Short Programming Courses: A Pathway to Increase Women's Participation in Technology in Colombia

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***Abstract*—The gender gap in the technology sector remains a global challenge, and Colombia is no exception. From an economic and social point of view, women have been considered a vulnerable population in the technological field. This article explores how short programming courses (bootcamps) can serve as a viable alternative to increase women's participation in technology. Through qualitative research conducted with five coding schools in Colombia, this study analyzes the actions and initiatives that have contributed to improving gender inclusion in these programs. The results highlight key factors that motivate women to opt for short courses, such as their flexibility and practical approach and their positive impact on female employability. One finding of this research is that the impact of bootcamps is measured by dropout/retention and employability metrics, especially for vulnerable populations, as part of its business model. However, significant challenges were also identified, such as cultural and structural barriers that limit access and retention of women in these initiatives. The study concludes that while bootcamps provide a practical alternative pathway to bridge the gender gap in the tech industry, it is necessary to strengthen inclusion policies and design more comprehensive strategies to ensure their long-term sustainability.**

Keywords — short courses, coding bootcamp, women in STEM, gender inclusion, programming, informal education, continuing education, professional development, educational innovation.

I. INTRODUCTION

The underrepresentation of women in the technology sector is a persistent issue worldwide, and Colombia is no exception, according to Colombia's Ministry of Education [1]. Despite significant efforts to promote gender equality, especially in STEM fields (Science, Technology, Engineering, and Mathematics) [2, 3], women remain underrepresented in tech-related careers. This disparity is shaped by a complex set of factors, including sociocultural norms, the limited visibility of women in technology, gender stereotypes, and structural barriers within educational systems, as reported by [4, 5] and UNESCO [6]. These barriers discourage many women from pursuing software development and data science careers, where the demand for talent is growing.

Short programming courses or bootcamps have emerged as an alternative pathway to reach the tech industry. Bootcamps are characterized by their intensive, short-term training programs designed to equip participants with in-demand coding skills and prepare them for employment in the tech and digital industry. Unlike formal education, bootcamps focus on practical, hands-on learning and offer a more flexible, cost-effective, short training, and accessible route into the industry. According to [7, 8], these characteristics make them particularly attractive to women who may have previously been deterred from entering technology careers due to time constraints, financial barriers, or the intimidating nature of traditional academic settings.

In Colombia, bootcamps have become a viable option for women seeking to enter the technology industry. While not initially designed to address gender disparities, these programs have shown potential to help bridge the gap by offering a supportive environment that fosters learning and development for women. Research reported by the World Bank in Colombia and Argentina [9] indicates that these intensive courses positively impact the development of tech and software development abilities in women, increasing job possibilities in the tech industry. However, significant challenges remain, including retention issues, cultural biases, and the need for more inclusive learning environments.

This research explores the role of bootcamps in increasing women's participation in the technology industry in Colombia. Furthermore, the study highlights the challenges that must be addressed to ensure that bootcamps can fully serve as a tool for gender inclusion in technology.

II. THEORETICAL FRAMEWORK

This study builds on key concepts in education, technology, and gender participation, structured into two main areas:

A. Informal education

In this study, an important pillar is informal education as a lifelong learning form of development. Lifelong learning is essential for staying relevant in the fast-evolving technology industry. It provides continuous learning opportunities, both formal and informal, throughout a person's life, fostering personal growth and employability. From the perspective of this study, lifelong learning aligns with the needs of technology professionals who require frequent upskilling and reskilling. According to [10], lifelong learning encompasses learning beyond formal institutions and extends into informal settings from childhood to adulthood.

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Bootcamps have emerged as a popular and practical alternative to professional development, especially for women seeking to enter technology [8, 11]. In contrast with formal education in computer science, bootcamps offer modular training schemas and do not require prerequisites in advanced mathematical skills [10] since the focus is on developing practical computational skills. This perception is compounded by the societal constructs surrounding gender and technical abilities, which often discourage women from pursuing such degrees [12]. Moreover, lacking visibility and understanding of what a computer science degree entails adds another layer of complexity, making formal programs less attractive [13].

In contrast, bootcamps offer a more accessible and flexible educational model. They typically require a shorter time commitment, are more affordable, and emphasize practical, hands-on learning over theoretical foundations. For many women, especially those at later stages in their careers, bootcamps provide a non-intimidating environment to gain coding skills, bypassing the perceived hurdles of formal education [11]. These programs offer a direct and applied approach to learning coding and software development without an intensive mathematical background or the time investment required by a university degree [8, 14].

B. Women's Representation in the Workforce and Digital Industries

Despite progress in gender equality in education, women remain underrepresented in the global workforce, especially in technology sectors. Cultural and social norms continue to shape gender roles, limiting women's participation in technical fields. Reports by [15] and the International Labor Organization [16] highlight the persistence of this disparity, particularly in the aftermath of the COVID-19 pandemic, which significantly impacted women's employment. Globally, only 30% of women pursue STEM disciplines in higher education; of these, only 3% choose fields related to technology and telecommunications [17].

Research by [14] found no correlation between prior programming experience and success in bootcamps, further supporting their appeal to women looking to switch careers. This finding opens doors for women with diverse professional backgrounds, allowing them to succeed without needing prior technical expertise.

Regarding employability, studies have shown positive outcomes for women who complete professional development training in bootcamps, particularly in the United States, Argentina, and Colombia. While some large tech companies may still prefer hiring graduates from traditional CS programs, there is increasing openness to recruiting talent based on demonstrated technical skills, regardless of academic background. In interviews with tech managers, [14] found that after two years of working with bootcamp graduates, managers could not distinguish between those with traditional degrees and those who had completed bootcamps. This reinforces the idea that bootcamps are a viable entry point for women into the digital workforce.

III. METHOD

This section describes the type of study conducted, a brief description of the participant coding school, the role of the interviewee in the bootcamp, and the data collection and analysis methodologies.

A. Research Design

Qualitative methodology was chosen because it allows for an in-depth understanding of participants' experiences and the social contexts in which they operate. According to [18], qualitative research is particularly well-suited for exploring complex social phenomena, and this study seeks to investigate how bootcamps have influenced women's participation in technology, intentionally and unintentionally. This research was conducted following a phenomenological approach [18], focusing on the lived experiences of team members in Colombian coding bootcamps. Semi-structured interviews were used to gather participant data, providing flexibility while ensuring that critical themes were covered [19]. The research questions that guided this study are as follows: (1) What metrics does the bootcamp have to measure the success of their educational model? (2) What initiatives do you implement to increase retention and graduation? (3) What risk factors have you identified that lead to dropout from the course?

B. Participants

The study involved five coding schools out of eight initially invited to participate. Within the coding school that replied to the invitation, there were four selection criteria to invite participants to be interviewed to (1) have a general knowledge of the operation of the coding school, (2) be familiarized with the educational model, (3) know about the formative model of the coding programs, and (4) be closed to the students in term of being sensitive to the needs and training expectations. With these criteria, the participants were primarily leadership team members from these bootcamps, including those in academic coordination and administrative roles. In total, 12 participants were interviewed, including 11 women and one man, who had extensive knowledge of the bootcamp's operations, educational models, and gender-related initiatives. The bootcamps allies' critical role in their operational mode was identified during the data gathering. For this reason, two representatives from a global social impact network were interviewed, which funds several bootcamps, contributing to the results of this study.

Here is a brief description of the five schools, their coding bootcamps, and the role of the interviewed participants.

- Bootcamp 1 (B1). This school is in Bogota, Colombia. It has been offering courses for six years. They offer courses in entry-level software development. The roles of the three participants interviewed were Two Academic Coordinators and one Project Coordinator.

- Bootcamp 2 (B2). This school is in Bogota, Colombia. It has four years of experience offering software development entry-level courses. The roles of the three participants interviewed were Program Manager, Project Coordinator, and Academic and Innovation Coordinator.

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TABLE I. CHARACTERISTICS OF THE BOOTCAMP COURSES AND MAIN DIVERSITY, EQUITY, AND INCLUSION PRINCIPLES SUPPORTED BY THE CODING SCHOOL

Coding school	Modality	Duration of courses	Course offer includes	DEI support
B1	Hybrid	4-6 months	Three levels of software development	Equity and inclusion
B2	Hybrid	4-6 months	Software development at entry-level	Equity and inclusion
B3	Hybrid	100 hours - 4 months	General software development courses	Equity
B4	Online	4-6 months	Digital and software development courses only for women	Equity and inclusion
B5	Hybrid	4-6 months	Software development courses with English training	Equity

- Bootcamp 3 (B3). This school is in Bogota, Colombia, and has been in the market for over five years, offering software development courses and short training. The roles of the three participants were CEO, Project Manager, and Employment Leader.

- Bootcamp 4 (B4). The school was founded in Peru, with operations in more than four countries in Latin America, including Bogota, Colombia. It has 10 years of experience in the market and is the only school offering digital and software development courses only for women. The roles of the two participants were Bootcamp Operations Director and Bootcamp Manager.

- Bootcamp 5 (B5). The school is in Bogota, Colombia, and has three years of experience in the market. It offers software development courses with English training as part of the curriculum. The roles interviewed were Operations Vice-President and Training Leader.

To complete the context of the bootcamps, Table I summarizes course characteristics, the scholarship details of the participants interviewed, and the schools' support for diversity, equality, and inclusion.

C. Data Collection

Data was collected through semi-structured interviews conducted via video conferencing [19]. The interviews followed a pre-designed guide with open-ended questions, allowing participants to share their insights on the impact of bootcamps on women's inclusion in technology. Interviews lasted 60 min (approximately). The interviews were recorded (previous informed consent of the participants) for later transcription and coding.

To prevent marketing promotion or disclosing private information about the schools, staff, or students, this study uses labels for the bootcamp programs. It does not mention the names of the participants.

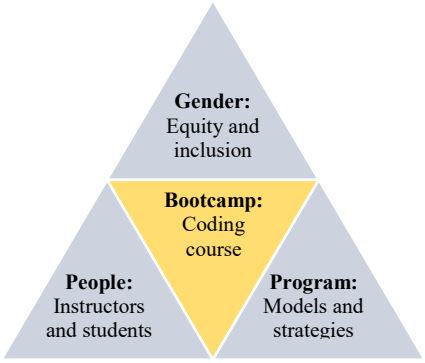

Fig. 1. Categories that foster gender inclusion in the technology sector. Source: Authors

D. Data Analysis

The data was analyzed using a coding process based on the process described by [19, 20]. This process involved multiple readings of the interview transcripts, followed by categorizing critical themes. The analysis focused on identifying patterns of critical topics related to the investigation's questions.

IV. RESULTS AND DISCUSSION

The findings from this study are organized into three main categories derived from the qualitative data analysis: (1) *Programs*: the training models and strategies reported by the participant bootcamps; (2) *People*: instructors and students; (3) *Gender perspective*: equity and inclusion supported by the participant schools (Fig. 1).

A. Programs: Training Model, Course Logistics, Teaching Strategies

This category focuses on the teaching models and logistical aspects of the bootcamps, including course duration, program structure, and business models. One of the primary findings is that the bootcamps analyzed were designed to be practical and accessible, focusing on employability. For example, the bootcamps of this study operated on short-term, intensive programs. That is, no more than six months of training to quickly equip participants with the technical skills necessary for the job market. Moreover, the bootcamps had clear training objectives and target audiences. Thus, the courses offered flexibility in scheduling and attractive cost, particularly to women seeking to develop their technological skills to advance their career development.

A common aspect of four out of the five bootcamps was the financing model, which involves funding through scholarships provided by external organizations such as private companies, foundations, or NGOs. The participants of the Ally organization confirmed the importance of business and funding models in shaping the boot camps' training structure, logistics, and results-focused approach. This finding revealed that the payment by results model was critical to mobilizing the bootcamps to a commitment to achieve the targets agreed upon with their stakeholders.

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The teaching strategies adopted by bootcamps are essential to their success. Most bootcamps reported favoring hands-on strategies and project-based learning, emphasizing peer collaboration. Also, they argue that using real-world examples makes technological concepts more approachable for participants with little prior experience. Additionally, mentorship and individualized support were critical factors in student success. Bootcamps that adopted inclusive teaching strategies, such as tailored support for women and other marginalized groups, reported higher retention rates.

Another important strategy implemented by the schools aimed to decrease dropout rates by understanding factors contributing to student attrition. Key dropout factors identified by the participants include time constraints of the students, lack of access to technology (e.g., computers or internet), and external personal challenges such as caregiving responsibilities, especially for female students. Participant bootcamps that have implemented retention initiatives, such as time management workshops, mental health support, and flexible learning schedules, indicated a positive response by increasing the completion rates of women. They reported that the involvement of trainers in providing personalized support and guidance was essential in reducing dropout rates.

B. People: Instructors and Students

The teachers' role in bootcamps is significant in shaping the learning experience. Findings indicate that the most successful bootcamps prioritized hiring instructors with technical expertise and soft skills. However, a notable challenge was the scarcity of female instructors, which limited the presence of role models for female students. This gap in gender representation among instructors reflects broader issues in the tech industry but also highlights an area for improvement in bootcamp operations.

On the other hand, the students in bootcamps are typically diverse in terms of background, with many women coming from non-technical fields. Participants interviewed agreed that women attending these programs usually seek career changes and see bootcamps to boost their skills in a shorter time and lower cost. Interviews with participants revealed that the enrolled students reported that the bootcamps' flexible structure and practical focus were decisive factors. Bootcamps offering targeted outreach to women, such as gender-focused cohorts, were more successful in attracting and retaining female students.

C. Gender perspective: Equity and inclusion

The impact of bootcamps on increasing women's participation in the technology sector was one of the central findings of this study. Despite persistent barriers such as societal stereotypes and a lack of confidence, bootcamps provide a supportive environment that enables women to enter the tech field. Interviewers noted that the practical, project-based learning format helped the women in their courses overcome initial fears about coding and technology. However, challenges remain, particularly in addressing the "imposter syndrome" many women face when seeking tech jobs [21].

Bootcamps reported that they are increasingly incorporating a gender perspective into their curricula and operations. Several programs have introduced initiatives such as all-women cohorts, gender diversity training for staff, and mentorship programs designed to empower female students. These efforts have resulted in more inclusive environments and better success rates for women. However, some bootcamps coordinators indicated that their schools still face challenges in fully integrating these perspectives, particularly in addressing unconscious biases within their teaching and administrative staff.

In response to the research questions, we can state that the bootcamps that participated in this study measure the number of dropouts/retention and the reason for not completing the course. Also, they record the number of participants who graduated from their courses and their success in getting employed. This information allows them to modify their teaching strategies, attraction campaigns, and course content to be attractive and to increase their impact.

V. CONCLUSIONS

By analyzing the experiences of coding schools in Colombia, this research seeks to contribute to the growing body of research on alternative educational models as mechanisms for improving gender equality in tech fields. Despite the growth of bootcamps, gender inequality remains a significant challenge in the technology sector. Women still face structural barriers and gender bias, including family responsibilities, cultural perceptions of women's roles, and the enduring stereotype that men dominate technical fields. These barriers contribute to low participation and higher dropout rates among women in technology programs. However, bootcamps have shown a potential to mitigate these challenges by creating supportive, non-traditional learning environments, especially those coding schools that have adhered to a gender perspective in their course offered, the financial support opportunities, and the flexibility in their course modality.

An interesting finding of the research is the crucial role of allies and funding organizations in the success of bootcamps, particularly in shaping their gender inclusion strategies. By supporting initiatives targeting women's unique needs, allies can help bootcamps implement effective retention programs and mentorship networks. These efforts contribute to the ongoing inclusion of women in technology.

The flexibility and practical focus of bootcamp teaching methods have proven effective in delivering high-impact, hands-on learning. Project-based and peer-to-peer methodologies create an environment where women feel more comfortable and supported in their learning. Additionally, the rapid iteration of bootcamp models allows for continual improvement in curriculum and student outcomes.

Although bootcamps have seen success in attracting women, dropout rates remain a concern. Women often face external challenges such as caregiving responsibilities and limited access to technology, which contribute to higher dropout rates. Successful retention strategies include personalized support, flexible schedules, and initiatives focused on mental health and time management.

To further enhance the impact of bootcamps on women's inclusion in technology, this study recommends formalizing

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gender-focused strategies, implementing mentorship programs, and collaborating with other bootcamps to share best practices [22]. Last, creating a more structured approach to gender inclusion will help bootcamps increase female participation and retention.

Last, boot camps should make an offer to include computational thinking [23]. Given the recent impact of artificial intelligence tools (AI) in every job or activity, these are actual and relevant skill requirements in the workforce.

Future research should further investigate the long-term career trajectories of women who graduate from bootcamps and the broader impact of these programs on gender diversity in the tech workforce. Additionally, a comparative study between women who pursue formal technology degrees and those who attend bootcamps would provide valuable insights into the effectiveness of non-traditional education pathways.

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