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Women's Career Development in the Information Technology and Computing Sector in Argentina: How Counterspaces Cultivate Self-Efficacy

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Abstract: The purpose of this study was to investigate the role of social environments in women's career development in Information Technology and Computing (ITC) by examining how two distinct environments—workforce development programs and informal online communities—shaped the career development of postsecondary female students in Argentina. We drew on self-efficacy and counterspaces to frame the study. Our data came from in-depth interviews with 29 women who were studying or had graduated from college. We analyzed the data using iterative coding, which enabled us to apply our framework. All had completed short workforce development programs and were members of informal, online communities for women in ITC. We found that when counterspaces fostered a sense of safety and belonging, they enabled women to take risks and engage in mastery experiences. Second, we found that the counterspaces helped the women build or join a supportive community, providing them with vicarious learning experiences and verbal

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persuasion. Finally, when the counterspaces provided all three benefits to women—a supportive community, safety and belonging, and the mitigation of stereotypes—the women experienced emotional arousal. We conclude the manuscript by connecting our findings to the extant literature and suggesting directions for future research.
Keywords: career development; information technology and computing; self-efficacy; counterspaces; Argentina

El desarrollo profesional de las mujeres en el sector de tecnologías de la información y la computación en Argentina: Cómo los contraespacios cultivan la autoeficacia

Resumen: El propósito de este estudio fue investigar el papel de los entornos sociales en el desarrollo profesional de las mujeres en el ámbito de las Tecnologías de la Información y la Computación (TIC), examinando cómo dos entornos distintos—programas de desarrollo de la fuerza laboral y comunidades informales en línea—configuraron el desarrollo profesional de mujeres estudiantes de educación superior en Argentina. Nos apoyamos en los conceptos de autoeficacia y contraespacios para enmarcar el estudio. Los datos provinieron de entrevistas en profundidad realizadas a 29 mujeres que estaban cursando estudios universitarios o que ya se habían graduado. Analizamos los datos mediante un proceso de codificación iterativa, lo que permitió aplicar nuestro marco analítico. Todas las participantes habían completado programas breves de desarrollo laboral y eran miembros de comunidades informales en línea para mujeres en TIC. Encontramos que, cuando los contraespacios fomentaban una sensación de seguridad y pertenencia, posibilitaban que las mujeres asumieran riesgos y participaran en experiencias de dominio. En segundo lugar, observamos que los contraespacios ayudaron a las mujeres a construir o integrarse en una comunidad de apoyo, proporcionándoles experiencias de aprendizaje vicario y persuasión verbal. Finalmente, cuando los contraespacios ofrecían simultáneamente los tres beneficios—una comunidad de apoyo, seguridad y pertenencia, y la mitigación de estereotipos—las mujeres experimentaban activación emocional. Concluimos el manuscrito vinculando nuestros hallazgos con la literatura existente y sugiriendo orientaciones para futuras investigaciones.
Palabras clave: desarrollo profesional; tecnologías de la información y la computación; autoeficacia; contraespacios; Argentina

O desenvolvimento da carreira das mulheres no setor de tecnologia da informação e computação na Argentina: Como os contraespaços cultivam a autoeficácia

Resumo: O objetivo deste estudo foi investigar o papel dos ambientes sociais no desenvolvimento da carreira das mulheres na área de Tecnologia da Informação e Computação (TIC), examinando como dois ambientes distintos—programas de desenvolvimento da força de trabalho e comunidades informais on-line—moldaram o desenvolvimento profissional de mulheres estudantes do ensino superior na Argentina. Utilizamos os conceitos de autoeficácia e contraespaços como base teórica do estudo. Os dados foram obtidos por meio de entrevistas em profundidade com 29 mulheres que estavam cursando ou já haviam concluído o ensino superior. A análise dos dados foi realizada por meio de codificação iterativa, o que possibilitou a aplicação do referencial analítico. Todas as participantes haviam concluído programas de curta duração de desenvolvimento profissional e eram integrantes de comunidades informais on-line voltadas para mulheres na área de TIC. Constatamos que, quando os contraespaços promoviam um senso de segurança e pertencimento, possibilitavam que as mulheres assumissem riscos e se engajassem em experiências de domínio. Em segundo lugar, observamos que os contraespaços auxiliaram as mulheres a construir ou integrar uma comunidade de apoio, proporcionando

experiências de aprendizagem vicária e persuasão verbal. Por fim, quando os contraespaços ofereciam simultaneamente os três benefícios—uma comunidade de apoio, segurança e pertencimento, e a mitigação de estereótipos—as mulheres experimentavam ativação emocional. O manuscrito é concluído articulando os achados com a literatura existente e sugerindo direções para pesquisas futuras.
Palavras-chave: desenvolvimento de carreira; tecnologia da informação e computação; autoeficácia; contraespaços; Argentina

Women's Career Development in the Information Technology and Computing Sector in Argentina: How Counterspaces Cultivate Self-Efficacy

Though women are underrepresented across the disciplines of science, technology, engineering, and math (STEM) occupations, their underrepresentation is particularly pronounced in information technology and computing (ITC; Cheryan et al., 2017). Across countries in the Organization for Economic Cooperation and Development, women are three to eight times less likely than men to work in ITC (OECD, 2023). In Argentina, where this study is situated, 82% of students enrolled in ITC programs in higher education in 2020 were men. Similarly, 85% of students graduating with ITC degrees were men (Marino et al., 2023). Among individuals working in the Argentine ITC sector, women comprise only 33.3% of all formal ITC employees (OEDE-MTEySS, 2022). Women's participation is also unequal across subareas within the Argentine ITC, career levels, and salaries (Yansen, 2023).

Women's underrepresentation in ITC studies and careers results from multiple factors, including cultural and social influences, as well as educational and workplace barriers. For example, gender stereotypes about ITC persist and can unintentionally lead women never to consider or leave the field (Adya & Kaiser, 2005; Armstrong et al., 2018; Berg et al., 2018; Beyer, 2014; Chen et al., 2024; Cheryan et al., 2013; Deechuay et al., 2016; Denner et al., 2012; Sax et al., 2017; Varma, 2010). Similarly, girls and women interested in ITC may be discouraged from taking or persisting in ITC courses (Vainionpää et al., 2021). Furthermore, they may lack effective role models who can dispel stereotypes about computing (Cheryan et al., 2011, 2013). Finally, women who do persist in ITC may encounter a hostile workplace where men are unaccustomed and even opposed to women in the sector (Annabi, 2023; Kuteesa et al., 2024; Naseviciute & Juceviciene, 2023). Once they are working, women may struggle to find the mentors they need to be successful (Clarke-Midura et al., 2017; Kuteesa et al., 2024) and to achieve work-life balance (Kuteesa et al., 2024).

In response to the many challenges women face when entering the ICT sector, researchers, educators, policymakers, and industry have sought ways to address the problem's roots. Educators and researchers have developed curricula (Goode et al., 2012; Scott et al., 2014), informal learning programs (Gan et al., 2022; Goode et al., 2012; Maciel et al., 2018; Nandi & Mandernach, 2016; Pinkard et al., 2017; Robinson et al., 2016), provided mentoring (Boston & Cimpian, 2018; Cozza, 2011; Dasgupta & Stout, 2014; Ericson et al., 2022; Lee, 2019), role models (Black et al., 2011) and leveraged informal online communities (Fields et al., 2017) to foster girls' and women's interest and success in ITC.

Despite the increased attention to women's low participation in ITC, researchers have paid less attention to how to support young women (Akar et al., 2024; Makola & Kgosinyane, 2020; Prieto-Rodriguez et al., 2022) and how different learning environments can support them. Indeed, a recent review of research on women in ITC highlighted the importance of the social environment in which women learn computing, concluding that "social contexts may be especially malleable and well-positioned for gender-equity-focused computing interventions" (Perez-Felkner et al., 2024, p.

543). Social environments refer to the formal and informal spaces in which individuals encounter and engage with computing. As Perez-Felkner and colleagues describe them, social environments range from "technological toys and games in childhood to computing major selections in adulthood" (p. 543). Importantly, social environments are *social,* and girls and women often interact with other people as they engage with computing.

The purpose of this study was to respond to the call to investigate the role of informal social environments in young women's career development in ITC by examining how two distinct social learning environments (workforce development programs and informal online communities) shaped the career development of postsecondary female students in Argentina. By doing so, we are addressing an essential question: how do formal and informal social learning environments support women's career development in ITC? Furthermore, we take on this task in the national context of Argentina, which has received relatively little attention but is undergoing rapid change. The following research question guided our study: *How do vocational and job training programs and informal networks shape the experiences of women studying ITC in Argentina?* Drawing on Bandura's concept of self-efficacy (Bandura, 1977, 1982, 1986) and the notion of counterspaces (Ong et al., 2018; Solorzano et al., 2000), we argue that workforce programs and informal online communities constitute counterspaces that offer women opportunities to develop their ITC self-efficacy.

Women's Career Development in ITC: Self-Efficacy and Counterspaces

We considered Argentine women's experiences as part of a broader career development process to answer our research question. Self-efficacy is part of this process, stimulating individuals' outcome expectations and interest (Lent et al., 1994, 2000, 2011). To understand how workforce programs and informal online communities shaped women's self-efficacy, we turned to Solorzano and colleagues' (2000) notion of *counterspaces*.

Self-Efficacy

We relied on self-efficacy as a starting point for understanding women's experiences in IT studies and careers. Self-efficacy refers to individuals' beliefs about their ability to complete a given task (Bandura, 1982, 1986). What we believe about ourselves and our ability to complete a task is instrumental for learning, our career expectations, and future decisions (Lent et al., 1994, 2000, 2011). Individuals with high self-efficacy have higher expectations and believe it is possible to tackle challenging situations (Bandura, 1989, 1993).

Bandura (1977) outlined four mechanisms to cultivate self-efficacy: mastery experiences, vicarious experiences, verbal persuasion, and emotional and physical arousal. Mastery experiences are those learning experiences in which we can accomplish the task. These experiences are the most potent source of self-efficacy because successfully overcoming challenges builds confidence in one's abilities. Vicarious experiences are those in which we observe others complete a task. Seeing someone like us succeed can strengthen our belief that we, too, can succeed in that domain. It also can yield insight into how to complete a task successfully. Verbal persuasion is the feedback and encouragement from important people (e.g., parents, teachers) that relate to our ability to complete the task. When delivered authentically and specifically, such encouragement can help individuals see they can complete a task and persist in the face of difficulty. Finally, emotional and physical arousal or states refer to our well-being and mood when we attempt to complete a task. High levels of stress or anxiety may undermine self-efficacy, whereas feelings of calm and excitement can enhance one's belief in their ability to succeed. Being in a positive state of mind is associated with greater self-efficacy, whereas being in a negative state is associated with lower self-efficacy. We used self-efficacy

and its four sources to examine how vocational and job-training programs and informal networks shape Argentine women's ITC self-efficacy.

Gender Stereotypes, Self-Efficacy, and Women in ITC

Gender stereotypes are a significant barrier for women in ITC. Indeed, much of society continues to view—and portray—ITC as a masculine field (Adya & Kaiser, 2005; Armstrong et al., 2018; Berg et al., 2018; Beyer, 2014; Chen et al., 2024; Cheryan et al., 2013; Deechuay et al., 2016; Denner et al., 2012; Sax et al., 2017; Varma, 2010), associating it with solitary work and a narrow focus on technology (Cheryan et al., 2013; Lin, 2016; Main & Schimpf, 2017). This stereotype may make women perceive ITC as incompatible with their interests, values, or identity (Cheryan et al., 2013). Additionally, stereotypes such as the "geek" or "nerd" image, which suggest a lack of social skills and intense dedication to computers, reinforce the idea that computing is a male-dominated domain (Berg et al., 2018; Cheryan et al., 2013; Sax et al., 2017). These perceptions can influence women's sense of belonging and lead them to question their place within the field (Cheryan et al., 2013; Cundiff et al., 2013; Denner et al., 2012; Höhne & Zander, 2019; Lin, 2016; Smith et al., 2020; Völkel et al., 2018).

Gender stereotypes also can have profound effects on women's self-efficacy in ITC. As a result of gender stereotypes, women are more likely to doubt their abilities (Deechuay et al., 2016; Denner et al., 2012; Dickhäuser & Stiensmeier-Pelster, 2003; Goh et al., 2007; Höhne & Zander, 2019; Lin, 2016; Varma, 2010; Wilson, 2002) despite performing at similar or higher levels than their male counterparts (Denner et al., 2012; Höhne & Zander, 2019; Lin, 2016; Smith et al., 2020; Völkel et al., 2018). Lower self-efficacy directly affects women's motivation and persistence in ITC programs and careers, discouraging them from fully engaging with the subject or pursuing it as a college major or career path (Chen et al., 2024; Denner et al., 2012; Dickhäuser & Stiensmeier-Pelster, 2003; Gürer & Camp, 2001; Höhne & Zander, 2019; Smith et al., 2020; Varma, 2010) or persisting in the field once they enter (Lin, 2016).

Other factors also contribute to women's ITC self-efficacy. Early exposure to computers, encouragement from parents, teachers, and peers, and early achievements in technology-related activities positively influence self-efficacy. However, a gender disparity in access to such experiences often exists, with boys typically receiving earlier and more intensive exposure to computing (Adya & Kaiser, 2005; Ash et al., 2006; Beyer, 2014; Beyer & Haller, 2006; Denner et al., 2012; Dickhäuser & Stiensmeier-Pelster, 2003; He & Freeman, 2010; Katz et al., 2003; Lehman et al., 2023; Main & Schimpf, 2017; Varma, 2010). Belonging uncertainty, fueled by unwelcoming environments and "chilly climates" in educational and professional settings, further undermines women's confidence and motivation to persist in ITC (Chen et al., 2024; Höhne & Zander, 2019; Scott et al., 2017; Weidler-Lewis et al., 2019). Finally, some studies suggest that men might perceive ITC as more useful for future goals than women (Höhne & Zander, 2019). This difference in perceived utility value can influence career aspirations.

Research points to ways to support women's participation in ITC fields via higher self-efficacy. One way is to provide early exposure to ITC (Denner et al., 2012; Lehman et al., 2023; Main & Schimpf, 2017; Völkel et al., 2018), create inclusive environments (Cheryan et al., 2009, 2011; Höhne & Zander, 2019), and promote female role models and mentors who can challenge stereotypes and inspire confidence (Berg et al., 2018; Chen et al., 2024; Denner et al., 2012; Lehman et al., 2023; Lin, 2016; Main & Schimpf, 2017). Collaborative learning environments and playful learning experiences that cater to women's preferences can cultivate their self-efficacy. Collaborative working and learning environments may invite diverse perspectives, provide emotional support and validation, and increase access to and retention in coding and programming course activities for girls and women, who tend to be more heavily influenced by the social element of STEM fields (Pantic &

Clarke-Midura, 2023). Exposure to gender-egalitarian attitudes can also help protect females from negative stereotypes (Deechuay et al., 2016; Weisgram & Bigler, 2006). Educators can also encourage collaborative, socially engaging projects to counter the "geek" stereotype and foster an inviting atmosphere (Chen et al., 2024; Mau & Li, 2018). Emphasizing the real-world impact of computing and showcasing diverse career opportunities can also attract women by aligning with their interests (Main & Schimpf, 2017; Sax et al., 2017).

Finally, peer networks and family engagement initiatives can offer additional support, as research has shown that strong social backing can bolster confidence and belonging among women in ITC. Establishing supportive peer networks and mentoring programs specifically for women in computer science can provide valuable support and reduce feelings of isolation (Boston & Cimpian, 2018; Main & Schimpf, 2017). Supportive communities, mentoring networks, and peer support foster a sense of belonging and increase women's engagement and persistence (Cozza, 2011; Ehrlinger et al., 2018).

Counterspaces

One approach to supporting women in ITC involves creating environments where women can support one another, validate their experiences, and counter negative stereotypes (Ong et al., 2018, 2022; Pantic & Clarke-Midura, 2023; Ruttenberg-Rozen & Hynes, 2022; Solorzano et al., 2000). Researchers call such environments *counterspaces* because of their instrumental role in helping marginalized students resist and persist (Ong et al., 2018, 2022; Ruttenberg-Rozen & Hynes, 2022; Solorzano et al., 2000). Though counterspaces are not new, there is a need to understand better how they work, particularly in spaces that have received relatively less attention, such as ITC. Indeed, Ong and colleagues (2018) argue that "it is imperative to understand the formal and informal structures and relationships that support [women], as well as enable them, to contribute innovative knowledge and perspectives in STEM and to serve as role models for the next generation" (p. 207).

Researchers have found that counterspaces can exist in a range of settings. Solorzano and colleagues (2000) and Ong and colleagues (2018) found that counterspaces often exist in informal settings, such as student groups, mentoring relationships, and peer-to-peer relationships. However, they also can exist in formal settings, for example, in academic departments (Ong et al., 2018), in structured research programs (Morton, 2021), or in fellowship programs (Townsend & Sloan, 2016). In this study, we examine how formal *and* informal learning environments shape women's experiences as they progress toward ITC careers.

Self-Efficacy and Counterspaces in the Present Study

In this study, we conceived of workforce training programs and informal online communities as counterspaces where women can feel safe in a career dominated by men and that can cultivate their self-efficacy. Based on our analysis and as we outline in Table 1, we found the workforce programs and informal online communities played three roles: 1) help women build or join supportive communities; 2) create a sense of safety and belonging; and 3) mitigate negative stereotypes. By way of these three mechanisms, the counterspaces helped make our participants more willing to take chances and learn (mastery experiences), observe others who are experts in ITC (vicarious learning experiences), enabled them to encourage others and receive encouragement (verbal persuasion), and helped them support each other through a positive environment (emotional and physical arousal). As we discuss further below, we also found that, under some conditions, the formal and informal learning environments did not serve as counterspaces. We also found that providing safe, supportive spaces was not always enough, and that the participants had to be proactive to get the most out of their learning environments. With this study, then, we shed light on when social learning environments are most likely to cultivate self-efficacy among women studying

and working in ITC in Argentina. As we continue the discussion, our findings have implications for how governmental and nongovernmental agencies can structure learning spaces to best support women in ITC.

Table 1

How Workforce Programs and Informal Online Communities Cultivate Self-Efficacy

Strengthening Self-Efficacy				
Workforce programs and online communities as counterspaces	Mastery experiences	Vicarious learning experiences	Verbal persuasion	Emotional & physical arousal
Build/Join a supportive community		Observe others who are more expert	Women encourage each other	
Create a sense of safety and belonging	Women are willing to take chances and learn			Women support each other and help create a positive environment
Mitigate negative gender stereotypes			Women encourage each other	

Design and Methods

Context and Setting

This study took place in three different cities in Argentina. In the years leading up to the 2023 presidential election, Argentina took several steps to increase women's inclusion in STEM areas. The first law of note, which passed in 2006 ("Comprehensive Sexuality Education", No. 26,150), required all educational institutions at all levels to promote gender integration. The government created the Ministry of Science in 2007, which enabled policies and programs to increase women's participation in science (Subsecretary of Science and Technology, 2024). Then, in 2019, the national congress passed another law ("Law for Obligatory Gender Training" or "Micaela's Law", No. 27,499) that required all public servants, including teachers, to have training in gender dynamics and violence.

Furthermore, in 2018, the National Institute of Technological Education established the Gender Equity Commission, which aimed to promote a gender perspective across all areas of STEM education. Just one year later, the government formed the Ministry of Women, Gender, and Diversity, which promoted other gender-related policies. However, the 2023 presidential election ushered in a new administration that has sought to eliminate all instances of gender-focused policies and programs in the country. For example, the new administration eliminated the Gender Equity Commission and the Ministry of Women, Gender, and Diversity, among other steps.

All the women who participated in our study were university students. Some were studying areas such as Systems Analysis and Informatics, and Web Design in short tertiary programs. Others were majoring in engineering and data science, primarily at the University of Buenos Aires and the

National University of Technology. All of them had completed one of three informal workforce development programs (see below for more details about the participants).

We studied three types of workforce development programs. We selected programs based on the ICT career development literature (Dughera et al., 2012; Millenaar et al., 2024), which points to three types of learning: a) formal degree-conferring programs (e.g., university programs), b) non-formal programs such as courses and certificates that do not confer a degree, and c) informal learning, such as through on-the-job "trial and error" (Dughera et al., 2012, p. 92), mentorship, and blogs, among other sources. For this reason, we included a formal workforce program administered by the Buenos Aires Municipal Ministry (which local students attend in person), non-formal training courses, and informal online communities for women in ICT. For the non-formal programs, we selected those that focus on closing the gender gap between men and women, either by reserving a certain number of slots for women or by serving only women.

The first type comprised general municipal programs. Public workforce development programs in Argentina typically last between four months and two years and are delivered in public centers, union centers, or other civil society organizations, in partnership with the provincial educational system. In general, these programs offer courses that align with a traditional understanding of the gender-based division of labor. For this reason, the specializations offered are 'typically feminine' or 'typically masculine', with ITC being an example of the latter. The one we studied was located in and run by the City of Buenos Aires.

The second type was an informal public program that focused on gender to eliminate gender bias in ITC. This program is called Arm-in-Arm (*Codo a Codo*; CaC) and is in the city of Buenos Aires; however, it is offered online and is therefore open to anyone in the country. The program teaches programming to youth and adults who have completed at least secondary school and lasts 20 weeks. There has been tremendous demand for the course nationwide, and in 2023, 80,730 individuals applied for 18,000 spaces. In 2022, 13,252 people completed the program. The program reserves 50% of spots for women and offers the option of having a mentor. When mentors are women, they also serve as role models and offer vicarious learning experiences, in addition to providing women with mastery experiences in the program.

Finally, we recruited some participants from other workforce development programs open only to women. One of these was Women Programmers, which was in the city of Corrientes in the northeast of the country. The program offers short, four-week courses to get women interested in ITC. Women must have completed secondary school to participate. This program caters only to women, utilizes strategies to personalize the experience, and offers guidance. We also recruited women from two additional training programs, "boot camps," offered by two nonprofits: Women in Technology (*Mujeres en Tecnología*, MeT) and Girls in Technology (*Chicas en Tecnología*, CeT). These programs aim to increase women's access to programming. The participants in our study from these two programs were from the provinces of Córdoba and Chaco, in the north of the country.

Participants

We designed a qualitative study based on in-depth interviews. Our purposive sample comprised 29 women aged 19 to 38 who were either enrolled in or had graduated from university *and* participated in a workforce development program and an informal online community. The sample, therefore, was not homogeneous regarding age, place, or residency; however, it was homogeneous in terms of participants' education levels and participation in workforce development programs and collective spaces. To recruit participants, we approached all the selected programs with whom we already had worked and requested contact information for women who had completed their programs *and* were university students. Eligibility criteria, therefore, included: a)

program completers from one of the programs we described above, and b) university graduates from ICT-related majors. We used the contact information to call eligible women, explain the study and its objectives, and explain the confidentiality of their participation. Once we began the interviews, we used the snowball sampling technique, asking participants to refer us to similar friends or colleagues who might be interested in participating (Flick, 2006). Prior to interviewing participants, we obtained verbal consent in accordance with our approved IRB protocol.

As shown in Table 2, although all participants had some college education, more than half were the first in their families to complete secondary school (i.e., first-generation students). In terms of their work situation, the majority already were working in the IT sector: nine in software, three in testing, two in web design, three in IT training, and two in leadership positions. Four participants were working in other sectors, and the others were not working at the time of the interview. About half of the participants lived in metropolitan Buenos Aires, the capital of Argentina, and the rest lived in other provinces. A small minority were mothers with children. Finally, all the participants had been through a workforce development program: 22 in programs focused on gender and seven in traditional programs that did not.

Table 2

Participants' Demographic Profile

Demographic Characteristics	Count	Percent
Age Groups		
19-29 years old	22	75%
30-38 years old	7	25%
Place of Residency		
Metropolitan Buenos Aires	15	51%
Other provinces	14	49%
Higher Educational Level		
College started, but not completed	20	69%
College complete	9	31%
First-Generation Status		
Not First-Generation	14	49%
First-Generation	15	51%
Work Status		
Working	23	80%
Unemployed	1	3%
Not searching for work	5	17%
Mother with Children		
Yes	6	20%
No	23	80%
Participation in Workforce Development Programs		
Traditional Program (public co-educational programs)	7	24%
Programs Focused on Gender (co-educational; *CaC*)	11	38%
Programs Focused on Gender (women only; Women Programmers, Corrientes; MeT, Cordoba; CeT, Chaco)	11	38%

Data Collection and Analysis

We carried out some interviews virtually and others in person at the institutions we contacted. The interviews were semi-structured, and we used the same interview protocol to guide all interviews. The interviews lasted between 45 and 60 minutes. We conducted the interviews in March and May of 2023 via Google Meet.

We began our analysis by transcribing and uploading the transcripts into Atlas.ti. We carried out the coding process in phases (Saldaña, 2009), beginning with open coding to identify relevant excerpts. We segmented the information we identified and assigned emergent labels or code names. In the second phase, we started with emergent codes and began organizing them into more abstract codes, understanding how the more abstract codes related to each other. This way, we reorganized, compared, regrouped, and more precisely reformulated the codes and categories. We refer back to Table 1 above, which synthesizes how the data emerged at the intersection of our two frameworks, to share more about how our codes led to the categories summarized in the table. The "willing to take chances and learn" category included the following codes: "learning challenges", "overcoming learning obstacles", and "feelings of confidence in their learning". The "observe others who are expert" category derived from the following codes: "mentoring relationships", "relationship with female instructors", "relationship with male instructors". The "encourage each other" category emerged from the following codes: "relationship with female cohort members", "relationship with male cohort members", and "valuing belonging". Finally, the "help create a positive environment" category emerged from "overcoming learning obstacles", "feelings of confidence in their learning", "valuing belonging", "strategies to address gender-related obstacles", and "valuing the learning process". At the same time, we also analyzed other codes related to motivations, experiences, strategies, and obstacles, both in their university education and in their work experience. The categories allowed us to construct meta-categories to highlight how the programs served as counterspaces: "build/join a supportive community", "create a sense of safety and belonging", and "mitigate gender stereotypes".

In the third phase, we created code families, allowing further comparison across the interviews. The code families enabled us to identify the principal dimensions of the study findings: counterspaces and self-efficacy. The analysis, therefore, allowed us to engage in iterative interpretation and comparison, regularly returning to theory and the workforce development programs' role (Flick, 2006; Saldaña, 2009).

Researcher Positionality

As a research team, we approached this study from different perspectives and experiences. The first author is a woman from Argentina. A sociologist by training, she is a researcher working on career and technical training from a gender perspective in the capital, Buenos Aires. The second author is also a woman but is from the United States. Though she has lived in Buenos Aires, she is an outsider to the country. She brings expertise in STEM career development for minoritized populations, including women.

Findings

In this section, we explain how the three institutional settings served as counterspaces for the participants, and how those counterspaces helped develop their self-efficacy and outcome expectations. We posit (Table 1) that when counterspaces create a sense of safety and belonging, they enable women to take chances and have mastery experiences. Second, we argue that when counterspaces help women build or join a supportive community, they enable women to gain

vicarious learning experiences and experience verbal persuasion. Finally, when counterspaces provide all three benefits to women—a supportive community, safety and belonging, and the mitigation of stereotypes—women experience emotional arousal. While there were many examples of these intersections in our data, we would be remiss if we did not share and discuss instances in which the counterspaces did not act as such and, therefore, did not support participants' self-efficacy development.

How Positive and Supportive Communities Support Self-Efficacy

The counterspaces we heard about helped participants join or build positive, supportive communities within ITC, thereby strengthening their self-efficacy. We observed that this happened in two ways. First, being part of a supportive community offered the women vicarious learning experiences because they could observe experts in ITC. Second, it provided verbal persuasion, as women participating in workforce development programs and informal online communities encouraged one another. At the same time, we observed instances when these spaces were not positive or supportive. We also describe examples of these.

Vicarious Learning Experiences

The workforce programs, as positive and supportive communities, offered our participants vicarious learning experiences, which are learning experiences in which participants observe others carrying out a task. Particularly in programs targeting women, participants were exposed to other women experts in the field through their instructors, program mentors, and special guests invited to class sessions. The women experts served as role models, helping our participants see themselves and that a career in ITC was possible. For example, a 19-year-old participant from the CaC program in the city of Buenos Aires shared how powerful it was to hear the mentors' stories of struggle on their way to success. She told us that,

> For me, it was really enriching…stories from women who had been through stuff. Who had a plan A, but plan A didn't work, so then their path took a new direction, and now they've reached their goals. That is motivating. … This woman, she's the woman of my life, she helped me emotionally when my university scholarship didn't come through. I mean, she was so motivating and coming from a person who had achieved so much… you know? It makes you say, "Well, what better example than her?"

As this quote demonstrates, the participant learned vicariously about career pathways and the importance of persistence from the mentor's experiences.

The second way vicarious learning occurred was through the programs' exposure to the types of work the women would perform once in a job. We saw this in several participants' experiences, across program types, including one 22-year-old woman from a traditional program in the province of Buenos Aires, who described how the workforce development program she was enrolled in helped prepare her for the challenges she was likely to face. She shared that "the experience is pretty good, enriching, and it prepares you for what you're going to go through." In other words, the program offered vicarious learning by helping the participant learn indirectly about the work to come.

Though our observation was that the mentoring and role-modeling roles female instructors played had a positive impact, not all participants connected with a mentor. In particular, participants who described themselves as timid did not take advantage of working with female instructors in the same way as other participants. Furthermore, really connecting with the instructors as mentors requires time that not all the participants may have had. For example, one participant from CaC in the province of Buenos Aires shared the following:

> You can sign up, and they can assign you a mentor, and I guess that person is the one who guides you on your career journey. The truth is that I didn't sign up when I had the chance (...) I'm really shy, and there was no way I was going to jump into having these conversations and share my feelings. I don't know, I guess I was embarrassed.

As this excerpt makes clear, it is not enough for the program to offer mentoring if the mentors—and the mentees—do not have some level of preparation for getting the most out of the relationship.

Verbal Persuasion

The positive, supportive community participants found in these spaces included other students and their instructors. We found many cases of peers and instructors offering verbal persuasion, feedback, and encouragement to participants. For instance, one participant from the CaC program in the city of Buenos Aires described how her female instructors encouraged and celebrated their efforts. She told us:

> What I liked the most was the companionship of the instructors.… I remember that an instructor had asked us to complete an exercise with something new, and I finished it in a couple of seconds. She grabbed me by the shoulder—I thought she was going to get mad at me because I'm a little shy—and she said, "What's this?" Moreover, I responded, "it's the exercise." And, she said, "Incredible, this is great!" And all the instructors had that attitude, they congratulated us … And it was new for me. Because before that, I really didn't think I had any potential, that no one was on my side.

In this quote, we see how impactful receiving such positive feedback was for the participant. Indeed, the participant went on to explain that the instructor's encouragement made her feel seen and efficacious--that she could do the work.

We found that our participants gained communities that encouraged them not only in their courses but also through the online communities they joined. All our participants were part of an online community connected to their program (e.g., a virtual club or WhatsApp group) that helped them make connections, keep each other company, and support one another. Our participants shared that the members of the online communities helped each other, as this 34-year-old participant from the MeT program in Cordoba shared: "There are a lot of women's groups, it's really impressive. I'm in all the groups on WhatsApp and Instagram. Everything there is, I sign up. I share, and I learn. I can help, and people help me." These participants' experiences of finding a supportive community through their courses and in online communities were consistent with Ruttenberg-Rozen and Hynes' (2022) argument that counterspaces for women in ITC constitute "communities of care" (p. 46) where women can build relationships with other women and support and encourage one another.

While many of the women described similarly positive instances of encouragement, others highlighted how the people they encountered in the ITC spaces we studied did not always encourage them or provide positive feedback. For example, some women described working with male instructors who did not support their learning. One participant from the province of Buenos Aires shared with us how she felt her male professors had let her down. She recounted, "I was so frustrated one time that I jumped up and said to the instructor, 'I barely learned anything from you all! I had to work hard to teach myself all the tools that I'm now using.'" Indeed, even though participants in all the settings described learning useful skills, those in more traditional learning

spaces were less likely to receive the additional encouragement that participants in gender-focused spaces did, which seems to have been crucial for the development of their self-efficacy.

How Safety and Belonging Cultivate Self-Efficacy

We found that the workforce programs and informal online communities eased participants' fears about ITC and made them feel like they belonged. This sense of safety and belonging, in turn, helped cultivate the women's self-efficacy in two ways. First, the sense of safety and belonging helped the women take risks and engage in mastery learning experiences. Second, this mechanism gave the women a space to support each other and receive support, which can create emotional arousal. As in the previous section, we offer examples of situations in which the programs did not cultivate a sense of safety and belonging.

Mastery Learning Experiences

The programs made many participants feel they belonged, enabling them to have mastery-learning experiences in which they completed meaningful tasks. We found this connection particularly prominent in those programs directed at or limited to women. For example, one participant from Women Programmers in Corrientes, which only serves women, told us how being in a program only for women emboldened her to participate and take more risks:

> I know I would not have gotten up the courage if it had not been a class only for women. I'm shy. It's like I know the answer, but I can't bring myself to say anything. In contrast, I always felt like I could participate in the program.

According to this participant, being in an all-women program helped her overcome her shyness and engage more fully in the program and its work.

A 20-year-old participant in the MeT program in Cordoba (women only) shared that the workforce training program she enrolled in provided the practical learning experiences she needed to succeed in her university program. She explained that she had felt lost in her university class and needed to catch up: "The major was theoretical. I was getting behind and dropping courses because it was hard." She went on to explain how the workforce program made her feel like she belonged and enabled her to have mastery experiences that boosted her self-efficacy:

> Deciding to enroll in the [workforce development] program was really important. Not only did it mean that I could start working right away, but also, I began to feel much more confident. At school and at work, I began to feel like, "I belong in systems, don't treat me like a dummy."

As she explains, the program helped her begin working, directly applying her new knowledge and skills, and boosted her sense of belonging and belief in her ability to do the work.

Not all the participants believed that their learning spaces cultivated a sense of belonging, thereby enabling mastery learning, for all women. Indeed, we observed that many of the women described having strong personalities that helped them overcome obstacles and cope with the challenges they faced during their education and later careers. This characteristic seemed to be prevalent among women in the sector. Indeed, several participants alluded to the mediating role of personality, with one 29-year-old participant from CeT program in Chaco (women only) noting that, "we have strong personalities…we are all sort of similar." Participants explained the importance of having a 'strong personality' as a defense mechanism that facilitated their success in more hostile environments but that ended up excluding women who "don't get it" or "don't have that personality". Somehow, the women come to understand that the law of "the survival of the fittest"

is how one gains access to and persists in the sector. The question, then, is, what happens to women who do not have "strong personalities" and, as a result, lack confidence in themselves?

Emotional Arousal

The counterspaces also helped the women feel safe and like they belonged, which led to emotional arousal, or a sense of positive well-being. We found this to be true in programs that served only women. For example, multiple participants from the all-women programs described how being among women made them feel safe and supported. One 35-year-old participant from Women Programmers in Corrientes explained that the course she was in, "was like a first encounter with programming but directed at women. Everyone was a woman… They were really nice, and it totally erased the fear you enter with because everyone comes in at the same level—with no previous knowledge." Another participant, 19, from the *Codo a Codo* program in the city of Buenos Aires (co-ed but focused on women), admitted that, though she felt like a digital native, she had always believed that a career in ITC was for boys, not for her. The workforce development course created a space that helped change her perspective and see that she did belong:

> Having done the course was key for me because, even though I'm a digital native…I had not seen technology as an opportunity; I never saw myself in that profession. When I thought about programming, I said, "Well, it's for my brother," like a social message I already carried: programming was for boys. In the programming course, I had that first encounter and realized I was good at it and that this could be an option for college.

These two excerpts demonstrate how the programs as counterspaces enhanced the women's sense of belonging and changed their beliefs about their potential for success in ITC. In other words, the sense of belonging created space for them to believe in themselves.

Many of our participants derived similar positive feelings of safety and belonging from the online communities they had joined. Our participants spoke about the value of these connections, such as what the following shared: "Yes, there's a lot of solidarity among us… there is a strong sense that we need to help each other and that's really good." (19 years old) Another participant who was 29 and in the MeT program, which served only women in Cordoba, described the communities she had joined and how the women supported each other:

> There are WhatsApp and Discord groups where we support each other a lot. Above all, the women help out the new girls. It's something really typical in programming: connecting to lend a hand.

The comfort that these participants derived from the two types of counterspaces (workforce development programs and online communities) echoes what other studies of girls in ITC programming have found—that girls often enjoy these spaces, feel more comfortable learning without boys, and report more positive attitudes towards ITC than girls in co-educational settings (Kamberi, 2017; Marquardt et al., 2023). Their shared experiences align with research on counterspaces and how they help marginalized students feel like they belong (Ong et al., 2018; Solorzano et al., 2000).

How Mitigating Negative Stereotypes Cultivates Self-Efficacy

We found that participating in informal online communities helped cultivate the participants' self-efficacy through all three mechanisms. However, because we have already discussed how supportive communities and a sense of safety and belonging cultivate emotional arousal, we focus here on how mitigating negative stereotypes can lead to emotional arousal. We argue that

participating in informal online communities helped mitigate pervasive gender stereotypes about ITC and, therefore, cultivate women's well-being (emotional arousal). We found that the informal online communities helped the women see, question, and redefine the stereotypes they encountered. For example, one 28-year-old participant from the Codo a Codo program in Buenos Aires (women only) reflected on the discrimination she had experienced in her studies and how other women in an online group had helped her resist the inequalities around her and persist:

> I might have left the major if they hadn't motivated me. Because everywhere in the college, I see the inequality and the gap. So, being part of the group really helps you stay motivated to continue.

Another participant from a traditional program in the province of Buenos Aires shared how her experience with informal online networks helped her realize that she was not alone in feeling like an impostor. Further, the online community helped her push back on her sense of inadequacy:

> We talk a lot about imposter syndrome, which is the sense that you know less than you really do. It's really common among women in this area. So, to be able to talk about it, interrogate it, give it a name, feel that it happens not only to you but also to others… you don't know how important that is.

In these examples, we see how the women not only confronted the stereotype that ITC is not for women through their online communities but also refuted the stereotypes. In this way, the women's interactions and how they supported each other created a positive environment—a haven (Ong et al., 2018)—and gave them a space to resist by responding to hostile narratives and social stigmas about women in ITC (Ong et al., 2022; Ruttenberg-Rozen & Hynes, 2022).

Discussion

The purpose of our study was to examine how formal and informal social environments shape the ITC career development of women in Argentina, a country with relatively little research on this topic. In doing so, we respond to a call for more research on the role of social environments in supporting gender-focused ITC interventions (Chen et al., 2024). The two external supports we examined comprise social environments in which participants interacted with each other, mentors and role models, and with computing knowledge and skills. These social environments not only exposed the participants to ITC knowledge and skills but also strengthened their beliefs in their ability to succeed in ITC. We also found, however, that the spaces we examined differed in how they shaped participants' self-efficacy. Specifically, we observed greater benefit for participants when the programs had an explicit focus on helping women, either because they guaranteed spots for women (CaC, Buenos Aires) or served only women (Women Programmers, Corrientes; MeT, Cordoba; CeT, Chaco). In this way, some of the formal and informal spaces served as counterspaces, giving the participants a safe place to share their experiences and challenges and gather strength to resist and overcome (Ong et al., 2018; Ruttenberg-Rozen & Hynes, 2022; Solorzano et al., 2000), while others fell somewhat short of that potential. Because our study is exploratory, we propose that having a gender focus or preference be treated as a hypothesis to be formally tested. Though other researchers have asked similar questions (e.g., Marquardt et al., 2023), there is a need for more formal investigation of the hypothesis that programming for women can benefit women more than co-educational programming.

Through our investigation, we also addressed the need for further research into career development processes in South America, particularly in Argentina. Prior research indicates career development processes are similar globally, with shared challenges and support mechanisms (e.g.,

Sheu & Bordon, 2017). Argentine women in ITC also face opportunities in a growing sector but encounter gender stereotypes. Also similar to their counterparts in other countries (e.g., the U.S., Germany, and India), our participants relied on external supports and two counterspaces to lower barriers and find ways to enter and persist in ITC. We add to the literature by noting that formal and informal social environments with a gender focus may be more effective in supporting the development of self-efficacy among women in ITC.

The two types of counterspaces we described offered the women safe places and communities, as well as a space for resistance to the barriers they encountered when they focused on women. Prior research points to the value of creating inclusive environments (Cheryan et al., 2009, 2011; Höhne & Zander, 2019), pairing women with mentors and role models (Berg et al., 2018; Chen et al., 2024; Denner et al., 2012; Lehman et al., 2023; Lin, 2016; Main & Schimpf, 2017), and creating collaborative and supportive learning environments (Pantic & Clarke-Midura, 2023) to cultivate self-efficacy. Other research has found that creating counterspaces where women can share their experiences and fears and, together, counter negative narratives about women in ITC can improve their experiences in the field (Ong et al., 2018; Ruttenberg-Rozen & Hynes, 2022). Our findings offer additional evidence to support these claims. That said, we also found that workforce development programs that center on women, either through preferential admissions or serving only women, may be more effective.

Our findings also complicate prior conclusions about how mentors and role models can support self-efficacy. Though most of our participants reflected positively on the mentors and role models they encountered, describing how they encouraged them to take risks, showed them they belonged and could be successful, and celebrated their success, we did find that some participants admitted they did not take advantage of the mentors or role models. These women explained that they were timid and had not sought out the help and guidance made available to them. Comments from other participants also pointed to the potential role of personality in influencing who seeks and accepts help, particularly in a male-dominated environment. These findings connect with work by Ash and colleagues (2006), which found differences in personality traits related to gender and IT careers. We encourage other researchers to examine the extent to which having a "strong personality" moderates women's engagement with supports available through programming.

Future research should continue to examine both spaces, with a particular focus on the role that single-gender programs or programs that guarantee spots for women can play in developing women's self-efficacy. Though we did not formally compare the two types of programs, we did see evidence that programs serving women, either exclusively or by protecting spaces for them, may have had an even greater impact.

Limitations

As with any study, ours has its limitations. Because our goal was to understand *how* two types of social environments strengthened a small sample of women's self-efficacy, we cannot conclude that our findings will generalize to other settings. Scholars should collect career development data on larger samples of women in Argentina and other parts of the region. Another limitation was that we spoke only to women who had found the workforce programs and online communities and had persisted in their studies. We did not interview women who had not found these counterspaces or had left their ITC studies. The sample, therefore, may limit our understanding of the effects of counterspaces or their interaction with other necessary push or pull factors that drive women out of—or keep them in—ITC. We recommend that researchers create a sample of women who have been successful and unsuccessful in ITC to learn more about the role of counterspaces in strengthening self-efficacy and under what conditions they may (or may not) be sufficient. We spoke

with the participants once and did not follow them over time. Longitudinal studies are necessary for career development precisely because it is a process that unfolds over time. Therefore, we only heard retrospective reflections from the participants. In future qualitative or quantitative studies, researchers should follow participants over time to understand how counterspaces shape their experiences and outcomes. Finally, though we are confident in our data collection and analysis processes, this study was exploratory and yielded emergent findings. Therefore, it is possible that we did not reach saturation and that other researchers might surface other findings. We encourage more studies on these questions, including qualitative ones that dig deep and quantitative studies that test our findings.

Conclusion

Our study aimed to investigate how formal and informal social environments shaped the career development processes of women studying ITC in Argentina. We argued that in many (but not all) cases, the formal and informal spaces where our participants encountered and learned about ITC acted as counterspaces and enhanced their self-efficacy. Self-efficacy is vital in the chain of processes and beliefs that culminate in career preferences and choices. The counterspaces worked in three ways to shape participants' self-efficacy: fostering a supportive community, creating a sense of safety and belonging, and mitigating negative gender stereotypes. Combining the three mechanisms cultivates self-efficacy by offering women mastery experiences and the courage to take advantage of or seek them out; vicarious learning experiences through mentors and role models; verbal persuasion through encouragement; and emotional arousal through the positive environments the women found. However, we also conclude that these processes did not always promote participants' self-efficacy, and that other conditions may need to be in place to reach and support more women. Our findings shed new light on how counterspaces work to cultivate self-efficacy and offer directions for future research.

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