ISSN 1982-5587

Research articles

Study of female representation in a Technical Course in Computing

Estudo da representatividade feminina em um Curso Técnico em Informática

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HOW TO CITE: BARBOSA, E. M. C.; CAMPOS, D. Study of female representation in a Technical Course in Computing. **Revista Ibero-Americana de Estudos em Educação**, Araraquara, v. 21, e19191, 2026. e-ISSN: 1982-5587. DOI: https://doi.org/10.21723/riaee.v21i00.1919102

Abstract

The article analyzes testimonials from female students and graduates of a Technical Course in Computer Science Integrated with High School at the Instituto Federal de Educação, Ciência e Tecnologia do Rio Grande do Sul from research developed between 2020 and 2022 and seeks to understand the reasons why female students persist or abandon the computing field, especially when they come from a technical course in the area. In addition to bibliographic research on the subject, semi-structured interviews were conducted with twelve graduating students or graduates from the mentioned educational institution. The results show that, although some continue in technical education, the majority opt for other fields, despite recognizing the importance of computer science education. This highlights the need for technical courses, especially in STEM (acronym for Science, Technology, Engineering, and Mathematics), to focus on gender issues and the role of women in professional and academic careers.

Keywords: computing; high school; gender; education.

Resumo

O artigo analisa depoimentos de alunas e egressas de um curso Técnico em Informática Integrado ao Ensino Médio do Instituto Federal de Educação, Ciência e Tecnologia do Rio Grande do Sul a partir de uma pesquisa desenvolvida entre 2020 e 2022 e procura compreender os motivos que levam as mulheres estudantes a persistirem ou abandonarem a área da computação, em especial quando são oriundas de um curso técnico da área. Além de uma pesquisa bibliográfica sobre o assunto foram realizadas entrevistas semiestruturadas com doze alunas concluintes ou egressas da referida instituição de ensino. Os resultados mostram que, embora algumas continuem na formação técnica, a maioria opta por outros campos, apesar de reconhecerem a importância da formação em informática. Isso evidencia a necessidade dos cursos técnicos, especialmente em STEM (acrônimo de Science, Technology, Engineering and Mathematics), focarem nas questões de gênero e no papel das mulheres nas carreiras profissionais e acadêmicas.

Palavras-chave: computação; ensino médio; gênero; educação.

FRAMING THE CONVERSATION

Only 17 women have won a Nobel Prize in physics, chemistry, or medicine since Marie Curie in 1903, compared to 572 men.

Today, only 28% of the world's researchers are women.

Such huge disparities and deep inequality do not happen by chance.

Too many girls are held back by discrimination, biases, social norms, and expectations that influence the quality of education they receive and the subjects they study.

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Submitted: April 09, 2024
Reviewed: February 02, 2026
Approved: February 02, 2026
Financial support: IFRS and CNPq.

Conflicts of interest: There are no conflicts of interest.

Ethics committee approval: CAAE no. 46515621.0.0000.802.

Data availability: The data supporting this article are available within the article itself.
Study conducted at Instituto Federal de Educação, Ciência e Tecnologia do Rio Grande do Sul (IFRS), Farroupilha, RS, Brasil.

> Girls' under-representation in STEM education is deep rooted and puts a brake on progress towards sustainable development. (Organização das Nações Unidas para a Educação, Ciência e Cultura, 2018, p. 10).

We begin this article with the quotation above, drawn from a recent UNESCO publication, as it summarizes the concern that prompted us to examine the representation of women as students in the field of technology. This article results from reflections developed within a research project conducted since 2020 at the Federal Institute of Education, Science, and Technology of Rio Grande do Sul (IFRS)[1]. In the first stage of the study, quantitative data were gathered on the enrollment and retention of female students in computing programs across three IFRS campuses between 2017 and 2020[2]. The findings indicated lower female participation in these programs when compared to that of male students. From this observation, the research proceeded with a closer examination of the reality at the Farroupilha Campus, adopting a qualitative methodology that employed semi-structured interviews with graduating female students and alumnae of the Integrated Technical Course in Informatics, a secondary-level vocational program offered at IFRS. Accordingly, this article is, essentially, grounded in the analyses of interviews conducted during the second stage of the research project, entitled "Female Representation in Computing-Related Programs: A Study of the Factors Influencing Women's Decisions to Continue in or Leave This Field of Study," carried out between 2021 and 2022[3].

In continuing this research, our objective was to investigate student interest while analyzing the factors that hinder or encourage female students in the Integrated Technical Program in Informatics to pursue careers in Computing. Before presenting the rationale, it is important to note that we, the authors, are faculty members at IFRS – Farroupilha Campus with over a decade of experience in the Informatics program. It was from this professional experience, together with our perception of the low representation of female students in the program, that this research theme emerged.

The reality we have witnessed over the years in the Informatics program is not far removed from what unfolds in other educational contexts in Brazil. Data from the Higher Education Census (Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira, 2021a) indicate that in the broad field of Computing and Information and Communication Technologies, fewer than 15 percent of undergraduate degrees were awarded to women. By contrast, in Education, women account for approximately 78 percent of all graduates. When examining the 20 undergraduate programs with the highest enrollment nationwide, a clear gendered distribution becomes evident. Women outnumber men in 15 of these programs, including Pedagogy, Social Work, Biomedicine, Nursing, Nutrition, Human Resource Management, Psychology, Physiotherapy, Dentistry, Pharmacy, Veterinary Medicine, Medicine, Accounting, Business Administration, and Law. In the remaining five programs, men remain the majority: Information Systems, Civil Engineering, Production Engineering, Physical Education, and Physical Education with Teacher Education (Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira, 2021b).

In contrast, among the population aged 18 to 29 years, women have, on average, more years of schooling than men and represent the majority of both entrants and graduates in undergraduate programs (Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira, 2021b). These data reveal that inequalities in access to education have been overcome, with a reduction and even reversal of systematic differences between men and women. However, this quantitative progress does not imply gender equity, given the low representation of women in fields related to Science, Technology, Engineering, and Mathematics (STEM).

[1] The research received institutional support through scientific initiation scholarships (Internal Funding, IFRS) as well as scientific initiation scholarships for secondary-level students funded by the National Council for Scientific and Technological Development (CNPq).

[2] Barbosa et al. (2021).

[3] We would like to thank the students who participated in this study, as its primary subjects, and who supported us throughout this process by helping to elucidate some of the questions that motivated this investigation. We are also especially grateful to the scholarship students, whose contributions were essential in assisting with the interviews and carrying out their transcription.

From a labor market perspective, the study *Women in the STEM Labor Market in Brazil* (Machado et al., 2021) reports that approximately 3% of Brazil's total workforce, including both men and women, is employed in STEM occupations, compared to roughly 6% in the United States. The study further notes that while women account for 45% of the general workforce, they remain significantly underrepresented in STEM fields, where they hold only 26% of positions. Furthermore, the data reveal that female participation in Mathematics and Computing occupations ranged from 23% to 31% during the 2013–2019 period.

A In addition to showing the low representation of women in the STEM labor market, the data also indicate a shortage of professionals in these fields. Therefore, women's participation in STEM careers, beyond being an ethical and social justice issue, is also of interest from an economic and technological standpoint (Brito et al., 2015).

Thus, this statistical overview indicates the low representation of women in STEM fields in academia and, consequently, their impact on the labor market, particularly in computing. From these data emerges a question that several studies seek to address: "What lies behind this gender disparity in STEM?" This reality results from the interaction of multiple elements in the processes of socialization and learning, encompassing social, cultural, and gender norms that shape how girls and boys are raised, how they learn and relate within family, school, and social contexts, and ultimately influence their beliefs, behaviors, and choices (Organização das Nações Unidas para a Educação, Ciência e Cultura,, 2018).

In the literature on the topic, the low representation of women in STEM is extensively reported and discussed as a direct response to three factors: (1) gender stereotypes and socialization practices; (2) the role of peer groups in academic experiences; and (3) professional role models in STEM (Reinking; Martin, 2018). Thus, initially, the socialization process begins in early childhood, when children learn the social expectations, attitudes, and behaviors associated with their gender (Barker, 2006; Bussey; Bandura, 1999). This gender awareness emerges through interactions with parents, relatives, peers, and teachers and has immediate consequences for children's attitudes and behaviors toward members of their own and other genders (Martin, 2014). In this process, children begin to recognize cultural gender stereotypes. The construction of stereotypes takes shape through a dichotomy in play activities, learning opportunities, and behavioral patterns considered appropriate for boys and girls. From early childhood, in family interactions, it is not uncommon for toys such as building blocks, construction tools, and electronic cars to be associated with boys, while toys simulating kitchen utensils, makeup, and dolls are associated with girls. By differentiating what is considered appropriate for one or the other, the construction of gender stereotypes is reinforced (Barbosa et al., 2021). Therefore, it becomes established that boys are prone to activities related to technology, logical reasoning, strength, and exploration of physical space, whereas girls are directed toward activities associated with care, appearance, and domestic responsibilities (Bian et al., 2017). Over time, these patterns become naturalized, shaping girls' perceptions of themselves and permeating their family, school, and social relationships.

Another approach emphasizes peer group theory, a concept that refers to the influence peer groups have on individuals' behavior, attitudes, and opinions. Especially during adolescence, understood as the period between the end of elementary school and the course of high school, students aspire to achieve performance comparable to that of their peers, which may be associated with the search for group acceptance, a factor of considerable importance at this stage of life. It is observed, however, that at this point young people undergo a gradual shift from interest in science and mathematics to disinterest, boredom, and feelings of failure in the school environment (Organização das Nações Unidas para a Educação, Ciência e Cultura, 2018). Additionally, studies reveal that girls lose interest in STEM subjects over the period spanning the end of elementary school and high school, while boys begin to move away from this field as they approach graduation (Organização das Nações Unidas para a Educação, Ciência e Cultura, 2018). Thus, in the case of female students, if the group does not achieve success in STEM subjects, the perceptions circulating within that group, whether expressed through words or through inaction, tend to result in fewer girls remaining interested in these subjects and, consequently, in their distancing from these areas.

Finally, there is the role model hypothesis (Betz; O'Connell, 1992), which holds that young people's career interests are shaped by identification with individuals who resemble them, whether in terms of race/ethnicity or gender, for example. Thus, for women to become interested in and pursue STEM fields, it is important that they identify with other women working in these areas, so that they may feel a sense of belonging and recognize that these fields are also meant for them. However, these domains remain predominantly male-dominated and are often associated with traits such as being male, white, and socially isolated (Cheryan; Master; Meltzoff, 2015). The term socially isolated relates to the perception of computer science as a field associated with work performed by someone with high intellectual ability who interacts with machines and is therefore viewed as disconnected from communal goals such as teamwork and engagement with social issues.

This association further hinders women's entry into and persistence in these fields. The idea of social isolation, in particular, intersects with processes of gender socialization, through which girls are encouraged to be social, kind, and pleasant—traits that stand in contrast to the image of social isolation. Boys, in turn, are less often encouraged to cultivate these qualities and are more frequently perceived as inherently more intelligent (Sainz et al., 2019). Such a division of behaviors and gendered expectations results in stereotypes that directly affect women's interest and confidence in pursuing careers in STEM, reinforcing the need to disrupt these patterns and to create a more inclusive and welcoming environment for all those interested in this field.

Methodologically, the research that gave rise to this article adopts a qualitative, descriptive, and exploratory design (Prodanov; Freitas, 2013). It brings together theoretical reflections and core concepts that frame the investigation with interviews conducted with female students at IFRS – Farroupilha Campus enrolled in the Technical Course in Informatics Integrated with High School, as well as graduates who completed their technical training in 2018 and 2019.

As previously noted, we opted to use semi-structured interviews as our research technique, as we considered that a flexible set of guiding questions would allow the participants to express themselves more freely and, in doing so, feel more comfortable sharing their experiences. Students who were completing the Technical Course in Informatics and female graduates of the program were invited to participate in the study. The invitation was sent by email and included the Informed Consent Form. After receiving the signed forms, we contacted the participants to clarify any questions and to schedule the interviews. As social distancing measures were still in place due to the COVID-19 pandemic, all interviews were conducted via the virtual platform Google Meet, recorded, and subsequently transcribed in full. The interviews were conducted by the authors and followed a previously prepared guide aligned with the research problem and objectives. At the same time, given their semi-structured nature, both interviewers and participants were able to explore additional topics considered relevant to understanding the research problem. Each interview lasted an average of 42 minutes, totaling 8 hours and 25 minutes of recorded conversations.

Eight female graduates of the Technical Course in Informatics who completed their secondary education in 2018 and 2019 were invited to participate in the study (of these, two chose not to participate), in addition to six female students who were completing the program in 2020 and 2021. Participants from these classes were selected because, since the implementation of the Technical Course in Informatics between 2011 and 2018[4], this had been the only option available for pursuing high school at the Farroupilha Campus. In this way, we delineated a group sharing the same entry condition with regard to course choice. Moreover, as these students were either completing the program or had concluded it recently (in the case of the 2018 and 2019 graduates), it was still possible to mobilize their recollections of their experiences during the technical course. Among the graduates invited to participate at this stage of the study were both those who continued their studies in the field of computing and those who chose to pursue another area of study or professional activity.

As stated before, the interview phase was preceded by a quantitative survey conducted as part of an earlier research project. At the Farroupilha Campus, between 2017 and 2019, 40%

[4] Beginning in 2019, the campus started offering the Integrated Technical Program in Administration, and, in 2020, it introduced the Integrated Technical Program in Electromechanics at the secondary level.

of the students enrolled in the Technical Course in Informatics were female; during the same period, the Technology Course in Systems Analysis and Development had only 10% female enrollment. It was therefore important to understand why this proportion, or something close to it, was not observed in higher education, even when considering female students who continued in the field at other institutions.

Although the numbers were quite revealing, a more in-depth analysis of the issues underlying the research was still necessary, and this was made possible through the interviews. In the interviews, we did not conduct an analysis based on socioeconomic or racial criteria; however, it is important to note that, among all the interviewees, only one is Black, which largely reflects the near absence of Black students at the institution, despite the affirmative action policy.

It is important to note that our having been instructors of the participants who completed the technical program facilitated contact and their willingness to take part in the study. We also recognize that our position as female researchers contributed to the discussion of certain topics.

The following section presents testimonials from students and alumnae, organized according to the interview themes previously outlined. These responses are discussed in alignment with the relevant theoretical framework. To preserve participant anonymity, all names have been replaced with pseudonyms. Furthermore, we have removed interjections from the transcribed excerpts and made minor grammatical corrections where necessary to ensure clarity.

"*IT WAS JUST A GAME*": EARLIER ENCOUNTERS WITH COMPUTING

To examine whether the decision to pursue a technical course in Informatics was related to the students' socialization processes and prior experiences, an effort was made to prompt recollection of their lived experiences in childhood, within the family sphere and in school relationships, particularly in activities of a technological nature. These women's accounts centered especially on memories of school practices, their contact with computers, and encouragement received from their families.

The socialization process takes place through interactions within the family, at school, and in other social contexts, shaping individuals' awareness of their gender and the cultural stereotypes associated with it (Barker, 2006; Bussey; Bandura, 1999). Such stereotypes begin to develop in the first year of life, when boys and girls start to show preferences for different toys and to adopt behaviors like those of others of the same sex (Organização das Nações Unidas para a Educação, Ciência e Cultura, 2018).

Regarding family encouragement, the interviewees reported that during their childhood, through dialogue and everyday interaction, especially within the family sphere, they received guidance free from stereotypical views. We recognize, however, that this perception emerges from the recollection of memories from the standpoint of the present, in which discussions of gender are part of these women's daily lives and are therefore marked by this present.

The alumnae reported, for example, that during their childhood they had the opportunity to engage with toys that interested them and that, later, in their professional guidance, they were free from gender bias. This statement is illustrated by the comment of the participant Priscila:

> (...) In my family, nobody ever said anything to me about that, like whether it was women's work or men's work. Actually, they've always been really supportive of me pursuing anything. I've always been interested in architecture, in civil engineering... so I've always had support to do whatever I wanted, whether it was engineering, architecture, or any other field. (Priscila).

Regarding school activities and computer use, many participants reported that their experience with technology during primary education was limited and largely restricted to the use of the computer lab:

> We didn't really learn much about technology; it was more like just going there to play games, maybe something a bit educational, but still just using the computers. Later, when I was older, in middle school, I'd go there to do assignments or research, things more along those lines. (Priscila).

This excerpt suggests that the school environment failed to provide incentives for more complex computing activities. Like this participant, others associated technology primarily with simple tasks, regarding these activities as having limited relevance or appeal. Helena noted that, during elementary school, computer classes occurred once a week: 'The teachers taught us how to use Word and PowerPoint to make little presentations (...) and do our homework' (Helena). Similarly, another interviewee reported that her weekly computer period was a time when 'sometimes you play a little game and then you learn something about computers, but nothing too focused' (Isabel).

In any case, although most of the alumnae interviewed did not identify elements in their elementary school experiences that might have influenced their decision to pursue a technical course in Informatics, they nonetheless enrolled in a technical education institution and chose a course integrated with high school. In the next section, we seek to further understand the students' motivations for enrolling in a Technical Course in Informatics.

"HIGH SCHOOL WAS THE MAIN REASON WE ENROLLED": MOTIVATIONS FOR PURSUING A COMPUTING COURSE

For a significant portion of school-age youth in Brazil, completing elementary education and entering high school constitutes a natural rite of passage, often occurring within the same educational institution. For those who choose to undergo a competitive admissions process and enroll in an institution dedicated to technical and vocational education, it is reasonable to infer that an additional motivation is at play beyond simply completing a stage of schooling: one that relates to a future professional trajectory. Accordingly, one of the questions posed to the interviewees concerned what motivated these young women to choose the Technical Program in Informatics.

Of the twelve interviewees, the majority (ten) stated categorically that their primary motivation was the quality of teaching and the general academic education offered by the institution. Thus, technical training, at least initially, was not their main objective. Their statements correspond to a perception frequently expressed by teachers when speaking with students in the course. From this perspective, Caren "confessed" that her decision to enroll in the Technical Course in Informatics was more closely related to "high school itself than to the course." She added: "I knew about the course, obviously, I had that notion, but I enrolled more (...) [because of] the quality of high school and because my sister was already studying there in higher education" (Caren).

Possibly, students' preference for the quality of education offered is a pattern that extends across most integrated technical courses at the Federal Institutes in Brazil, given that their teaching model and institutional structure have, in many cases, provided an educational experience perceived as superior to that of public high schools in the country.

Another point worth highlighting is that admission to the institution occurs through a selective entrance examination. In the case of IFRS and the program analyzed here, students, as a rule, tend to reflect strong academic preparation, even though the majority come from public schools. For this reason, though not exclusively, the choice to enroll in the Federal Institute's integrated secondary program is often motivated by the opportunity to pursue a high-quality general education, already recognized in the region, and evidenced by the academic performance of former students, and not solely by the prospect of technical training.

> The distinctive aspects of Federal Institutes attract the attention of different segments of the population, who seek access to better quality education. And with a view not to terminal education and entry into the labor market, but rather to better preparation for entry into public universities. (Queirós; Resende; Piotto, 2022, p. 8).

Notably, while female students report that their primary motivation for enrolling is the quality of the general education and the increased likelihood of admission to a public university, this does not preclude the benefits of technical training. Even if vocational preparation is not their primary objective, it remains a significant component of their educational experience:

> I think my answer will be very similar to a lot of people who entered the Federal Institute in Farroupilha (...): I didn't really know much about the program, but there are a lot of people, like my parents for example, and others too, who always spoke very highly of it, praised the teaching, especially the high school at the IF, and that was the main reason I decided to try the program. (...) It wasn't even because it was IT or related to programming; it was more because everyone said the quality of the IF was really good. But I already liked this area a little, so I was curious to take the program, and, in a way, I saw two good sides: the program itself seemed interesting, and the high school had a reputation for very good quality. (Isabel).

Once the barrier of admission to the program and the new institution had been overcome, the students began the first of four years of secondary education. According to all the interviewees, this was the most challenging period of their trajectory in the Informatics program, because in addition to beginning high school, they were also required to engage in technical training—something entirely new for 14- and 15-year-old students who had just completed elementary and middle school. Consequently, they encountered an institutional environment markedly different from the one they had previously experienced. At IFRS, they began to share the same class shift with cohorts from undergraduate programs, with no bells signaling changes of periods or the beginning and end of classes. They were required to navigate the greater autonomy granted by teachers, along with the responsibilities this entailed, and to cope with an extensive volume of academic content. As a result, many of the narratives suggest that the first year functioned as a barrier they needed to overcome to move forward. For Alice, it was like a "blow... but afterward, it became more manageable."

However, beyond adapting to the new institution, new classmates, and shifting social dynamics, the students also had to confront the dreaded programming course. In the interviews, when reflecting on their educational trajectory in the technical program in Informatics, the participants overwhelmingly identified the programming course as their primary source of difficulty.

> In the first year, I thought... I don't even know what to say. The first year, regarding the computer classes, was really hard because everything was so new, you know? I wasn't used to it, and even though, of course, the teachers were always really supportive, I was pretty lost because there was all that programming stuff, and I just got very lost. And in that first year, I even failed one of the computer classes... it was programming, but I managed to make it up the next year because there's always the extra time for recovery, so I recovered and everything was fine. In the second year, it was easier—I was already used to it (...) and the only [subject] that stayed all four years was programming. The other three years, the computer classes kept changing: two would come in, two would go, so it wouldn't be repetitive. (Denise).

Although studies indicate that the ability to program computers is not associated with gender (Lau; Yuen, 2009), there was a prevailing sense among the girls interviewed that programming was difficult. This perception has been linked to issues of self-efficacy in ICT (Information and Communication Technologies) (Organização das Nações Unidas para a Educação, Ciência e Cultura, 2018).

Self-efficacy is defined as an individual's belief in their ability to organize and execute specific actions (Bandura, 1997 *apud* Nunes, 2008, p. 30). In this sense, people tend to engage in activities they believe they can perform successfully and in which they expect positive outcomes. Under this conception, girls tend to report lower levels of confidence, even in contexts in which they outperform boys (Australian Council For Educational Research, 2013). These issues can be seen in the participants' statements, as illustrated below:

> Actually, one thing I notice is... I don't know... I'm speaking for myself, but I've also heard that the girls, all the girls in computer classes, don't have that much experience with programming. So in the end, it ends up being easier for the boys. (Denise).

At this point, the discussion shifts to processes of socialization and the construction of gender stereotypes, which are closely linked to the lower levels of self-efficacy reported by

the participants, as the student noted above. For her, as for others, "programming is easier for boys."

However, this idea does not arise when a young woman encounters programming or algorithmic problem-solving tasks. Authors working in this area indicate that, by the age of six, children already associate exceptional intellectual ability, or "genius," with masculinity (Bian; Leslie; Cimpian, 2017). Such early-constructed stereotypes help explain the underrepresentation of women in fields where innate brilliance is perceived as essential, based on the assumption that women are less likely to possess this trait (Leslie et al., 2015; Galdi; Cadinu; Tomasetto, 2014). From this perspective, programming may come to be viewed as a particularly demanding activity, associated with individuals of high intellectual ability. At the same time, women remain underrepresented among professionals in this field. These elements can reinforce lower levels of self-efficacy among female students, who may anticipate less favorable outcomes in activities perceived as requiring exceptional ability. This suggests the importance of considering educational strategies that challenge the assumption that aptitude for computing-related activities, such as programming, is linked to gender.

"WE COME FROM A SOCIETY THAT IS NOT VERY WELCOMING TO WOMEN IN THIS FIELD": GENDER EQUALITY CONDITIONS

So far, we have examined the interviewees' childhood memories in order to explore the impacts of socialization processes, the construction of gender stereotypes, and the transition from elementary school to an Integrated Technical Program in Informatics at the high school level. In this section, we turn to the participants' perceptions of learning opportunities and of the receptivity encountered in the program by both male and female students, particularly within classroom experiences related to the technical aspect of the curriculum.

Regarding learning opportunities and treatment by the teachers, interviewee Renata tells us that she "saw"

> (...) a certain favoritism from the teachers toward the boys because they had more background to discuss things, to think of new ideas in computer science. I was still learning the basics and was kind of distant from all that. It wasn't just me, because I talked with the other girls too, and it was a relatively collective feeling [laughs]. (Renata).

In a similar vein, participant Caren alludes that

> (...) the teachers gave more attention to the boys. I always felt that, and my classmates could confirm the same because we went through the same experiences. We always had the impression that since the boys had an easier time—some of them already had the knowledge, had previous contact with certain subjects—the attention was focused on them, not on those who were just starting, who didn't understand, who didn't know how it worked. (Caren).

Based on these testimonies, when participants referred to differential treatment by teachers that appeared to favor boys due to their perceived abilities—for example, that "they had more to talk about (...) in the area of computer science" (Renata) and that "they had an easier time, since some already had prior knowledge" (Caren)—it suggests that, even if unintentionally, there was a reinforcement of the stereotypical view that boys are better prepared in this field. The document Cracking the Code: Girls' and Women's Education in STEM (Organização das Nações Unidas para a Educação, Ciência e Cultura, 2018) identifies schools as key institutions in promoting interventions aimed at fostering students' interest and engagement in STEM. In this sense, it is important that teachers remain attentive to gender issues so that they can address these perceptions and develop and implement practices and curricula aimed at promoting greater gender equity, rather than reinforcing stereotypes such as those described above.

From another perspective, Denise indicated that she did not perceive any distinction in learning opportunities or treatment based on gender. In her interview, she stated that the campus environment "was always very good in this regard, for both girls and boys. They were always welcoming, they listened to everything we said, all our questions, and never left anyone out"

(Denise). Roberta expressed a similar view: "(...) inside the classroom, I never felt that my learning was hindered because I was a girl" (Roberta).

Priscila also stated that she perceived the course as offering learning opportunities that benefited everyone; however, she saw the lack of female role models as a problem:

> Seeing few women in the field. There are way more male teachers than female teachers... We learned very little about the history of computing, and when they talk about who created something or who started something, they usually mention men. Or who's famous in a certain area, certain work... So, there's a lack of role models for you to see yourself in that space. (Priscila).

Supporting this account is the statement from Isabel:

> (...) in the first year, we studied a little about the history of computing, and learned some of the better-known names. I also remember that we only studied men. So I think the program kind of prepares you to realize that most of the people you'll be studying with are men. (Isabel).

What stands out in these accounts is the association between the field of Informatics and a predominantly male presence. Renata also expressed her disappointment at the lack of female representation among the teaching staff:

> (...) one thing that was disappointing was that we saw that all the computer science teachers were men. We had a female computer science teacher in the last year, but she didn't even teach our class. I saw that she taught another class, and even so, my classmates would make jokes about her. So that was relatively discouraging when it came to choosing the program. (Renata).

The students' references to the lack of female representation, whether among computer scientists in the field or among teachers in the course, point to the issue of role models. When girls do not see people with whom they identify, this may become an important factor in their decision not to pursue their educational paths in this area (Dasgupta, 2011; Cheryan; Master; Meltzoff, 2015).

Revisiting the statements of Isabel and Renata, we turn our discussion to the fact that scientific careers in STEM fields, including Computing, are still largely male domains. As a result, there is a perception that "science is them, science is not me" (Nosek; Banaji; Greenwald, 2002), which implies that the more "they" are in science, the less science is seen as belonging to women. We find this idea echoed in Denise's account, when she says: "(...) every year the teachers were men... you feel afraid that you won't succeed, even though you have all this support." (Denise).

Providing female role models and broadening the image of these fields enables students to develop a sense of scientific identification without having to conform to widely circulated stereotypes of success. Expanding the representation of those who work in these professions, as well as of the careers themselves and the environments in which they are practiced, can significantly strengthen students' sense of belonging and interest in the field.

> I don't remember there being that many girls, especially toward the end of the program. It's always really hard to speak up if you wanted to say something. Many of my high school classmates think I'm a mean person, but that's the mechanism I found to, in environments where most people are men, make myself heard; [otherwise], no one listens, they interrupt you, and just speak over you. I do feel that when we're talking, especially about technical matters, for example with a boy, they have this air of superiority. Dealing with colleagues like that was really difficult. (Roberta).

Another issue that emerged from the interviewees' recollections concerns the attitudes of male classmates toward the presence of women in the program, whether in the form of a woman teaching in the technical area or in the presence of the female students themselves. We illustrate these accounts with Renata's remark: "(...) I saw that she was teaching another class, and even so my classmates made jokes about her [the teacher]" (Renata). In the same

vein, Isabel reports that "(...) I felt there was a certain difference in the treatment my classmates [boys] gave" (Isabel) to the girls.

Continuing with the students' recollections of the treatment they received from their male classmates, we turn to Roberta's statement: "(...) I never aligned myself with the group that had more technical knowledge; I aligned myself with many people who had difficulties very similar to mine" (Roberta). In this account, she refers to her male classmates as those with "technical knowledge," while referring to her female classmates as those who "had difficulties very similar" to her own. Likewise, another interviewee reflects:

> we kind of built our own support system so we wouldn't have to ask out loud. So if I had a question, I'd ask one of the girls, and they'd ask me, and we'd build our understanding that way, little by little. Every now and then we'd ask the teachers, but most of the time we tried not to put ourselves out there. (Renata).

Indeed, "the peer group corresponds to a social laboratory, where adolescents experiment with roles and functions, make decisions without their parents' intervention, and adapt their behavior to sociocultural norms" (Rabaglietti; Ciairano, 2008). The accounts highlighted here show that peers significantly shaped the interviewees' motivation and sense of belonging to the program and, consequently, to computing. As reported in the interviews, attitudes and stereotypes associated with male classmates, combined with the perception that female peers "(...) didn't know as much about these things, weren't as involved in this universe (...)" (Estela), reinforced disinterest and feelings of low self-efficacy, undermining the girls' confidence in considering a future in the field. The interviews also indicate that the female peer group developed a collective strategy for "getting through" the program. Notably, only two of the twelve interviewees went on to continue their studies in this area.

For young women to feel that they belong in this space and, perhaps, continue their educational path in computing, they need an environment free from gender stereotypes. The school environment, especially during technical high school, through awareness-raising initiatives and open discussions about the presence of women in STEM fields, particularly in computing, constitutes a fertile space for fostering collective engagement with gender issues. We believe that this ongoing dialogue would have a positive impact on the retention of female students in the field of computing.

"(...) I GOT A LITTLE UPSET; I'VE CARRIED THAT WITH ME EVER SINCE": BEYOND THE CLASSROOM — SCHOLARSHIP AND INTERNSHIP OPPORTUNITIES

The Federal Institutes of Education, Science, and Technology offer, within the scope of institutional programs and projects, scholarships linked to teaching, research, extension, or innovation activities for regularly enrolled students. In addition, all students may undertake internships within the institution to meet specific demands. Selection is carried out through specific public calls issued for each opportunity. This brief explanation is necessary because the possibility of a female student being awarded a scholarship or internship in the field of Computing was a recurring topic in the interviews.

Among those who raised the issue of scholarships, a common point emerged: it was emphasized that it is "very difficult for a girl to be selected" (Roberta), even when she goes through the process and meets all the requirements. Helena offers a particularly compelling account of this situation:

> There's just one thing that still makes me upset to this day, but it wasn't in the first year; it was in the third, when the IT area opened a scholarship for us to help out in computing. I was the only girl to interview for that scholarship, and they ended up choosing a boy. Maybe it was because he had more knowledge than me, but he was in the first year and I was in the third. So I got a little upset; I've carried it with me ever since [laughs]. (Helena).

During the interview, she further added:

> (...) I remember that during the interview the guy even asked me if I would feel out of place in the little IT room, since there were only men there. I said it wasn't a problem, that I would just work normally. There's no reason for it to be any different, and it ended there. (Helena).

From her account, it became clear that the opportunity in question was an internship in the campus IT department. She notes that this episode was particularly significant in her educational trajectory, as she still recalled the incident at the time of the interview, even after completing the program. Renata, in turn, offers something of a retrospective on women's participation as scholarship recipients or interns in the field of Informatics:

> (...) this is very clear: just look at the teaching scholarships in programming, tutoring... we never had a girl. We never had a teaching assistant or extension student in programming, at least in my time. The girls got scholarships in history, biology, philosophy, in extension, in research, but not in programming. In my whole experience, all the monitors were boys. (Renata).

In recent years, specific programs in both the public and private sectors across different countries have promoted scholarship opportunities for women, particularly in professions in which they are underrepresented (Organização das Nações Unidas para a Educação, Ciência e Cultura, 2018), such as Computing. The objective of these programs is to develop and encourage women to pursue their educational trajectories and enter these professions. We maintain that this movement must continue to expand and become irreversible if gender disparities in these fields are to be effectively overcome.

It is concerning to observe that qualified young women in Informatics have been passed over in scholarship or internship selection processes, thereby reinforcing stereotypes, or that they may not feel capable of applying for such positions simply because they are women. There is no justification for denying academic and professional development opportunities on the basis of gender alone. Particularly in an educational institution, diversity of ideas, experiences, and perspectives must be upheld, as it is fundamental to advancing women's representation in the field of Computing.

"*IF PARTICIPATION IN THE FIELD WERE A LITTLE MORE BALANCED ...*": CONCLUDING REMARKS

As previously mentioned, of the twelve interviewees, only two continued in the field of Informatics. Even among those who did not participate in the study, we know that, since the program was created, these two are not joined by many others, and clearly, this is a problem. This issue is not confined to the institution, to its faculty, or to the staff members who work there and are committed to providing an excellent education for their students. Nor is it a problem that affects only women. Rather, it is a broader societal issue, as we have seen that opportunities are not equally available to everyone, even though prevailing discourses suggest otherwise.

We encountered many accounts. Not all of them could be included in this article, and not everything was expressed during the research process. We recognize this, and such recognition stems both from everyday experience and from preliminary quantitative research (Barbosa et al., 2021). However, in the interviews, we heard from women who face and have faced situations of gender inequality, and from their narratives subtle events emerged that may have been overlooked throughout their educational trajectories. A concern that was already present among the authors prior to the study has, in some ways, intensified and must now be transformed into concrete action to help change this scenario.

In the labor market, these difficulties become even more pronounced, as the environment is generally not as "welcoming" or "protected" as the school setting. This is evident in the accounts of what students experienced in the classroom as they engaged with computing knowledge and progressed through their coursework, as well as in the statements of those who worked in the field during or after completing the program. Isabel's remarks suggest that,

had she experienced greater interaction with women colleagues throughout her educational and professional trajectory, she might have remained in the field of Computing:

> there's [...] the difficulty of being a woman in this field. It's just harder. Every time I start working somewhere, I'm working only with men, 95 percent of the time. And sometimes I'm not treated the same way. They always expect less from my work. They always assume I won't be as good as I actually can be (...). That definitely affected me. If participation in the field were a little more balanced between men and women, maybe I would have stayed longer. I don't know. (Isabel).

Drawing on gender studies, we know that even in the early days of industrial capitalism, women were incorporated into the productive system, albeit in a condition of extreme subordination. From the outset, they received the lowest wages, occupied the most devalued positions, and were subjected to violence and sexual abuse. As Méndez states, women's entry into the labor market was viewed as a "'necessary evil,' a resource to supplement the meager household income" (Méndez, 2005, p. 52). In this way, "capitalism brought into the public sphere the discrimination that women faced in the private sphere" (Méndez, 2005, p. 52). However, women did not remain silent in the face of this problem. With the advent of feminism, the struggle for better working conditions and pay became, and remains, an important demand. Yet, even with the increasing structural complexity of the productive system and the consolidation of women's struggles, inequalities persist and are more evident in certain sectors, particularly those offering higher levels of remuneration, such as Computing.

In this regard, many of our interviewees stated that one strategy for changing the current situation of gender disparity in the field of Information Technology would be to create spaces for discussion, speak openly about the issue, and demonstrate that there is space for women in the world of work. Educators who work with these students must create opportunities to respond to this demand.

We also understand, within the scope of the research conducted, that the advocated model of Integrated Secondary Education implemented in the Federal Institutes aims to provide students with the possibility of entering the labor market through their technical training, pursuing higher education in the same technical field, and, having had access to an excellent general education, pursuing further studies in a different area. However, what we perceived in the accounts of some of the interviewees, read considering the studies on this topic, is the existence of an invisible barrier that prevents certain individuals, because of their gender and all the issues we have outlined throughout this text, from accessing particular professions and opportunities.

Consequently, educational institutions cannot shy away from engaging in discussion and critical self-examination regarding how they address these issues, which we know are not unique to the campus analyzed here. The results make it evident that data on women's participation in STEM reflect broader national and international patterns. The low representation of women in these areas, highlighted in this study, reinforces the need to devise strategies aimed at overcoming barriers and dismantling stereotypes that may influence women's choice to pursue these fields. Based on the analyses and reflections presented in this article, it is hoped that the contributions offered here may inspire effective change and concrete measures to promote gender equality in science and technology.

ACKNOWLEDGMENTS

To IFRS and CNPq for the scientific initiation scholarships granted.

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Authors contribution
EMCB and DC: Conceptualization, Methodology development, Project management, Data collection and analysis, Manuscript writing.

Editor: Prof. Dr. José Luís Bizelli
Deputy Executive Editor: Prof. Dr. Flavia Maria Uehara