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"I Started Seeing Myself as a Computing Person": Exploring Latina Women's Computing Identity Development in College

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This qualitative study employs interviews to explore the process of computing identity development and maintenance among Latina undergraduate students, beginning from their experiences in introductory computing courses and extending beyond. The findings shed light on the significant influence of factors such as peer and faculty recognition, engagement in identity-based extracurricular organizations, and familial and community relationships on the formation of students' computing identities and their determination to persist in the field. These insights highlight the multifaceted nature of computing identity development for Latina students and provide valuable knowledge for promoting inclusivity and support in computing education.

Historically, undergraduate computing programs have demonstrated a pattern of enrolling individuals with privileged social identities and backgrounds, particularly White and Asian men from higher socioeconomic backgrounds and who are continuing-generation college students (Margolis, 2017). Unfortunately, the representation of women of color, specifically Black, Latina, and Native American women, remains significantly low in the field of computing (Hodari et al., 2016; NASEM, 2022). Furthermore, Latin*[1] students, who constitute one of the fastest-growing racial/ethnic groups in higher education, with 58% of them being women (*Excelencia* in Education, 2019), continue to be underrepresented in science, technology, engineering, and mathematics (STEM) fields, including computing, despite an increase in enrollment in undergraduate computing departments and calls for diversification (NASEM, 2022). In the academic year 2020-2021, Hispanic/Latina women accounted for nearly 10% of bachelor's degrees awarded across all fields, but represented only 2% of degree earners in computing (National Center for Education Statistics, 2022), suggesting that

[1] We use the term Latin* as a gender-inclusive term to refer to people of Latin American descent (Salinas, 2020; Perez-Felkner et al., 2024) and acknowledge that individuals may prefer to self-identify with their specific ethnic group or nationality.

certain aspects of the discipline and institutional characteristics discourage the enrollment and participation of Latinas.

Explanations for the underrepresentation of women of color in STEM and computing often adopt an individual-focused approach that places blame on the students themselves for their decisions not to pursue STEM majors. However, this approach fails to examine the role that institutions or environments play in student attrition (Hodari et al., 2016). By solely emphasizing individual characteristics such as student preparation, motivation, or interest in STEM, the broader impacts of departmental culture and interactions with peers and faculty on the interest of women of color in these disciplines are overlooked (Ong et al., 2011).

Research has shown the significant role of introductory STEM courses in engaging students in STEM disciplines, including computing (Gasiewski et al., 2011). Understanding the role of these introductory courses in Latina students' pathways into the major is crucial, as racially and ethnically minoritized students tend to drop out of these "gatekeeper" courses at higher rates compared to their dominant counterparts, such as White male students (Crisp et al., 2009). Moreover, numerous studies argue that women of color, including Latinas, face challenges in persisting in STEM and computing fields due to a lack of sense of belonging (Carlone & Johnson, 2007; Espinosa, 2011; Ong et al., 2011; Ong et al., 2017; Rodriguez & Blaney, 2020). Introductory computing courses play a significant role in either reinforcing students' interests in the field or discouraging them from continuing in the major. Despite these factors, there is a scarcity of studies that focus on the experiences of Latinas in computing or investigate their experiences from introductory computing courses to degree completion.

Therefore, the primary objective of this study is to investigate the experiences of Latina students in computing with the aim of identifying practices that can enhance their persistence in computing fields. Additionally, the study seeks to examine the role of computing identities (Rodriguez & Lehman, 2017) in shaping Latinas' persistence. By doing so, this study aims to bridge the existing gap in the literature and deepen our understanding of the experiences that contribute to the development of Latinas' computing identity during their undergraduate education. The following questions serve as the guiding framework for this study: 1) How do Latina students in computing develop and maintain their computing identities throughout their college experiences? And, 2) how do collegiate introductory computing courses influence computing identity development for Latina students?

Literature Review

In this section, we review relevant literature on the experiences of Latina undergraduates in STEM and computing and the practices they employ to develop their identities and persist in their majors.

The Experiences of Latina Women in STEM and Computing

While a growing body of literature includes Latina students' experiences in computing (see Villa et al., 2016), research that focuses explicitly on Latinas in computing is scant. For instance, some research explores Latinas' experiences within STEM (see Contreras Aguirre et al., 2020; Rodriguez et al., 2019a, 2019b; Rodriguez & Blaney, 2020; Venegas & Espinoza-Wade, 2020), and other work centers on women of color within computing (see Hodari et al., 2014, 2016; NASEM, 2022; Ong et al., 2017).

Nevertheless, a small but growing literature focuses explicitly on Latinas in computing (see Rodriguez et al., 2020b, 2023; Thiry & Hug, 2014). The following section provides an overview of related studies on Latinas in STEM and, when available, in computing.

Facing Unwelcoming Environments

Scholars investigating the underrepresentation of women of color in STEM and computing fields have consistently identified the presence of racism and sexism within these environments (Carlone & Johnson, 2007; Erete et al., 2021; Rankin & Thomas, 2020; Rodriguez et al., 2020a). Research indicates that Latina students often face skepticism from male peers who question their belonging in STEM disciplines (Contreras Aguirre et al., 2020; Rodriguez & Blaney, 2020). These encounters can hinder the development of their computing identities and contribute to a diminished sense of belonging within the campus community for women of color in STEM (Carlone & Johnson, 2007; Rodriguez et al., 2019a). Specifically, a hostile computing environment can impede students' ability to cultivate a computing identity, as their identity formation relies on their interactions with others in the field, including faculty and peers (Carlone & Johnson, 2007). Moreover, women of color often leave these fields due to the isolation they experience (Hodari et al., 2016; NASEM, 2022)

Latin* Familial and Professional Support Networks

Despite the hostilities and challenges women of color face in computing environments, they utilize various strategies to persist in their field (Hodari et al., 2016). One strategy is to develop and participate in *counterspaces* outside of the classroom via identity-based (i.e., geared toward women and/or racial/ethnic groups) organizations (Ong et al., 2017). Such counterspaces allow students to be in community with similar race and/or gender peers and role models, enhancing their experiences and promoting their persistence in the field (Hodari et al., 2016; Ong et al., 2017). Women of color in computing report that having role models who look like them provide "examples of what success looks like" (Hodari et al., 2014, p. 87).

Rodriguez and colleagues (2023) employed a community cultural wealth lens to conduct a qualitative examination of the experiences of Latina undergraduate students pursuing a major in computing. The researchers discovered that these students actively engaged in race and gender-focused STEM organizations and conferences as a means to foster relationships and cultivate a sense of community during their college years. Similarly, Thiry and Hug (2014) found that Latina undergraduate students in computing highlighted the importance of their participation in conferences and organizations specifically designed for underrepresented women and/or Latin* students, which played a vital role in shaping their perception of opportunities in the field. Furthermore, Rodriguez and Blaney (2020) found that Latina undergraduates' involvement in identity-based STEM organizations positively reinforced their sense of belonging. Numerous studies consistently demonstrate that Latina students in computing often experience a shared sense of community and camaraderie with other Latin* peers (Thiry & Hug, 2014; Villa et al., 2016).

Previous research has highlighted the significance of familial support networks for Latina students in overcoming challenges encountered while pursuing STEM degrees (Contreras Aguirre et al., 2020; Rodriguez et al., 2019a). In the study conducted by Contreras Aguirre and colleagues (2020), Latina undergraduate participants emphasized the influence of their mothers and fathers in their decision to

pursue STEM majors and expressed a motivation to "give back" to their younger siblings, a finding that aligns with the study conducted by Villa et al. (2016). Furthermore, some participants shared how their upbringing in low-income households served as a driving force in their pursuit of STEM fields and aspirations for high-income careers (Contreras Aguirre et al., 2020).

Villa and colleagues (2016) discovered that familial support played a critical role in the development of computing identities among Latina students. These students received essential emotional support and encouragement from their families, which helped them persevere through academic challenges. Similarly, in the study conducted by Rodriguez and colleagues (2023), Latina undergraduates in computing relied on family members working in the computing field, including extended family members such as cousins, to acquire knowledge about the computing major and the technology industry. Even when family members did not possess computing expertise, they still provided valuable emotional support and assisted in building students' self-confidence (Rodriguez et al., 2023).

Latinas' Identity Development in Computing and STEM

Family members and other significant individuals have a crucial impact on the development of Latina students' computing identity. Rodriguez et al. (2019a) observed that Latina students received external recognition as scientists, primarily from their peers, faculty, and family members. Recognition from faculty was particularly important as it validated their expertise in the field. In some cases, Latina students had to compartmentalize their identities within STEM environments to persist (Garcia et al., 2020). How students compartmentalize their identities influenced how they engaged in various college activities (e.g., student organizations, co-curriculars) and built same-identity mentoring relationships (e.g., gender, racial or ethnic group, first-generation college attendee). While not all students exhibited a strong sense of science identity, some students demonstrated resilience and empowerment, recognizing their marginalized position in STEM and challenging the prevailing norms (Rodriguez et al., 2019a).

In a related study, Rodriguez et al. (2020a) explored how Latina undergraduates resisted marginalization and oppression in STEM disciplines. Through interviews with 17 Latinas in various STEM fields, the authors found consistent criticism of the racist, sexist, classist, and invalidating nature of STEM environments. Although invalidating experiences can negatively affect students' sense of belonging, they can also serve as motivators for students to resist and challenge the hegemonic notions of who belongs in STEM (Rodriguez et al., 2020a). Similarly, Latina computing majors expressed motivation to persist due to the underrepresentation of women, particularly Latinas, in the field of computing (Rodriguez et al., 2023).

Conceptual Framework

Carlone and Johnson (2007) assert that women of color in STEM face racism and stereotypes based on their racial and ethnic identities, as well as sexism based on their gender identities. A significant factor in the success of women of color in STEM is the development of a strong science identity, which refers to how individuals recognize themselves and are recognized by others as a "science person" (Carlone & Johnson, 2007). The formation of a scientific identity involves three dimensions: competence, performance, and recognition. Competence is achieved through acquiring disciplinary

knowledge and understanding the subject matter, while performance entails actively engaging in scientific practices such as conducting research, problem-solving, and participating in conferences. Demonstrating competence and performing science are crucial for recognition as a science person. Recognition involves being acknowledged as a scientist by meaningful individuals, including peers, faculty, and other scientists, and recognizing oneself as such. External recognition plays a significant role in women of color's self-recognition and their identification as scientists (Carlone & Johnson, 2007).

The development of a scientific identity can foster sustained interest in the field and, ultimately, persistence for women of color in STEM (Carlone & Johnson, 2007; Rodriguez et al., 2019a; Rodriguez & Lehman, 2017). When applied to Latinas' experiences and interests in computing, Carlone and Johnson's (2007) science identity framework offers insights into the formation of their computing identities throughout their college journey. Moreover, the science identity framework enables a more explicit focus on the intersecting racial, ethnic, and gender identities of Latinas and situates the study's findings within the broader context of oppression and the construction of meaning.

Study Background and Methodology

This study is part of a larger research initiative, BRAID (Building, Recruiting, and Inclusion for Diversity), housed at *Momentum* at UCLA. BRAID was founded in 2014 by leadership at AnitaB.org and Harvey Mudd College to support computing departments at 15 research universities in their efforts to increase the recruitment and retention of women and racially/ethnically minoritized students in undergraduate computing majors. Although the specifics of the efforts varied by institution, all BRAID institutions committed to making change around four core tenets of the program: improving introductory computing courses, initiating outreach efforts to high school students, building stronger undergraduate computing communities, and developing interdisciplinary courses and programs. Our team has focused on introductory computing courses as a key site of experiences that shape students' trajectories through computing majors and into computing careers and graduate programs, with a particular emphasis for women and students of color (e.g., George et al., 2022; Lehman et al., 2022; Lehman et al., 2020; Wofford et al., 2022). While the BRAID research team has endeavored to investigate differences by race/ethnicity and gender, we encountered challenges in obtaining sufficient sample sizes for students from racially/ethnically minoritized groups, especially those identifying as Black, Latino/a/x, and/or Native American or Indigenous. Therefore, in this study, our team has adopted a qualitative approach to center the experiences of Latina students, given their underrepresentation in our survey samples.

Interviews

This study utilized a narrative approach to examine the lived experiences and computing identity development of nine undergraduate Latina students in computing. Narrative inquiry allows us to examine "how participants come to understand their own story through retelling and interpreting their experiences" (Bhattacharya, 2017, p. 93). Given the goal of understanding students' collegiate experiences and computing identities, a narrative inquiry was the most suitable method for analyzing the qualitative data.

The participants engaged in two hour-long interviews where they shared their narratives and provided detailed accounts of their pre-college and collegiate experiences in computing. The interviews covered various aspects, including their encounters in introductory computing courses, participation in extracurricular activities, interactions with peers, and skill development. Participants also discussed the influences of their families and culture and explained their motivations for pursuing computing. Finally, they described how they developed and made sense of their identities as Latinas in the computing field.

Sampling and Participant Recruitment

Participants for this study were selected from a pool of Latina respondents to the BRAID surveys. Out of the 126 survey participants who identified themselves as Latina and expressed a willingness to engage in future research activities by providing their email addresses, invitations to participate in the present study were sent via Qualtrics along with a background questionnaire to assess their eligibility. Criterion sampling was employed to recruit participants who met the following criteria: (1) Latina/x, (2) women, (3) classified as juniors, seniors, or within one year of graduation, (4) currently pursuing or having completed a computing bachelor's degree at the time of the interviews (i.e., computing majors), and (5) consented to be contacted for participation in future studies.

Out of the 30 individuals who responded to our invitation and completed the background questionnaire, 17 met the eligibility criteria for participation. Multiple rounds of invitations and reminder emails were sent, resulting in nine individuals ultimately taking part in the study. Participant information can be found in Table 1. At the time of the study, participants were juniors or seniors in college or had recently graduated. Thus, participants were asked to remember their experiences from several years prior. As a token of appreciation, participants received a $20 Amazon gift card for each completed interview. The interviews were conducted over a period of three months during the 2019-20 academic year. While participants could have come from any of the 15 participating institutions, most participants attended universities in the Southwest, many of which are Hispanic-Serving Institutions (HSIs).

Table 1. Student Demographics and Academic Information.

Name	Current class standing	Major	First-gen status	Socioeconomic Status
Elena	Senior	Computer Science Engineering	No	Below Average
Alejandra	Graduated	Computer Science (Cybersecurity)	Yes	Above Average
Araceli	Graduated	Computer Information Systems	No	Average
Christine	Senior	Computer Science	No	Above Average
Cindy	Graduated	Computer Science, Mathematics	No	Above Average
Kiara	Senior	Computer Science (Software Engineering)	No	Above Average
Isabella	Graduated	Computer Science	No	Poor
Natasha	Senior	Computer Science	Yes	Average
Reina	Junior	Information Technology	Yes	Below Average

Note: This table provides an overview of the participants' academic and demographic details.

Data Collection Procedures

The data collection and analysis for this study were conducted by the first and second authors, with feedback provided by the third and fourth authors. Building rapport with participants was challenging in the virtual setting; however, the two-interview semi-structured format proved to be effective, particularly because the same interviewer conducted both interviews with the same student, fostering rapport over time. The first interview aimed to establish a connection and build trust with participants. It delved into their backgrounds, experiences in introductory computing courses, reasons for choosing a computing major, and their career goals in the field. The second interview served as a follow-up, focusing on the participants' unique experiences in computing. It explored various aspects of their educational trajectories, including computing internships, involvement in computing clubs, and interactions with faculty and peers. By conducting follow-up interviews, we were able to delve deeper into their narratives, gaining a nuanced understanding of their computing identities and sense of belonging in the field.

Analyses

To analyze the qualitative data, we (the first and second authors) engaged in a multistep thematic analysis process. Thematic analysis is a method used to categorize and analyze qualitative data, which involves getting acquainted with the data, coding excerpts, generating and refining themes, and writing the results (Braun & Clarke, 2022). The first step in our analysis involved the development of analytic memos where we outlined the main points of the participants' interviews, emergent findings, and questions to follow up on in the second interview. We followed the same step after the second interview to note emergent themes. Next, we (the first and second authors) developed a codebook that definitions and examples of code applications related to the conceptual framework such as recognition, as well as emotion codes which identified students' emotions (Saldaña, 2016). We engaged in a deductive coding process, applying existing codes, but also engaged in an inductive approach in subsequent rounds, where we opened up possibilities to code for additional concepts we had not previously considered. To ensure consistency in coding, we coded the same set of transcripts and used Dedoose qualitative data analysis software (https://www.dedoose.com/) and we engaged in peer debriefing throughout the coding process. Next, we organized the codes into analytic units, known as themes, and we identified patterns and discrepancies in the data (Bhattacharya, 2017). This approach enabled us to analyze the data comprehensively and identify significant themes and patterns that emerged from the participants' narratives.

Ensuring Trustworthiness

To ensure trustworthiness, we implemented several measures throughout the data collection and analysis process (Merriam & Tisdell, 2016). Along with developing analytic memos, we conducted a pre-coding exercise on several interviews to ensure consistent understanding and application of codes. The research team met regularly throughout the data collection and analysis processes to refine techniques, interpretations and identify emerging themes. After the data collection phase, we shared a copy of the interview transcripts with the participants and invited them to provide corrections, clarifications and ask questions. Two participants provided feedback, one sharing her job placement after graduation and the other explaining her decision to drop out of college since the interview. Their updates allowed us to contextualize their

experiences further and incorporate the changes in our analysis. These measures enhanced the rigor and trustworthiness of our study.

Positionality

We recognize that studies occur within various contexts and are shaped by the research team's identities, beliefs, values, and assumptions. All of the study's researchers identify as women and, as such, share a gender insider status with the participants. The first and second authors also identify as Latin*. We acknowledge that our shared identities do not give us complete access to participants' experiences, but we are committed to valuing and centering their perspectives. Furthermore, while we do not have degrees in computing, we have extensive knowledge and experience working with underrepresented students in STEM, including women of color in computing. The first, third, and fourth authors were part of the team leading BRAID research, and the second author is an affiliate who has collaborated on several BRAID projects. Our expertise and experiences allowed us to build trust and rapport with student participants and better understand the social and field-specific contexts in which students navigated their experiences.

Findings

Our research questions were addressed through qualitative methods which sought to understand Latina students' experiences and computing identity development through the computing major. Interview data highlighted how students often entered introductory computing classes with varying levels of expertise and knowledge of computing fields, which complicated how they perceived their computing identities and belonging in computing environments. Over time, participants were recognized by key others and themselves as computer scientists. Through their experiences, participants noted their heightened awareness of their underrepresentation in computing spaces and described their motivations to give back to their communities and pave the way for other Latinas to enter the computing field.

Experiences in Introductory Courses, Navigating Computing Environments, and Developing a Computing Identity

Pre-college computing experiences, both informal and formal, through the home and school, shaped how Latina students entered introductory computing courses and recognized themselves as computing people. While some participants took formal computing courses in high school, others had informal computing experiences before college, specifically through family members in computing. Elena, who did not take any computing courses prior to college, shared, "because most of my family are computer scientists, I've known stuff [with regard to] coding…one of my cousins made me do a website on a very old computer." Several participants were exposed to computing through family members such as aunts, uncles, siblings, and cousins. Others had more formalized experiences such as Cindy, who, during secondary school, competed in a Grace-Hopper all-women hackathon in Mexico, as she described:

> I knew a bit of computer science and I went to this hackathon…because of that, my very first semester in college I took the intro to CS course, and then from there I actually ended up doing really well… For me, that was a huge motivation boost.

Although prior to college Cindy was inclined to pursue math, her experience at the hackathon and subsequent success in the introductory computing course motivated her

to pursue a computer science major. Notably, Cindy's parents both held advanced degrees and jobs in STEM, which Cindy recognized had given her access and the encouragement to pursue computing-related experiences in ways that most of her Latina peers did not.

Although several participants in this study had some sort of knowledge and experience with computing prior to college, many still described a sense of discomfort and lack of belonging in computing environments in part due to the competitive culture and lack of representation of other Latina students. Kiara, who took prior computing courses in high school shared that when she first started taking college computing courses she felt "very unsure" of herself, and although she was doing well, "there [were] just so many other people that seemed…so much smarter and had so much more experience in computer science." The competitive nature of computing environments often made Latinas in this study feel inadequate, particularly those who did not have prior computing experiences, such as Christine who stated:

> Back then [in my first semester] I was more insecure about my abilities because it felt like everyone else around me already knew what they were doing. They all took AP Computer Science in high school, they did it in their free time since they were 12. Meanwhile, there was me who came in there not knowing anything and I was just always trying to keep up.

Christine's experience highlights how difficult it is to establish a sense of self-recognition of computing identity when one has not had the opportunity to establish competence or perform as a computer scientist. As such, her introductory courses did not help to alleviate such tensions, instead perpetuating those feelings of inadequacy and complicating computing identity.

Nevertheless, Christine noted how she overcame her challenges in learning the content and developing her competence, stating "I think by going to office hours and the tutoring centers, they were able to…instill in me better problem-solving skills and approaches to coding problems."

Participants in this study expressed a hyperawareness of the stereotypes associated with being Latinas in computing. Such awareness influenced their sense of belonging within those environments. Isabella's reflection serves as an example:

> I'm really measured when I talk to other people because I don't want to sound stupid…I feel like people already look down on me for being Hispanic, so I don't want them to think I'm dumb or I don't know what I'm talking about.

For Isabella, actions associated with performing her computing identity (i.e., verbally communicating with peers) was intertwined with her awareness of her racial/ethnic identity. She recognized that a misstep in her verbiage had the potential to expose a perceived incompetence and negatively impact her recognition by others (i.e., outside recognition) as a computer scientist. As computing environments are often competitive, which can negatively shape students' sense of belonging and efficacy in computing (Ngyuen & Lewis, 2020), Latinas in this study largely described experiencing discomfort within introductory courses, primarily on the basis of perceived competence of the material, and their identities as Latina women.

Within the introductory courses, particularly among peers, participants noted their discomfort and questioned their own competence. However, participants described seeking help from teaching assistants and faculty to develop their competence in the

material, further developing their computing identities through outside recognition. For example, Cindy shared that as a shy first-year student, she sought feedback from a particularly validating teaching assistant. She stated, “as long as there’s one person who notices that you’re really good at whatever, at computer science or something that interests you, [it] can boost people’s confidence little by little.” Similarly, Adriana reflected on her interactions with faculty, sharing that “there has been maybe one or two professors that are like, ‘Maybe you should change [majors]’ But all my other professors are like, ‘No. You can do this.’” Being recognized as competent by significant others like faculty and TAs helped students develop their general and computing-specific self-efficacy and computing identities.

Reinforcing Computing Identities Through Extra-Curricular Computing Experiences

Latina students often sought identity-based campus clubs, organizations, and conferences to interact with women and Latina/o/xs in STEM and computing. These organizations bridged students’ classroom knowledge with workforce information and opportunities (i.e., competence). Such clubs invited representatives from companies to speak on “career development, making you the best candidate, help you work on your elevator pitch, resume reviews, [and] how to tackle the career fair,” Christine detailed. Additionally, clubs provided students with opportunities to attend hackathons and conferences. During the first hackathon she attended, Christine explained, “I was actually learning something that I wouldn’t normally learn in my classes, then I got to actually use it in the project that I was working on.” Findings show that students benefit from applying their learned skills to real problems and increase their computing competence.

Several participants attended conferences for women in computing, providing them access to career opportunities, especially computing internships, where they would develop their computing competence and performance. Cindy recalled how the Grace Hopper Celebration of Women in Computing Conference allowed her to gain knowledge about companies and options for her future, stating, “I wasn’t sure what I wanted to do after college, whether grad school or industry, so it really helped me know all my options, and…I had an interview on the spot.” Cindy was offered an internship that eventually led to a full-time position when she graduated college. The conference, she mentioned, put her on the “path for being a software engineer, and being in industry.” Internships in computing were instrumental to building students’ computing identities, allowing them to perform as scientists and solidify their interests in pursuing tech careers, as expressed by Kiara:

> After that [first] internship I was more confident with myself and I kind of knew that this was the career that I want to have…I kind of started seeing myself as a computing person or that I’m meant to do this. And I had more confidence through that.

Annual summer internships allowed her to recognize herself as a computer scientist and offered her an inside view of computing careers. Kiara also received outside recognition from mentors in her internship who had “taken her in” under their wing; she detailed:

> Having mentors like that makes me want to also do that once I become more established in the computing field, just to be a mentor to other people who are trying to get into the field. And also, I’ve realized through my internships that I

> think someday I want to do more like a leadership role or a more management role within whatever company I work for just because I want to diversify the tech industry more and just be a leader.

These experiences allowed students to "see themselves" in these roles (i.e., self-recognition), influencing their sense of belonging in computing and helping build their computing identities. Additionally, internship experiences helped bridge students' coursework with real-life problem-solving tasks and provided students with skills such as communication and teamwork.

All but two participants in this study had at least one internship during their undergraduate careers. Natasha and Reina, both first-generation college students, did not have internship experiences. Natasha did not know about internships until it was too late. Reina, an online student majoring in information technology, expressed:

> [I come from] a family where we don't even know what IT was or what it is. My parents don't even understand what I do. I come from where people think IT is for geeks, if they've heard of it. We don't come from doctors or people that go to school. It doesn't even sound like a job that we kind of know of.

Reina did not have family members in computing nor participated in internships as many other students did, so she was limited in using her new skills. Reina explained, "That's why it's even difficult for me…because I know I can engineer stuff and I can work with stuff, but I don't even know where it's applied to in the real world." It is possible that being an online-only student may have impacted Reina's access to opportunities to pursue computing-related experiences. As the findings have illuminated, having access to extra-curricular experiences (i.e., internships, hackathons) where students could apply their skills to solve real problems enhanced their competence and developed their computing identities.

Reinforcing Computing Identity and "Paving the Way" for Latinas in Computing

Students understood that they would continue to be marginalized without an increase in the number of women, especially Latinas, in undergraduate computing. Participants took it upon themselves to volunteer with local schools and organizations to foster young people's STEM identity building. For example, Christine did outreach at local elementary schools where she offered short lessons about computing to young students; she shared,

> Being a Latina in computer science, I want to bring that awareness and show that representation…I really want to go back to my hometown as well and I want to show others like, "Hey, I did it. It was tough, it was super tough, but I did it, and you can do it too."

In the future, she plans to return to her rural hometown to promote computing in schools. Christine hopes that her journey resonates and encourages their computing identity growth.

Participants reported a deep connection to their communities and desired to pave the way for others from similar backgrounds to enter computing fields. At one of her jobs, Kiara observed how employees evaluated applications for an award based on applicants' computing experiences and merit. She noticed how "one of the applications that came in was from a high school, and it was actually from where I'm from…one of the lower-income schools." To her, this applicant displayed a "self-discovery of computing." However, that applicant received a lower ranking than applicants who had

enrolled in STEM clubs or hackathons. Kiara's observation emphasized how the scoring system disproportionately favored those from more resourced backgrounds, which maintains exclusion in computing. Kiara's realization fueled her desire to encourage Latin* children to persist in computing regardless of their perceived lack of experience.

Although it is not their responsibility to represent an entire ethnic group or solve the persistent marginalization of Latinas in computing, participants routinely cited their lack of representation in computing as a motivator to persist despite the challenges they overcame. As Isabella noted, "I realized that there are not many of us, I'm just hoping that I can be in that position where I can maybe help other Latina women who want to get into the field." Though Isabella realizes that her need to prove herself might not be a "good thing," she works hard to "show to people that us Latina women are just as good as anyone."

Discussion

This study describes Latina undergraduates' range of experiences in introductory computing courses and their pathways into computing majors. Furthermore, we explored the persistence of Latina students in computing as well as their desires to pave the way for others.

Getting to the Introductory Course: The Importance of Backgrounds & Pre-College Computing

Previous research has demonstrated that parents' careers are essential in fostering students' choice to major in STEM (Moakler & Kim, 2014). Moreover, within computing specifically, having a parent with a career in STEM was a significant predictor of persistence in computing majors (Lehman et al., 2022). Latina students' families play an important role in their persistence in STEM and computing by helping to foster their early interest in the field, providing emotional support, and serving as role models (see Contreras Aguirre et al., 2020; Rodriguez et al., 2019b; Villa et al., 2016). Indeed, our interview data support the importance of families, particularly continuing-generation families, and extend our understanding to include the importance of extended family members (siblings, cousins, aunts, uncles) who provided initial exposure and interest in computing. Only three of the nine participants in this study identified as first-generation college students, yet they had extended family members with degrees and jobs in computing who provided some knowledge and navigational tools similar to those who were continuing generation. Thus, this study further complicates what we mean by first- and continuing-generation college students and points to the need for a more nuanced discussion of familial network computing connections. These points speak to the issue of higher education as an institution that perpetuates the status quo, particularly within the STEM fields. This study makes a significant contribution to our understanding of how to disrupt the status quo so that more Latina students, particularly first-generation students from a lower socioeconomic status, can enter and succeed in computing.

Given the importance this study and others have placed on familial support for Latina students' success, future research should investigate the extent to which Latina students have computing connections and consider the best forms of support to ensure that all students, regardless of their familial connections to computing, have appropriate support to pursue key computing opportunities, such as internships.

Narratives from our interview participants illustrated how students without prior computing experiences felt insecure in introductory courses. These findings suggest

that pre-college computing experiences are particularly important for Latina students' intentions to major in computing in college. Pre-college exposure to computing can mitigate first-generation college students' insecurities and enhance their computing identity in the introductory course and through the major. This study suggests the need for Latin* students to participate in pre-college computing through formal and informal experiences (e.g., hackathons, AP computing courses) as they can build competence and provide spaces for recognition.

Introductory Courses as a Potential Growth Space

Our study highlights introductory courses as spaces of growth that – perhaps inevitably – create complications for Latina students. Although most Latinas in our BRAID survey sample enrolled in the course because it was a requirement for their major, 40% enrolled in it out of curiosity, suggesting an opportunity to recruit more Latinas into computing majors. However, while introductory courses are crucial in developing students' computing interest (Sax et al., 2018), they may also have an undesired effect if students have negative experiences with course content or peers.

Interview participants detailed *how* they developed their computing skills and confidence through activities like going to tutoring or seeking support (and subsequently, recognition) from their teaching assistants. Confidence in Latinas' computing skills has been linked to developing a sense of belonging in the field and persistence in the major (Rodriguez et al., 2023; Thiry & Hug, 2014). This study explicitly draws connections between help-seeking, particularly through teaching assistants, and computing identity development.

Persistence and Paving the Way

This study provides insight into the persistence of Latina students in computing as well as how they can transform computing spaces into sites of social justice. In introductory courses, participants referred to the perceived inadequacy of their prior computing experiences relative to their peers. Moreover, they experienced moments of invalidation by their predominantly white male peers, which caused them to monitor their speech and actions in computing courses out of fear of seeming incompetent. While their in-class peer relationships were not always positive, participants got involved with identity-based organizations that provided students with social networks of similar ethnic and gender individuals. Such outside-of-the-classroom computing experiences—including internships, conferences, and hackathons—provided opportunities to be in community with Latinas who could provide mutual support.

Our findings suggest that having an internship can significantly impact students' computing identities and desires to persist. However, some students—particularly those who did not have family members in computing—did not participate or even know about internship opportunities; similar experiences are well-documented in the literature on Latinas in STEM (e.g., Contreras Aguirre et al., 2020; Rodriguez et al., 2023). This study's contribution to the literature is more about what is not here: Latina students consistently pointed to elements outside the academic curriculum that enhanced their experiences and contributed to a sense of computing identity rather than those experienced inside the computing classroom. In short, Latina students may be *surviving* academic spaces rather than *thriving* in them.

This study highlights the resilience of Latinas in computing as they overcome challenges in their introductory courses and throughout their computing experience. As

time passes, many Latina students in computing increase their drive to succeed and come to engage in a social-justice-oriented commitment to their communities. Students we interviewed describe growth in their commitment to succeed in computing and pave the way for future Latinas in computing. Further, they displayed a sense of responsibility to their communities; they volunteered to educate children about computing and help cultivate the next generation of computer scientists. They were hyperaware of the historical marginalization of Latinas in computing and sought to empower others to follow in their steps to increase their representation. Similar to previous studies (e.g., Garcia et al., 2020), this study demonstrated that Latina students often sought engagement and connections with identity-based organizations and with individuals who shared their identities. Unlike Garcia et al., (2020), the present study does not reflect elements of compartmentalization for identity development. It does highlight the connections between woman-affirming spaces (e.g., conferences, volunteering, organizations), resistance, and computing identity. Latina students' resilience and drive to succeed are noted elsewhere as a mechanism of resistance and agency within STEM and, more specifically, computing environments (e.g., Gonzalez et al., 2020; Rodriguez et al., 2020a; 2023). However, this discussion often overlooks the recognition of the added race-related labor performed by Latinas in computing and other women of color in STEM fields to increase the representation of women of color in STEM. While the issue of diversity, equity, inclusion, labor, and women of color has received acknowledgment at the STEM graduate level (e.g., Jones, 2016; Perez et al., 2022), it has received little attention at the undergraduate level. While touted for encouraging self-reflection, career preparedness, and STEM content knowledge-building (Nelson et al., 2017), such "paving the way" for future generations may also be experienced as cultural taxation on women of color in computing contexts.

Implications and Conclusion

Practitioners aiming to recruit, retain, and support Latina students need to prioritize fostering inclusive environments, particularly within their introductory courses. Latina students may persist, but often, this is done *despite* the environments in which they study computing. Such steps might include: ensuring that students have access to critical counterpaces, such as identity-based organizations and clubs that can connect them with peers and mentors who share their background; working with companies to create internship opportunities specifically for first-generation or other minoritized students; expanding tutoring and counseling services for computing students; funding students to attend conferences such as the Grace Hopper Celebration of Women in Computing and the Richard Tapia Celebration of Diversity in Computing. Given the influence of family members working in computing, departments need to consider how to engage computing family members and support Latina students whose families are not working in tech by connecting them to a broader network of Latin* computing professionals. Departments might consider forming partnerships with organizations and initiatives prioritizing improving conditions for marginalized students in computing, including the Center for Minorities and People with Disabilities in IT (https://cmd-it.org/), SHPE-tinas: https://www.shpe.org/shpetinas, and the TECHNOLOchicas initiative of the National Center for Women in Information Technology (https://technolochicas.org). In particular, these partnerships might be leveraged to encourage enhancements to

introductory computing courses and create a computing identity mindset among faculty, staff, and leaders within the institution.

These data are inclusive only of Latinas attending research-intensive doctoral-granting institutions, all participating in a national effort to diversify their undergraduate computing programs. As such, Latina students attending these institutions may have been exposed to particular efforts to recruit and retain women and students of color, though such efforts certainly exist at non-participating institutions. Still, the sample may not reflect the experiences of students from other types of institutions, including community colleges and baccalaureate-granting institutions. Additionally, while the experiences of students from Hispanic-serving institutions were represented in our study, further investigation is needed to understand the role of institutional context. In addition, data were collected in a limited time frame; longer-term follow-ups would be necessary to ascertain these women's longer-term participation in computing and the factors that shape it.

The women who made up the interview participants were selected for interviews because they persisted in the computing major. This method inherently yielded a sample of highly successful and engaged students, most of whom had parents or extended family members who worked in computing fields, which may not be representative of all Latina undergraduate computing students. In addition, only one of the respondents was an online student, as this study was conducted pre-COVID. It is not yet known what impact the transition to nearly universal online learning had on the experiences of students in computing, particularly students from marginalized backgrounds, though emerging research does suggest that taking computing courses completely online predicts lower levels of computing orientation and course satisfaction (Sax, et al., 2023).

In the future, scholars might also consider additional theoretical and conceptual frameworks that might be utilized in studying the introductory course and computing identity experiences. Rodriguez et al.'s (2020b) Model of Computing Identity for Latina Undergraduates could be an important lens through which scholars can understand the individual-level computing identity development experiences (e.g., interest, competence, performance, recognition, sensemaking and negotiations) as well as broader forms of assets (e.g., community cultural wealth, funds of identity) and encountered oppressions (e.g., intersectionality). For a Chicana Feminist approach, scholars might also look to elements of Anzaldúa's *conocimiento* or *nepantla*, which center the process of becoming and consciousness or considering these experiences through the concept of decolonizing higher education (Anzaldúa, 1987; Anzaldúa & Moraga, 1981), specifically within computing contexts (Rodriguez, in press). Furthermore, scholars might also look to understanding the role of institutional actors on these experiences through validation theory (Rendón, 1994) or how students engage in transformational resistance to resist oppression as they navigate introductory computing experiences and computing identity development (Rodriguez et al., 2020a; Solorzano & Bernal, 2001). Each of these lenses could present a more robust understanding of how Latina computing students navigate their experiences, interact with their environments, and resist oppression.

Conclusion

In sum, this study emphasizes the role of introductory computing courses in the persistence and computing identity development of Latina students. While most Latina

students who enroll in these courses persist, there is still work to be done to ensure that more Latina students are recruited and supported during their undergraduate experience. While they may experience challenges in forming and sustaining a computing identity, creating inclusive environments throughout their college years will enable students to transition smoothly from introductory courses to upper-division courses graduation and will empower them to give back to their communities.

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