* (pp. 109-113). Porto Alegre: SBC. doi:10.5753/wit.2019.6719
[16] Moura, D. H. (2007). Educação básica e educação profissional e tecnológica: dualidade histórica e perspectivas de integração. *Holos*, v. 2, p. 4-30.
[17] Pacheco, E. (2010). *Os Institutos Federais:* uma revolução na educação profissional e tecnológica. Natal: Editora IFRN.
[18] Pereira, S. (2009). Centenário da Rede de Educação Profissional. *Revista POLI:* saúde, educação e trabalho. Ano II, (7), p. 13-14.
[19] Posser, C., & Teixeira, A. (2016). Mulheres que aprendem informática: Um estudo de gênero na área de TI. In: *Anais do XXII Workshop de Informática na Escola*, (pp. 707-716). Porto Alegre: SBC. doi:10.5753/cbie.wie.2016.707
[20] Programa Meninas Digitais (2022). *Relatório Projetos Parceiros, 2021/2022.* https://meninas.sbc.org.br/, March 2023.
[21] Programa Meninas Digitais (2023). *Sobre o Programa Meninas Digitais.* https://meninas.sbc.org.br/sobre/, March 2023.
[22] Ribeiro, K., & Maciel, C. (2020a). Um Estudo sobre o Desenvolvimento da Carreira das Estudantes do Ensino Médio Integrado em Informática. In: *Anais dos Workshops do IX Congresso Brasileiro de Informática na Educação*, (pp. 21-30). Porto Alegre: SBC. doi:10.5753/cbie.wcbie.2020.21
[23] Ribeiro, K. S. F. M., & Maciel, C. (2020b). Meninas e Identidade Profissional: Percepções das Estudantes de Ensino Médio integrado em Informática sobre a área de Computação. In: *Anais do Computer on the Beach*, 11, 309-316. ISSN 2358-0852.
[24] Rodrigues, J. (2005). Ainda a educação politécnica: o novo decreto da educação profissional e a permanência da dualidade estrutural. *Trabalho, educação e saúde*, 3, p. 259-282.
[25] Santos, M. E. S., Rocha, T. S., Brasileiro, V. L. J., & Souza, C. C. (2019). What computing Brazilian community is saying about gender gap. *IEEE Revista Iberoamericana de Tecnologias del Aprendizaje*, *14*(4), 162-167.

[26] SBC, Sociedade Brasileira de Computação (2022). Educação Superior em Computação Estatísticas – 2020, https://www.sbc.org.br/documentos-da-sbc/summary/133-estatisticas/ 1420-educacao-superior-em-computacao-estatisticas-2020, May 2023.
[27] Souza, R. D. (2008). *História da organização do trabalho escolar e do currículo no século XX* (ensino primário e secundário no Brasil). São Paulo: Cortez.