“You Figure It Out by Yourself”: Women’s Transitions from Computer Science Education to the Workforce

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ABSTRACT

Despite ongoing efforts to broaden participation, women remain underrepresented in Computer Science (CS) education and the workforce. This study examines how institutional support shapes women’s transitions from CS education to professional practice. We conducted a thematic analysis of semi-structured interviews with current and former CS students and professionals, informed by frameworks on gender bias, identity development, and organizational culture. Findings show that persistence in CS is shaped less by individual ability than by uneven, often implicit institutional support, which becomes especially consequential during the education-to-workforce transition. These results identify intervention points beyond recruitment-focused approaches to improve long-term retention.

CCS CONCEPTS

• Human-centered computing → Human computer interaction (HCI) → Empirical studies in HCI

KEYWORDS

women, computer science, education-to-workforce, institutional support, persistence

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1 Introduction

Despite efforts to increase women’s participation in STEM, women remain significantly underrepresented in computer science (CS) education and the workforce, even as representation rises in other STEM fields [18,27,31,42]. As of 2021, women earned approximately one-fifth of CS bachelor’s degrees and represented about one-quarter of the CS workforce [18,21,31–33]. Comparatively, women earn approximately 85% of bachelor’s degrees in health, 61% in life sciences, 42% in math, and 40% in physical sciences, with workforce representation largely mirroring these trends [18,32,33]. In contrast, women’s representation in the computing workforce has declined sharply, from 32% to 25% between 1990 and 2020 [18]. As CS remains an outlier among STEM disciplines, this pattern raises questions about women’s uneven progression across educational and professional contexts. Understanding this requires examining not only entry into CS but also the historical, cultural, and systemic factors that shape women’s experiences [29].

Prior research on gender disparities in CS tends to focus on either recruitment into education pathways or workforce retention, rather than examining these stages in tandem, limiting insight into how these barriers persist across the academic-to-career pipeline. Recruitment efforts emphasize increasing early exposure, introducing female role models, and implementing outreach initiatives [2,18,27,42], while retention efforts aim to extend peer mentoring and social support to foster long-term cultural change [2,18,23,48]. At the undergraduate level, contextualized and identity-focused curricula (e.g., social impact, collaboration, interdisciplinary application) have strengthened women’s engagement and sense of belonging [47,49]. At the professional level, employee resource groups, mentorship programs, and inclusive policies (e.g., workplace flexibility, diversity initiatives) support greater self-efficacy and career persistence [23,25]. Despite these efforts, existing interventions remain fragmented, rarely capturing how gendered barriers interact across educational and professional contexts over time.

Our findings indicate that women’s experiences in CS are shaped by intersecting gendered dynamics across the academic-to-career pipeline, including: i) uneven early exposure and cultural perceptions that influence entry into CS, ii) persistent gender norms surrounding credibility, evaluation, and belonging, and iii) uneven institutional supports that shape how women navigate the education-to-workforce transition. Rather than technical ability alone, participants described persistence in CS as contingent on how institutional structures, such as curricula, workplace expectations, and available support systems, mitigated or amplified disruptions to confidence during transition. Together, these findings highlight the education-to-workforce transition as

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consequential, with past educational experiences, gendered expectations, and institutional support systems intersecting to shape long-term participation in CS. By integrating these perspectives, this study contributes insight into how gendered barriers and supports operate across contexts rather than at isolated stages, highlighting intervention points beyond recruitment-focused approaches to support sustained participation.

2 Theoretical Framework

Our theoretical framework draws on prior work in computing education, organizational studies, and feminist HCI to frame women's underrepresentation in CS as historically produced and institutionally reinforced. Rather than attributing disparities to individual interest or ability, it emphasizes how cultural narratives, structural conditions, and gendered evaluations shape women's experiences in educational and professional contexts.

2.1 Historical Context & Gendered Construction

Historically, women were not as underrepresented in CS as they are today [9,19,31]. Women's CS bachelor's degree earnings peaked in the mid-1980s, when they accounted for approximately 37% of degrees, but had dropped to approximately 18% by the early 2000s and have remained near this level [31,34]. Even earlier, from the 1940s to the 1970s, women made up a substantial portion of the computing workforce, serving as coders, operators, and system architects, despite not receiving formal recognition or advanced degrees [3,9,19].

Beginning in the 1980s, the rise of home computing and masculinized cultural portrayals narrowed women's participation [12,15,28,31]. The media increasingly portrayed programmers as "socially isolated male geniuses" and educational materials implicitly assumed prior, male-dominated "hobbyist" experience [7,12,31]. Narratives suggesting that women are "just not interested" in computing further entrenched these cultural messages [20]. Together, these historical shifts demonstrate that women's underrepresentation in CS is socially constructed, shaped by cultural narratives, unequal early access, and assumptions about belonging [9,12,15,20,28,42].

2.2 Gendered Stereotypes, Identity, & Evaluation

Women's underrepresentation in CS reflects the cumulative effects of stereotypes, bias, and cultural barriers rather than differences in ability [1,27,31,42,48]. Common stereotypes frame computer scientists as male, introverted, and socially isolated [2,13,20,43]. These stereotypes discourage women's participation and contribute to early gender gaps in exposure and interest, undermining self-efficacy and shaping educational and career choices [1,6,12,36,42,43]. Unequal access to early computing experiences compounds these stereotypes, as girls and young women are less likely to encounter opportunities framed as pathways to technical identity or future careers [7,12,15,28,31,42]. Because confidence in CS develops through repeated, affirming experiences, these disparities reflect structural constraints rather than disinterest. These dynamics persist within academic and professional settings, where admissions policies, prior-experience expectations, hiring practices, and organizational culture reinforce gendered assumptions about who is "naturally suited" for CS [1,28,30,37,42,45,46]. As a result, stereotypes about technical ability shape both self-perception and external evaluation, limiting recognition, opportunities, and sense of belonging [1,20,45].

Psychological frameworks further explain how these dynamics are internalized. "Stereotype threat" refers to the risk of confirming a negative stereotype about one's social group [45]. In CS contexts, stereotype threat contributes to alienation and concerns of biased evaluation [1,20]. Similarly, the impostor phenomenon captures persistent self-doubt among high-achieving women in male-dominated fields, often arising from repeated exposure to environments that question their abilities [21,36,40]. Stress and impostor-related experiences can contribute to reduced persistence among women and other underrepresented groups in CS, linking psychological strain to persistence outcomes [11].

Feminist HCI emphasizes how gender operates through evaluation, recognition, and labor distribution within technical environments. Emotional, relational, and coordination work, often described as "invisible labor" or "glue work", sustains teams but is rarely acknowledged or rewarded [4,5,10,16,22,35,39,41,44]. Women are disproportionately pushed toward such roles, reinforcing gendered divisions of labor and constraining opportunities for technical development [26,35].

2.3 Educational and Workplace Continuities

In undergraduate CS, women frequently report a lower sense of belonging, gender-based mistreatment, and limited peer or faculty support [6,43]. Classroom dynamics, group work, and peer interactions often reinforce male dominance, leaving women feeling unrecognized and excluded from meaningful participation [2,6,40,43]. Such experiences shape perceptions of credibility and technical competence that extend beyond the classroom. Similar dynamics emerge as women transition into professional computing environments. Women report having their technical competence questioned, navigating gendered "micro-climates", and encountering exclusionary communication norms, often requiring additional emotional labor to establish credibility and counter biased evaluation practices [17,18,23–25,48]. These dynamics appear regardless of employment status, suggesting continuity of gendered experiences across these stages [23,25].

The leaky pipeline framework helps to explain how cumulative barriers, rather than isolated incidents, contribute to who persists across educational and professional stages [1,2]. From this perspective, transitions function as critical inflection points where early gendered experiences persist and often intensify. Across these transitions, women disproportionately perform emotional labor, such as mentoring and managing team coordination, which are essential tasks for organizational functioning but are rarely recognized [10,22,41,42]. Feminist HCI conceptualizes this as a structural feature of technical cultures that shapes whose contributions are recognized as valuable or promotable [3,4,10,35].

These findings indicate that educational and workplace disparities cannot be addressed independently. Understanding persistence in CS requires an integrated approach that accounts for how early experiences, identity affirmation, and institutional structures interact across the academic-to-career pipeline. This study adopts this approach by situating women’s educational and professional narratives within a single setting.

2.4 Interventions

Prior work proposes interventions across recruitment, pedagogy, mentorship, and workplace policies to address persistent gender disparities in CS. At the education level, contextualized curricula, inclusive pedagogy, and mentorship programs have shown promising results in improving women’s engagement and retention [2,38,47,49]. Programs that integrate real-world or humanitarian applications of computing, linking technology to social good, are particularly effective at challenging narrow stereotypes and broadening technical identities. At the organizational level, diversity hiring initiatives, bias training, and work-life balance policies aim to improve inclusion, though effectiveness varies by institutional implementation [18,23,25,48]. However, these interventions are often implemented in isolation, overlooking the education-to-workforce transition. As a result, they fail to account for how early experiences shape expectations, confidence, and vulnerability to bias in professional roles. This study builds on prior frameworks by examining women’s experiences across the pipeline within a single study, emphasizing persistence and institutional responsibility.

3 Research Questions

The above research highlights shared challenges women face across CS educational and professional contexts, including male-dominated environments, gendered bias, limited belonging, and uneven institutional support that reinforce structural and cultural barriers [1,2,14,20,23,43,48]. We bridge this gap by combining educational and workplace perspectives. Specifically, we ask:

1. How do gendered norms, stereotypes, and institutional practices shape women’s pathways into CS and their experiences in CS education?
2. How do these gendered dynamics persist or shift as women transition from CS education into professional settings, and how do they shape persistence?
3. How do women describe the role of institutional support across the academic-to-career pipeline, and how do these experiences inform more equitable and approachable CS environments?

4 Positionality Statement

The research team consists of three researchers (two women and one man), all able-bodied and based at a U.S. R1 research institution. Our work is situated within a U.S. educational and professional context. Two members of the research team have personal experience as women in CS across educational and early-career contexts, which informed the framing of the research questions and sensitivity to issues of gender, belonging, and institutional support. To mitigate the influence of our own experiences on interpretation, analysis was grounded in participants’ accounts through systematic qualitative methods.

5 Methodology

5.1 Study Design

This study adopts a qualitative research approach to examine women’s experiences in CS education and the workforce. To capture experiences across the academic-to-career pipeline, we conducted semi-structured interviews with current or former CS students and professionals. Semi-structured interviews allowed for consistency across participants’ responses while providing flexibility for emergent themes and contextual details. This format supported in-depth reflection on early CS exposure, educational experiences, workplace dynamics, and transitions between academic and professional contexts, surfacing how bias, belonging, and identity shaped participants’ experiences and influenced persistence.

5.2 Recruitment Process

Participants were recruited through email outreach and professional social media, targeting academic networks, professional communities, and women-in-tech groups. Limited snowball sampling supplemented outreach, with participants invited to share study information with others who met the inclusion criteria. Interested individuals completed an online intake survey, which collected demographic information and preliminary background data on participants’ educational and professional CS experiences. Responses were reviewed for alignment with the inclusion criteria, and selected participants were contacted via email to schedule an interview. Interviews were scheduled upon confirmation of interest.

5.3 Participants

Participants included women with CS experience across educational and professional contexts, including current students, employed professionals, and formerly employed professionals in CS-related roles. Participants entered CS through a range of pathways, including both formal CS degree programs and alternative or indirect educational backgrounds (see Table 1). Inclusion criteria required participants to be at least 18 years old, reside in the U.S., have educational or professional CS experience, and be comfortable participating in an English-language, recorded interview. The study aimed to recruit 10-20 participants to support in-depth qualitative analysis. A total of 10 interviews were conducted, with 1 excluded due to incomplete data, yielding a final sample of N = 9. Recruitment concluded when thematic saturation was reached, defined as the point at which no new themes or codes emerged during the iterative analysis.

5.4 Interview Set-up and Protocol

Before each interview, participants electronically provided informed consent outlining the study's purpose, procedures, potential risks and benefits, confidentiality measures, and voluntary participation. Contact information for the researcher and faculty advisor was provided for any questions. Consent was also verbally confirmed at the start of each recorded interview. Interviews were conducted virtually, one-on-one, and lasted approximately 1 hour. Discussions followed a semi-structured format covering several core topic areas, including CS exposure, educational experiences, workplace dynamics, transitions between academic and professional contexts, and reflections on recommendations for change. Interviews were recorded with the participants' consent to support accurate transcription and analysis. Participants were also given the option to disable video if preferred. Audio recordings were transcribed, reviewed for accuracy, anonymized, and assigned participant IDs. All audio files, transcripts, and consent documents were securely stored and accessed only by the research team.

PID	Age	*Status*	*Educational Background*	*Years of Experience*
P1	18-24	Currently employed	Bachelor's, CS-related	4-6
P2	35-44	Previously employed	Bachelor's, English/Classics Master's, Library Science	7+
P3	18-24	Currently employed	Bachelor's, CS-related	1-3
P4	45+	Currently employed	Bachelors-PhD, CS-related	7+
P5	25-34	Currently employed	Bachelor's, CS-related	7+
P6	18-24	Undergraduate student	Bachelor's in progress, CS	1-3
P7	18-24	Undergraduate student	Bachelor's in progress, CS	1-3
P8	35-44	Currently employed	Bachelor's, Wildlife Conservation Master's, CS-related	4-6
P9	18-24	Currently employed	Bachelor's, CS-related	4-6

Table 1: Participant demographics

6 Data Analysis

Interview transcripts were analyzed using thematic analysis following Braun and Clarke's (2006) approach to facilitate systematic coding, organization, and comparison of interview data across participants [8]. This approach allowed patterns to emerge inductively from participants' narratives, while remaining informed by prior frameworks, to capture both shared experiences and variation.

6.1 Coding and Reliability

An initial codebook was developed through an iterative process, combining deductive codes informed by the interview protocol and theoretical frameworks, with inductive codes emerging directly from the data. The finalized codebook included codes related to early CS exposure, educational experiences, workplace dynamics, transitions, support systems, and factors influencing persistence. Inter-rater reliability (IRR) testing was conducted. An initial IRR score (0.28) prompted refinement of code definitions and clarification of overlaps. After revision, the codebook achieved acceptable reliability (0.75) and was then applied consistently across all transcripts. Codes were then clustered into higher-level themes through iterative comparison across transcripts, and were selected based on prevalence, coherence, and relevance to the research questions. Analysis emphasized participants' meanings and contexts to examine how gendered experiences in CS are constructed and sustained across educational and professional settings.

7 Findings

This section presents interview findings on women's entry into CS, gendered experiences across the education-to-workforce pipeline, and the role of support systems in shaping persistence.

7.1 Entry into CS

Participants' entry into CS was shaped by uneven early exposure, cultural perceptions of the field, and social interactions that legitimized or undermined initial interest.

7.1.1. Uneven Exposure and Indirect Entry. For most participants (7/9), CS was not an early or obvious career interest. Many first encountered CS through required coursework rather than intentional pursuit. As P5 explained:

> "Prior to going to university, I had no real interest in computer science. Hadn't been exposed to it at all, but I went to [university], they required everyone, regardless of major, to take a computer science class. And so once I took that, I realized, hey, this is really fun. I enjoyed it a lot, but I didn't think that I was smart enough or technical enough to do true computer science." (P5)

A smaller number of participants (3/9) describe early exposure through high school coursework, which helped normalize technical problem-solving and boost confidence. These accounts suggest that early exposure functioned less as a pipeline advantage and more as a legitimizing mechanism, shaping confidence and a sense of belonging.

7.1.2. Uneven Exposure and Indirect Entry.

Participants frequently described early perceptions of CS as male-dominated, socially isolating, or suited primarily to those with innate technical abilities, which contributed to hesitation and self-doubt, even among those who later developed a strong interest in or success in CS. P8 described imagining computer scientists as: "Nerdy dudes in their basement, or like Patagonia vest Tech-bros." Other participants similarly described hesitating to pursue CS due to anticipated gender dynamics in male-dominated environments.

7.1.3. Social Validation and Legitimacy.

Social feedback following initial exposure played a critical role in shaping continued engagement. Encouragement often legitimized interests that participants had not yet fully articulated. P3 described entering CS through peer suggestion: *"One of my friends was like, you would be pretty good at this, so you should try it. And I had never heard anything about it."*

In contrast, discouragement, often subtle or indirect, reinforced uncertainty, even when it did not fully deter participation. P2 recalled:

> "I remember my friends even saying, like, oh, well, you're a girl, so you obviously aren't going to do computer science... [but] I liked computers a lot. I was very interested in them." (P2)

Some participants (3/9) situated their early experiences within a broader historical context, noting shifts in gender representation over time. P4 reflected on decades of experience as both a student and a faculty member, describing a noticeable decline in women's participation during her career as a professor beginning in the mid-1990s: "*Where are all women? What happened?*" Rather than interest or ability alone, entry into CS reflected access to exposure, cultural perceptions, and social validation, requiring many participants to navigate uncertainty and gendered expectations even before formal undergraduate education.

7.2 Gendered Evaluation Across Transitions

Participants' undergraduate experiences, transitions into professional roles, and early workplace experiences were shaped by gendered norms surrounding evaluation, credibility, and belonging. While few participants describe overt discrimination, nearly all reported encountering subtle, cumulative barriers and challenges embedded in routine academic and professional interactions. These experiences shaped confidence, participation, and sense of belonging, producing patterns that extended across these contexts.

7.2.1. Gendered Inclusion, Representation, and Visibility in Undergraduate CS.

All participants (9/9) described navigating environments characterized by gender imbalances. Representation varied by institutional context and course level, with early coursework sometimes more balanced and upper-level courses marked by increasing underrepresentation. As P1 reflected:

> "Freshman and sophomore year, the classes [were] smaller... proportionally, there were more girls in the class... it was really nice... there were a lot of, like, other girls in the class that we could lean on for support." (P1)

However, this sense of inclusion diminished over time. P1 further reflected: "*I did notice like there were definitely less girls in the class as time went on, especially like, junior and senior year.*" Participants also noted limited representation among faculty members. P8 recalled: *"I only had one female professor... and her course was less technical... there [were] very few females that were not in like support roles in our department."*

Being one of the few women in these environments heightened visibility and representational burden. P3 explained: "*When you're the only girl in an environment, you kind of speak for all girls...*". Underrepresentation amplified visibility and representational burden, shaping women's participation and belonging.

7.2.2. Peer Dynamics and Participation Inequality.

Gendered norms were most pronounced in peer interactions, particularly during collaborative coursework. Participants (4/9) described being spoken over, dismissed, or positioned in less technical roles. P6 described leading a team project with a male peer who: *"...wasn't always speaking in the most kind way... [he'd] tell the professor, like, none of these people know how to decompose their code..."*. Participation inequality further reinforced gendered norms of credibility. P8 reflected: *"... male students would be a lot more dominant in classroom discussions... they would just say the answer..."*.

Participants (4/9) also described difficulty forming peer networks within male-dominated classrooms, limiting access to informal academic support. As P3 explained: "*It's harder to like, have that initial kind of common bond... when you're stuck on your homework, who are you texting?*" These dynamics restricted access to informal support systems and reinforced gendered perceptions of competence.

7.2.3. Task Allocation and Skill Development.

Group work was a primary site where gender dynamics surfaced, shaping participation and learning. Several participants (5/9) described being assigned organizational, communication, or design tasks, while male peers claimed technical work. P6 described:

> "...he was kind of pushing for us to, like, work on the design. Or, you know, he's like, I'll do this, and it'll be done [in], like, a week or whatever, and you guys can just do this... he was really against working on the design himself." (P6)

P6 went on to say: "I flipped the gender roles because I was like, you know, we have to learn how to do this too… And he was, like, fuming a little bit due to that. But, you know, I felt like I didn't want to be like, the designer, the make it pretty person". Although resistance enabled skill development, it often required additional emotional labor and risked tension, foreshadowing later professional role expectations.

7.2.4. Self-Efficacy and Impostor Syndrome.

Seven participants (7/9) described experiencing self-doubt or impostor syndrome during undergraduate CS education. These feelings were more strongly linked to comparisons with peers' prior experiences rather than to academic performance. P5 explained: *"I kept putting off becoming a computer science major, because I was like, well, what if I'm not good enough?"* Others described that these feelings were related to identity mismatch. P1 noted: "I lived a very different lifestyle than a lot of computer science students, so I felt like an impostor… just because I might not be your typical, like, gamer boy, I still find this field really interesting." These accounts suggest that impostor feelings reflected perceived misalignment with dominant CS identities rather than ability.

7.2.5. Education-to-Workforce Transition.

The transition into internships or full-time roles amplified existing gendered dynamics. Participants described that the loss of structured learning environments and explicit evaluation criteria led to uncertainty and disruption of confidence. P9 reflected: *"One of the biggest things coming out of college… is the feeling of, what did I even learn?... that was another big impostor syndrome, like moment for me."* P7 contradicted academic and professional expectations:

> "I'm used to professors, like, give me a prompt… this is completely different. They tell you, okay, I need this to be done… you can figure it out. Like, use your resources." (P7)

7.2.6. Workplace Representation and Visibility.

Participants' workplace experiences frequently mirrored educational gender dynamics. While early-career environments were sometimes described as supportive, underrepresentation persisted in senior technical and leadership roles. P5 explained: *"There's three women at my level… there are no women above me."*

Even in women-centered companies, leadership roles remained male-dominated. P2 expressed frustration with this disconnect: "…even in these companies that are about, like, period health… the CTO is a guy, and that drives me bananas, because it's like he doesn't know anything about this product". Persistent underrepresentation at senior levels shaped expectations for long-term advancement.

7.2.7. Workplace Credibility, Recognition, and Evaluation.

A prevalent workplace challenge involved repeatedly establishing credibility. Participants (5/9) described having to work harder to be perceived as competent, particularly when pursuing leadership roles or promotions. P1 reflected on a colleague's experience:

> "She really noticed it was harder to make cases for herself for promotion… she was like, I felt like it was very hard to, you know, get people on board with me holding that leadership role." (P1)

Participants (3/9) also described instances where their technical contributions were dismissed, ignored, or only accepted after validation by male colleagues. P8 described such interaction, saying: "*I must have tried to say it very diplomatically, like, a couple of times. Eventually I gave up, and I just messaged one of the senior devs… and the guy immediately changed it."* These patterns illustrate how credibility was unevenly granted, often requiring external validation to legitimize women's technical contributions.

7.2.8. Invisible/Non-Technical Labor.

Participants (6/9) describe being steered towards roles emphasizing coordination, communication, and service rather than technical development. This pattern emerged as a structural expectation embedded in team dynamics rather than explicit discrimination.

P2 described: "…women also do lots of this sort of invisible work… that they're not rewarded or appreciated for, and they end up getting really overworked." Similarly, P9 reflected: "Sometimes it could feel like I'm a mini secretary". Such labor was essential yet undervalued, constraining technical growth and shaping career trajectories.

7.2.9. Gendered Double Standards and Undermining.

Several participants described gendered double standards in how behavior was interpreted, where assertiveness or advocacy was sometimes framed negatively when expressed by women. Participants (4/9) also described sexualization, age-based bias, and microaggressions that undermined professional identity. P2 described: *"The biggest struggle has been like, people hitting on me…"*, and being told, *"you're too pretty to be a software engineer"*. These experiences demonstrate how gendered norms influence the interpretation of women's behavior, undermining professional legitimacy and technical credibility.

7.2.10. Persistence, Attrition, and Meaningful Work.

Participants (8/9) described persistence as shaped less by technical capabilities and more by recognition, meaning, and value of their work. Undervaluation and burnout contributed to decisions to leave roles, while mentorship and meaningful work supported persistence. P2 directly connected her influence to leave to these issues: *"…those skills of mine being undervalued at my last role. So I quit"*. These findings demonstrate that gendered norms of evaluation, credibility, and belonging shape decisions to remain in CS.

7.3 Support Systems as Mechanisms of Persistence

Across contexts, support systems functioned as key mechanisms of persistence rather than optional enhancements, helping participants navigate environments structured around uneven access, ambiguous expectations, and gendered evaluation. The presence, or absence, of support shaped participants' experiences and decisions to remain in the field.

7.3.1. Academic Support Systems. All participants (9/9) described engaging with at least one form of academic support during their education, including faculty mentorship, TAs, peer networks, women-centered organizations, research opportunities, and institutional scaffolding, such as beginner sections or study groups. Academic support systems were most effective when they reduced intimidation, created identity-safe spaces, and made resources available and accessible. Peer-based supports, particularly undergraduate TAs, were frequently highlighted as approachable and empathetic resources. As P6 explained: "*...having the undergraduate TAs was a big thing for me, because they're like, more relatable and helpful... it was kind of a bonding experience at times as well.*"

Women-centered organizations also played a critical role in normalizing struggle and providing practical guidance. Participation in groups such as ACM-W or Rewriting the Code helped participants contextualize their experiences and access career preparation resources. P6 also described an experience related to this: "*Seeing that other people were having the same sort of struggles... one girl helped me a lot with my resume... that was really a turning point for me.*" Participants also identified gaps in academic support, particularly around visibility and faculty engagement. As P8 explained: "*...it would have been nice to have the professor just get a little bit involved... like, have a list of groups... rather than, like, putting the onus more on the student*". These experiences suggest that academic support often depended on informal discovery rather than systematic design.

7.3.2. Workplace Support Systems. In professional settings, participants (8/9) described workplace support structures including mentors, supportive teams, employee resource groups, culture initiatives, and onboarding practices. While these supports contributed to adjustment and belonging, their availability and effectiveness varied widely across organizations. Formal mentorship was particularly impactful, especially when mentors shared similar identities or career stages. Participants also highlighted organizational initiatives aimed at fostering community and belonging. P8 described the formation of a "global tech culture council" following employee surveys: "We are responsible for, just like, fostering that sense of belonging and coming up with different things that we can do to help people just feel like they're not alone..." At the same time, participants identified weaknesses in workplace support systems, particularly around reporting, accountability, and protection from gender-based harm. The negative sentiment frequently focused on the lack of effective mechanisms for addressing inequitable treatment. P1 explained:

> "If women do feel like they're being treated unfairly... a lot of these coworkers, they say their solution is to, if they just can't be believed, they have to let it go and move on with their life... that's not good because the problem is never being solved, and the perpetrator might do it again to someone else." (P1)

Others emphasized the need for more structured onboarding and sustained support, such as bootcamps for recent graduates or interns. P2 noted: "...acknowledging that they're going to need way more hand holding than the average new CS grad...". These accounts highlight how workplace support systems often mitigate immediate challenges but fail to address underlying structural inequities.

7.3.3. Support Across the Transition. Across contexts, participants framed persistence during the transition as an active, ongoing process. Common strategies include seeking mentorship, engaging in self-directed learning, asking questions, and reframing challenges as normal parts of professional growth.

Support systems help to reduce isolation, normalize uncertainty, and provide navigational resources necessary for persistence. At the same time, reliance on informal or uneven support placed additional labor on individuals to seek out, maintain, and compensate for gaps in institutional structures. These findings suggest that persistence in CS is not achieved in isolation. Instead, it is enabled by the availability, visibility, and quality of support across educational and professional environments. When support systems are not firmly integrated into institutional practices, responsibility for persistence is shifted onto individuals, reinforcing inequities even in otherwise supportive environments.

8 Discussion

This study examines how institutional structures shape women's transitions from CS education into professional settings. Across interviews, participants described persistence as contingent less on technical ability and more on the presence and continuity of institutional supports. Rather than encountering isolated barriers, women experienced cumulative gendered norms of credibility, evaluation, and belonging that extended across the academic-to-career pipeline; specifically contributing to how these dynamics unfold across, rather than within, stages of the CS pipeline.

8.1 Persistence as Structurally Produced

Consistent with prior research that positions gender disparities in CS as socially constructed rather than ability-based [20,28,42], participants did not attribute difficulties to technical competence. Instead, they described navigating environments where competence was repeatedly questioned or unevenly recognized. The education-to-workforce transition did not fundamentally alter these dynamics, as patterns of unequal representation, participation, and credibility reemerged in professional settings.

While the leaky pipeline framework highlights cumulative barriers across these stages [1,2], our findings refine this account by centering transitions as institutional inflection points. Persistence depended not only on surviving barriers but also on whether institutions provided consistent support across contexts, such as mentorship, evaluation criteria, and identity-safe spaces. If support structures were absent or lessened during the transition to professional roles, confidence disruptions intensified. When similar supports remained, participants described greater long-term stability. Thus, transitions are not inherently destabilizing, but can become so if institutional support is uneven. While prior work has examined barriers within either educational or workplace contexts, our findings extend this literature by showing how these dynamics persist across the transition itself, highlighting the continuity of institutional structures rather than treating these stages in isolation.

8.2 Gendered Evaluation and Invisible Labor

Across both educational and professional settings, participants described gendered patterns of evaluation. Experiences commonly associated with stereotype threat and impostor phenomenon [21,36,40] emerged not as personal inadequacies but as responses to structurally embedded cultural gaps. Women reported repeatedly having to establish credibility, encountering subtle devaluation, and navigating behavioral double standards.

Feminist HCI provides a critical lens for interpreting these dynamics [4,5,16,39]. Participants' descriptions of "glue work", coordination labor, and representational burden illustrate how gender operates through the distribution and recognition of labor. Women were frequently steered towards relational and organizational tasks that sustained teams but were not equally rewarded [10,22,35,41,44]. This "invisible labor" constrained technical development and shaped long-term career trajectories, with these patterns emerging in both educational and professional contexts and persisting through the transition between them.

Recent work also suggests that emerging workplace technologies, particularly AI-assisted collaboration and coding tools, may reproduce or intensify these dynamics if existing gendered norms remain unaddressed [14,48]. Women who have recently transitioned into CS continue to face similar patterns of exclusion from informal networks and uneven visibility, now occurring through AI- and remote-work practices that reshape how participation and credit are distributed.

By framing emotional and relational labor as structural features of technical cultures rather than incidental, feminist HCI clarifies how contribution and value are institutionally defined. Persistence was strongly linked to recognition of technical contributions, and when invisible labor went unrecognized, burnout and exit became more likely. This study highlights the role of transition in reproducing, rather than disrupting, gendered divisions of labor.

8.3 Support Enables Persistence

Participants described mentorship, peer networks, women-centered organizations, and inclusive teams as providing the structure that enables persistence. These supports reduced ambiguity, normalized help-seeking, and offered navigational guidance during critical transitions. However, access to support was often uneven and informal. When mentorship or community-seeking required personal initiative to locate, responsibility for persistence shifted onto the individuals, reproducing inequity even in otherwise well-intentioned environments. Persistence, therefore, cannot be framed solely as resilience; it is institutionally enabled. This cross-context perspective contributes a more integrated account of persistence, emphasizing not only the presence of support within individual settings but the importance of continuity in support across the education-to-workforce transition.

8.4 Implications

Informed by participants' closing reflections on how CS culture could be reimagined and on the advice they would offer to young women, our findings suggest that recruitment-focused interventions, while valuable, are insufficient in isolation. Early exposure legitimized interest, but persistence depends on sustained institutional support. Educational programs connecting computing to social good appear particularly effective at broadening technical identities and challenging narrow stereotypes. Such curricula aligned with participants' accounts of meaningful, sustained engagement.

In workplace contexts, reforms must extend beyond diversity hiring toward accountability in evaluation, promotion, and task allocation. Bias training and employee resource groups may improve workplace climates, but without structural transparency in advancement criteria and recognition of invisible labor, inequities persist. Coordinated policy efforts between universities and industry may be particularly impactful. Structured onboarding, transparent evaluation standards, and sustained mentorship across transitions could mitigate confidence disruptions that arise during early professional stages.

8.5 Limitations and Future Research

This study draws on a qualitative sample of nine participants within the U.S., limiting generalizability. While thematic saturation was reached, experiences may differ across institutional types, geographic areas, or international contexts. Intersectional dimensions such as race, socioeconomic background, and first-generation status warrant deeper examination. Additionally, while this study centers on women’s experiences, many transition-related challenges may extend to CS graduates more broadly. The experiences described by participants also span different career stages, and contemporary workplace changes, such as remote work and the increasing use of AI-assisted coding tools, may shape transitions in ways not fully captured here.

Future research should examine how institutional structures operate across intersecting identities and throughout the education-to-workforce transition, and how these support systems can be strengthened to better serve all students. Examining transition-specific interventions, such as education-to-workforce mentorship programs, may provide actionable pathways to sustain persistence. At the same time, gendered barriers should continue to be examined alongside broader analyses of CS transitions to ensure that general support structures do not overlook persistent inequities.

8.6 Conclusion

Women’s persistence in CS is shaped not solely by individual capability, but by how institutional systems define credibility, distribute labor, and sustain support across transitions. By integrating educational and workforce perspectives, this study highlights the education-to-workforce transition as a pivotal moment where uneven institutional supports become especially important. Addressing gender disparities in CS requires moving beyond recruitment- and retention-based strategies toward sustained, structurally integrated reforms that redefine how technical competencies, contributions, and belonging are situated within the field.

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