

WIP: Understanding the Production of Highly Qualified Computer Science Teachers in a Predominant Hispanic Community: Computer Science Undergraduate Students' Perceptions of Becoming a Teacher

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Abstract— This research WIP paper describes computer science undergraduate students' perceptions of career pathways and becoming K-12 computer science teachers. Computer science (CS) education has become critical with the rapid pace of technological development to better prepare students for national technology and economic competitiveness and security. According to Code.org, 57.5% of U.S. public high schools offer foundational computer science courses in 2023; unfortunately, access to the courses remains unequal and maintains wide disparities by race/ethnicity and social class. For instance, Hispanics are 1.4 times less likely to take foundational CS courses compared to their white and Asian peers, and students with low socio-economic status are underrepresented in the overall population. The shortage of CS teachers is one of the significant barriers to why minoritized groups of students do not have equal access to learning CS. Various programmatic efforts have been implemented to address the gap, including the recruitment of undergraduate students who will earn bachelor's degrees in computing. This approach has been considered innovative in building a new pipeline for producing highly qualified CS teachers with the ability to transform computing education and the CS teacher community rather than training in-service teachers certified in other disciplines to receive credentials to teach CS. Studies report that CS degree recipients opt for industry roles and exhibit disinterest in alternative career pathways, such as teaching because they perceive this profession as having lower salaries and unfavorable aspects associated with the job. However, we need a more prosperous and in-depth understanding of why CS degree holders consider industry jobs of greater importance rather than teaching, which would reduce the disparity in K-12 computing education. As a first attempt to better understand the perceptions of computer science undergraduate students at an Hispanic-Serving Institution (HSI), we collected qualitative data (i.e., student artifacts) in a course offered in the computer science department. Driven by social cognitive career and FIT-choice theory, our findings from the preliminary analysis indicate that CS undergraduate students at an HSI acknowledged the importance of K-12 CS teachers in their communities, but at the same time, they have more concerns about the underpayment and undervaluation of the job. They have shown a conflict between

their perceptions of teaching CS and their own career aspirations as CS teachers. These preliminary findings draw attention to the importance of uncovering common career plans among CS undergraduate students.

Keywords—Computing education, CS teachers, CS career pathways

I. INTRODUCTION

The percentage of Hispanic students enrollment in public schools increased from 23 to 28 percent between fall 2010 and fall 2021 [1]. However, Hispanic students account for a small fraction of postsecondary computer science (CS) program enrollment [2], and according to data from the American Community Survey between 2009 and 2014, only 4.6% of workers in the computing and information technology sector of the economy were Hispanic [3]. These low numbers are likely due, in part, to the fact that there is already a national shortage of CS course offerings in secondary education. Furthermore, the low representation of Hispanics in computing classes and professions is also due to the historically low and uneven access of K12 students to computing [4] and to the lower prevalence of high-quality STEM teachers in high-minority and high-poverty schools [5]. Research reported that initiatives such as pre-college courses and early exposure to computing in home and school environments have shown the potential to motivate prospective students to pursue CS programs [6], [7]. Furthermore, early familiarity with the field can significantly influence career choices [8]. Increasing K-12 students' participation in CS courses and the number of CS teachers is crucial to rectifying the racial disparity in CS education [9]. Providing more students, particularly Hispanics, access to CS classes will require increasing the number of qualified secondary teachers who can prepare students in robust CS programs to inform them of computing career pathways.

The allure of lucrative salaries in the corporate sector often draws those who complete their CS degrees away from academia and into industry roles [10]; and unfortunately, this

trend exacerbates the shortage of computer science teachers. In addition, a deeply flawed computer science teacher certification process results in substantial hurdles in recruiting, training, and retaining computer science teachers [11]. Computer science is a relatively new subject in K-12 education, so there are few teachers certified to teach it [12]. The situation is further complicated by the fact that each state has its own unique requirements for certifying and authorizing teachers to teach computer science [13]. These complex and varying restrictions and requirements across different states may discourage aspiring educators from pursuing a career in this field. Thus, it is crucial to understand the local context in more comprehensive ways to address these challenges and produce more computer science teachers in K-12, promoting broadening participation in CS. As the first attempt, this work in progress (WIP) paper examined undergraduate CS students' opinions of teaching CS in K-12 and perceptions of considering it as their own career options.

II. BACKGROUND

A. Undergraduate CS Students' Perceptions of Becoming CS Teachers

The current landscape of undergraduate CS students reveals a prevailing inclination away from pursuing alternative career pathways, particularly consideration in becoming CS teachers with highly qualified knowledge and skillsets in computing. Numerous colleges face challenges in producing an ample number of CS graduates, and those who do complete their CS degrees often opt for industry roles instead of academia due to the allure of substantially higher salaries in the corporate sector [10]. Notably, a significant proportion of CS students exhibit disinterest in becoming CS teachers. The unattractiveness of the teaching profession to CS students stems from perceived lower salaries and unfavorable aspects associated with the job [14]. In general, for some students, teaching represents a last resort or backup option that they might reluctantly contemplate should they exhaust their ambitions for traditional CS career advancement. These trends underscore the prevailing preference among undergraduate CS students for industry positions, while teaching roles are often perceived as less appealing among the students who can potentially become CS teachers with the required content knowledge and skill sets.

B. Career Choices and Professional Goals of Undergraduate CS Students

Motivations and expectations are central to influencing the career choices and professional goals of CS students. These factors, such as salary expectations, job satisfaction, personal achievement, and a genuine interest in the field, play a pivotal role in students' commitment to pursuing a career in CS [14] [15], [16]. Student experiences and perceptions are intertwined with their initial expectations in both the short and long term. Short-term expectations relate to coursework, while long term ones encompass career goals [17]. Gaining insights into these expectations is essential for effective management of the student career-related experience within CS programs during college. Furthermore, self-efficacy and computer confidence influence students' career choices and persistence in CS, and their abilities and their comfort in using computers, in turn, influence their career trajectories [18], [19], [20]. Given the alignment of curriculum, specialization tracks aligned with students' goals

are pivotal for enhancing retention in CS programs [15], [21]. Especially for those who do not have traditional career pathways, teacher preparation, and certification models can be an alternative program, and this approach can also address the shortage of CS teachers and improve CS education [10], [22].

C. Theoretical Framework

Social Cognitive Career Theory (SCCT) explores the complex interplay of psychological and social factors that influence personal interests and guide decisions in educational and career trajectories. Initially, SCCT focused on fostering career-related interests, guiding the decision-making process in choosing academic and career paths, and promoting persistence in achieving educational and professional goals [23]. As the theory evolved, it broadened its scope to include other vital aspects such as satisfaction [24], well-being [25], and the complex dynamics of self-management [26] within educational and career contexts. In this study, SCCT provides an ideal framework for exploring the perceptions of undergraduate CS students about becoming teachers, as SCCT has been extensively validated as a model for motivating diverse groups to pursue education and careers in the broader landscape of STEM fields [27], [28], [29], [30].

In addition to SCCT, the Factors Influencing the Teaching Choice (FIT-Choice) framework are incorporated into the study to gain a more nuanced understanding of why Computer Science majors might choose to become K-12 teachers. While SCCT provides a comprehensive framework for understanding career choices, it is a broad theory encompassing a wide range of careers. Teaching, as a career, has unique characteristics and influencing factors that may not be fully captured by SCCT. The FIT-Choice framework, specifically designed to explore the motivations and beliefs influencing the decision to become a teacher, complements the SCCT and provides more detailed insight into the unique aspects of choosing a teaching career in the field of Computer Science. This combined approach allows for a better understanding of the specific motivations and factors influencing Computer Science majors in their decision to pursue a career in K-12 education. The FIT-Choice model aims to provide a systematic approach to understanding why individuals opt for a career in teaching. Unlike previous studies that primarily focused on the values associated with teaching, the FIT-Choice model takes into account both values and expectancies related to the profession [31]. The FIT-Choice model includes several motivational factors, such as social influences, positive prior teaching and learning experiences, perceived teaching abilities, and intrinsic value. The model also considers personal utility values such as job security, time for family, and job transferability, as well as social utility values like shaping the future of children/adolescents, enhancing social equity, making a social contribution, and working with children/adolescents. The model also examined the negative motivation of choosing teaching as a fallback career [32].

III. CURRENT STUDY

A. Motivation for This Study

The motivation for this research stems from the challenges in recruiting CS degree holders as teaching fellows for our federally funded project. The goal of the funded project is to

increase the number of CS teachers, particularly Hispanics holding a bachelor's degree in CS coupled with a graduate degree in education and teacher certification, to teach not only the basics of CS but also advanced topics and AP courses in K-12 in the Paso del Norte region of far West Texas area. Thus, the teaching fellows are equipped with the requisite knowledge, skills, and competencies to emerge as highly effective CS educators and serve to mediate the significant dearth of CS teachers in the area. In spring 2022, to attract and recruit high-quality CS Bachelor's degree holders, the project team devised comprehensive marketing materials (e.g., flyers, banners, and bookmarks) and leveraged diverse promotional activities, including presentations in senior-level CS courses, engagement with CS faculty, social media, information sessions at institutional partners of Computing Alliance of Hispanic-Serving Institutions (CAHSI) an NSF Eddie Bernice Johnson INCLUDES Alliance, and on-campus marketing platforms for a year and a half. Despite these endeavors, however, no applications were received until one year later. The results of our recruitment endeavors and acknowledging the common sense that CS degree holders prefer to get a job in industries inspired this research, which attempts to explore the perceptions of undergraduate CS students regarding alternative career pathways, specifically the prospect of becoming CS educators.

B. Institutional and Local Context

The teaching fellows program operates within a majority-minority Hispanic-serving institution in Texas, boasting an enrollment of over 20,000 undergraduate students as of Fall 2022, with over 88% identifying as Hispanic/Latino. Among these students, there are over 1,000 pursuing undergraduate degrees in computer science, with over 120 baccalaureate degrees awarded in the 2019-20 academic year. This institution is nestled in a bicultural, bilingual community on the U.S.-Mexico border. Spanish is the primary language for nearly three-fourths of households in this region. In this area, approximately 22.7% of local families live below the poverty level, compared to the national average of 12.7%, while only 21.7% hold a bachelor's degree or higher, in contrast to the national average of 30.3% [33], [34]. Regarding computer science education in K-12, the region comprises over 170,000 students enrolled in 260 public schools during the 2021-22 academic year. However, data collected by the project team in 2023 revealed a stark contrast in the availability of computer science teachers, with only 32 teachers dedicated to teaching CS in 2023.

C. Methods

In the spring of 2023, we collected qualitative data at an equity-oriented pilot course in leadership for undergraduate CS students at the same site as the teaching fellow project. The course has been piloted over four semesters to develop the leadership skills of undergraduate CS students [35]. To understand the undergraduate CS students' perceptions of becoming CS teachers in K-12, we collected student artifacts (e.g., their in-class reflections). The students were asked to provide their responses to the following questions: What are your top 3 priorities after graduation in terms of your career? How do you perceive teaching in CS in K-12? Do you want to become a CS teacher? List 3 reasons why you do/don't want to become a CS teacher. Among 48 students enrolled in the leadership course, 35 students fully submitted their responses.

We analyzed the data through a constant comparative method coding approach [36], in which we systematically coded and analyzed the data collected from participants.

IV. INITIAL FINDINGS

First, participants' responses to "What are your top 3 priorities after graduation in terms of your career?" were too general (e.g., getting a job, traveling, etc.) to be used and reported in our findings. Thus, we did not further analyze these responses and include the results in this WIP paper. Second, among the 35 undergraduate CS students who responded to the question, "How do you perceive teaching in CS in K-12?" 14 students (40%) expressed positive perceptions of teaching CS in K-12, describing it as "interesting, important, beneficial, and enjoyable." Negative perceptions were voiced by 10 students (29%), who described teaching CS in K-12 as "under-incorporated, undervalued, underpaid, demanding, stressful, and lacking in enjoyment." Interestingly, 5 students held mixed perceptions, reporting the importance of teaching CS while finding it challenging or not a priority. Third, 19 students out of 35 students rejected the idea of pursuing their career as CS teachers, while only 3 embraced this option. On the other hand, 13 students shared the potential of becoming CS teachers, expressing sentiments such as, "I never considered it, but it sounds intriguing; perhaps later in life; It's not currently in my plans, but I'm not opposed to it; at present, teaching CS isn't aligned with my goals, but I wouldn't easily dismiss the opportunity if it arose." Interestingly, upon analyzing students' responses to questions regarding their willingness to become CS teachers and their general perceptions of teaching CS in K-12, a conflict emerged. Table 1 shows that although 14 students had positive perceptions of teaching CS in K-12, 7 of them rejected the idea of pursuing a career for themselves. Additionally, among students with a neutral stance on teaching CS in K-12 (n=6), three students expressed disinterest in becoming CS teachers.

TABLE I. DISCREPANCY BETWEEN PERCEPTIONS OF TEACHING CS AND CAREER ASPIRATIONS AMONG UNDERGRADUATE CS STUDENTS

How do you perceive teaching CS in K-12?	Do you want to become a CS teacher?			
	Yes	No	Perhaps	Total
Positive	2	7	5	14
Negative	0	8	2	10
Mixed	1	1	3	5
Neutral	0	3	3	6
Total	3	19	13	35

Lastly, when students were asked to provide three reasons why they do or do not want to become CS teachers, we discovered that the widespread and common assumption that CS students are more likely to seek job opportunities in the industry for higher pay is not the sole factor why CS students did not want to become CS teachers. Instead, the majority of responses from students who did not wish to become CS teachers were centered around their personality traits or abilities, such as lack of patience, nervousness, and perceived inability to explain

concepts effectively. They also expressed disinterest in teaching, with teaching not being a priority in their career aspirations. Moreover, they held relatively negative views about teaching roles, characterizing them as “underappreciated, challenging, underpaid, dull, demoralizing, overly demanding, and restrictive.” In contrast, those aspiring to become CS teachers highlighted the social impact of computer science on communities, emphasizing its potential impact to influence students, inspire the younger generation, and shape the future. Additionally, they identified themselves as individuals who derive satisfaction from helping others, possess teaching aptitude, and have prior teaching experiences.

V. DISCUSSION AND IMPLICATIONS

The first finding suggests that there were more CS students who perceived teaching CS in K-12 positively, and there were also students who had mixed feelings about teaching CS. The positive perception of teaching CS in K-12 among some CS students suggests that there is potential to attract more CS students to teaching careers and produce more highly qualified CS teachers. According to the constructivist theory of perception [37], perception is not solely based on sensory input; rather, it involves making inferences by integrating sensory information with stored knowledge acquired through learning and experience. When CS students consider the prospect of teaching CS in K-12 settings, they may draw upon their existing mental models, educational background, and exposure to teaching practices. Therefore, educational policies and curriculum design could be tailored to address the unique perceptions and expectations of CS students. The second finding reveals that when CS students were asked whether they wanted to become CS teachers, most of them said that they did not, but some students showed consideration and the possibility of becoming CS teachers. Interestingly, we found a conflict between their general perceptions of teaching CS in K-12 and their career aspiration of becoming teachers. This conflict can be better understood through the lens of the Social Cognitive Career Theory. According to this theory, one's career choices are influenced by a combination of background contextual affordances and proximal contextual influences. These affordances, which can be either real or perceived supports or barriers, are considered distal contextual factors. In the context of undergraduate CS students, their decision not to pursue a career as K-12 CS teachers, despite some showing interest, could be influenced by these contextual factors. For instance, perceived barriers such as the societal view of teaching as a profession or the lack of support for teachers could discourage students from pursuing this career path. The conflict between CS students' perceptions of teaching and their career decisions indicates a need for more effective career counseling and guidance for undergraduate CS students exposed to alternative and various career pathways. Understanding the influences of background contextual affordances and proximal contextual factors could help in designing more targeted career counseling strategies. Finally, the last finding suggests that CS students wanted to become CS teachers because they viewed themselves as people who enjoyed interacting with people and wanted to help them. Also, they considered the value of CS teachers from social impact perspectives for the K-12 students and community. When considering the reasons why CS students either desired or

did not desire to become CS teachers, it becomes evident that their career considerations extend beyond monetary aspects [14]. This insight validates the applicability of the FIT-Choice theory to the decision to become a K12 CS teacher and underscores the unique role of altruistic motivations alongside intrinsic and extrinsic motivations [38]. The primary motivations for entering the teaching profession are altruism and a desire to work with children, which also apply to CS teaching in K-12.

While undergraduate CS students' opinions and perceptions of becoming CS teachers contribute to the literature, there are limitations that need to be addressed. First, this study used qualitative data collected from a course at an HSI. Thus, the students did not necessarily represent all undergraduate CS students enrolled at the institution. In addition, we acknowledged the students' socio-demographic characteristics, such as socioeconomic status and gender, can be closely related to their perceptions of career pathways and choices. However, we did not collect the demographic data as our attempt was to first understand undergraduate CS students' perceptions comprehensively and broadly. Lastly, students' career aspirations and plans can be changed over time, influenced by multiple environmental and personal factors. We collected the data once during their college; thus, this study did not capture the potential changes in their perceptions of alternative career pathways. Therefore, future work should develop a research design, considering potential variations in undergraduate CS students' career aspirations and plans across their socio-demographic characteristics and the potential changes influenced by personal, local, and economic contexts while enrolling in college for the long term.

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