

Introduction

Underrepresentation of women and students of color in science, technology, engineering, and math is a national epidemic. The lack of socioeconomic, gender, and racial/ethnic diversity in computer science is particularly pronounced—only 11% of recent computing graduates were women, while Hispanics comprised only 7% of all Bachelor degree earners in the United States (AUTHORS, 2016). Students of color face isolation in higher education, particularly in STEM majors, lack mentors, role models, and advocates who resemble them, and often experience implicit bias that can put them at risk for poor performance in the classroom (Seymour & Hewitt, 1997; Steele, 1995, Tate & Linn, 2005). Yet underrepresented students persevere in adversity and do become successful professionals in STEM fields, despite the odds.

This study aims to reflect an assets-based approach to the study of computer science undergraduates who persevere in the major at 6 public Hispanic-serving institutions (H.S.I.s), colleges and universities in which 25% of the enrolled student body identifies as Hispanic/Latinx. The social contexts of computer science and computer engineering departments at H.S.I.s are rich for the exploration of persistence because, like their students, H.S.I.s are often perceived as lacking in resources and prestige, yet these computing departments are struggling with growth as awareness of computing as a viable career option expands nationally (NASEM, 2018). The lower tuition and policies which make enrollment “open” to “less selective” provide access to students who may not typically have access to a 4 year degree, yet the institutions may lack financial resources needed to provide extensive student support services on par with predominantly white institutions (P.W.I.s). These settings are important contexts for studying persistence from a qualitative, socio cultural perspective that considers the strengths of students’ cultural and familial backgrounds rather than focusing on weaknesses and differences from the dominant culture (in the United States, that of white, middle class individuals). At the same time, our study can shed light on student-developed strategies to persevere in a demanding field of study.

The research question addressed in this paper is:

What elements of community cultural wealth do underrepresented computing majors use to persist in the major?

Conceptual framework

In this paper, we bring the concept of community cultural wealth to bear on students’ descriptions of their motivations and strategies for persisting in computer science undergraduate education programs at Hispanic Serving Institutions (Yosso, 2005). Aspirational, familial, social, resistance, linguistic, and navigational capital are resources individuals from subjugated cultural backgrounds may take up to persist in computing. In particular, three forms of community cultural wealth became relevant to this study: aspirational, navigational, and social. Aspirational capital refers to the enduring belief in one’s dreams (Samuelson & Litzler, 2016), and navigational capital to the ways in which students utilize agency to move through the institutional policies that were often designed for the dominant group of higher education students (Yosso, 2005). Much like Bourdieu’s (1986) social capital, the social capital described by Yosso (2005) involves the benefit of a network of individuals, though it extends the

network to the cultural group.

We also use Holland, Lachicotte, Skinner, and Cain's (1998) concepts of identity and agency to illustrate the experiences of computer science undergraduate students in their own meaning-making—the focus on student-described experiences gives voice to students' interpretation of their skills and assets. Participant identities are formed and re-formed through routine interactions, activities, and relationships. As they make meaning of their experiences in their majors, they “build up” personal identities as computer scientists.

Methods

This study is part of a larger investigation of 8 institutions engaged in a National Science Foundation-funded alliance of computing departments across the United States. All of the institutions are Hispanic-Serving Institutions, while 5 are also indicated as MSIs in which more than 50% of students identify as a member of an ethnic minority group. The goal of the larger study is to understand how computer science departments create (or fail to create) inclusive learning environments to support student learning. This paper focuses on focus group data with students.

Researchers engaged in participant observation (Spradley, 1980) of an annual Summit and regional circuit events, computer science courses, research group meetings, and other computer science departmental activities. Researchers also conducted focus group and individual interviews with students, faculty, and staff. Document analysis (e.g., syllabus and policy reviews) supplement interviews and observations.

The majority of student interviewees were Latinx and, although women are severely underrepresented in computer science, they comprised nearly half of our interview sample. We interviewed 18 student leaders individually (typically juniors and seniors) and randomly selected students enrolled in introductory computing courses for focus group interviews (22 interviews in total), comprising from 3 to 10 students. Student interview protocols explored their backgrounds, interest in computing, departmental experiences, trajectory in computer science, and the factors that have shaped their computing identity.

Thematic analysis is conducted on an ongoing basis, in which analysts use theory as well as emerging concepts from the data to develop a codebook used across all data sources. Findings can be substantiated across analysts and across data sources through inter-rater reliability metrics. While the entirety of focus group data transcripts were coded in this study, particular questions of interest were: “What barriers have you faced in your major, and how have you overcome them?” and “What is your greatest accomplishment so far in your major?” Persistence was a theme that emerged from the data, and community cultural wealth themes were interrogated to develop the theme.

Preliminary Results:

In initial data analysis, three forms of capital were described by students as valuable in their persistence in computing: aspirational capital, navigational capital, and social capital. We note the ways in which these forms of capital overlap and intertwine, a finding clear in Samuelson and Litzler's work in the fields of engineering as well (2016). We highlight five sources of data to illustrate use of community cultural capital, to be expanded in the full paper.

Value, Purpose in the Career

Students described how their dreams propel their persistence when they face hardships. Two Latinx women described how understanding the career opportunities in computing kept them engaged in the major. In this way, they utilized aspirational capital to persist. The second quote indicates the importance of emphasizing the opportunity in the field as a way that computing department stakeholders can activate aspirational capital in the underrepresented student populations they serve.

“In this field) you can see what’s on the other side of the world and see anything going on. That’s what’s still captivating about computing—it’s what we can do, what we can achieve.”

“I would like to stress that point again, once we know what we’re going to do, we persist. (The department) gives us a glimpse of the future, the career field paths that we can take. That would actually motivate me. Not in understanding of the material, or anything, but just knowing what I’m going to do after graduating.”

Navigating policy and seeking help

A male Latinx student who had transferred from the community college system described how he overcame a very real barrier in his computing career pathway—course taking policies that limit course reenrollment. The student describes his knowledge of the policy and the fear it induced. By seeking help and working hard, the student was able to expend extra effort in the course and succeed. He noted this experience as one of his proudest accomplishments.

“Me personally, going back to what I said before was, calculus, ‘cuz I ended up taking calculus three times and I was very frightening on the third time. Since I was in the (community college system) if you do not pass the class three times, you have to go somewhere else to pass your class. So it’s me not giving up and just knowing that if you keep going for help, if you keep putting in the effort you can make it in the end. With me putting my focus in, that one particular class, I actually ended up passing.”

In this way, we posit that the student utilized navigational capital (understanding of policies and implications, seeking help) and aspirational capital (continued effort in the face of adversity) to persist in the field.

Adapting, building persistence through educational engagement

A male student who identified as “black and Mexican” and a future first generation college graduate acknowledged how his extensive course taking in community college set the stage for his development of skills and a mindset towards deliberate effort to achieve long term goals.

“Persistence. I think persistence is just pretty much the only thing that helped me. At community colleges I took more classes than I needed, and didn’t pass all of them, but learned how to persist, keep trying to achieve my goals. Just ... academic wise I guess. My high school wasn’t too good or too smart so ... I had to learn everything in college, in community college.”

The student acknowledges structural inequities that shaped his educational experience (“my high school wasn’t too good or too smart”) and created the conditions in which he was able to develop in the community college setting. We posit that in telling of this story as a greatest accomplishment, the student honors the importance of hard work to achieve one’s aspirations (aspirational capital), and demonstrates navigational capital in positing that his career path was enriched by his experiences in

community college.

Utilization of departmental human resources

Accessing departmental resources, in this case in the form of instructor and tutoring assistance, shows use of navigational capital as well as social capital in efforts to persist. First generation students are less likely to interact with faculty than their more advantaged peers (Soria & Stebleton, 2012; Arum & Roksa, 2011) and so the decision made to seek out resources to support persistence is of note.

“Learning wise, if you're stuck somewhere, the teachers were willing to really help me out and sit down and be one on one. And besides that, there's always help and teaching and stuff, you can go to in room 736 and any problem you have with math, anything related, they sit with you and walk you through whatever assignment you have. It really helps when you have that aid when you need it. It really helped me (in the beginning of my studies). Once you have your foundation right, you know that it's really easy to pick up what's out there so that's ... What really helped me persevere.”

Discussion and Implications

In this qualitative study, we found evidence that computer science students at H.S.I.s made use of community cultural wealth, particularly aspirational, navigational, and social capital, as they persisted in their field of study. As we continue to analyze our data with community cultural wealth models in mind, we will continue to tease apart patterns of intersectionality in the responses from students, and will work towards disaggregating our qualitative data to see if patterns across and among subsets of the Latinx populations in this study. We highlight aspirational capital as a potential focus area for computing department stakeholders—the more students understand about the possibilities of careers the field of computer science, the better they are able to activate aspirational capital in motivating their success. Aspirational capital may be a particularly important mechanism for retaining students in the field of computing, given the myriad opportunities available at present. Department stakeholders could propagate understanding of career opportunities and could reflect these opportunities in the form of “*cuentos*” or stories of triumph, that express the pathways of alumni and upper level students. These *cuentos* can serve as fuel for aspirations of students just beginning in the field. We suggest H.S.I. computer science departments shift to an asset-based approach in considering student needs.

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