

# *The Role of Relationships in Engaging Latino/a High School Students in Computer Science*

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**Abstract**— Latinos are the fastest growing ethnic minority population in the United States but are underrepresented in computing-related majors and fields. Most efforts to broaden participation in computer science lack a cultural and contextual perspective, and focus on building individual competencies and motivation. In this paper, we propose that a greater understanding of relationships is critical to inform efforts to increase the interest and build the computational skills of Latino/a youth to enter and persist in a computing education pathway. The focus of this study is on a community technology center that serves primarily Latino/a youth in an agricultural region of California. The primary research question was “What is the role of relationships in Latino/a students’ interest in computer science?” Data were collected from high school students (97 surveys and 20 in-depth interviews), and from center staff (6 in-depth interviews). The findings show how relationships help students connect computer science to cultural values by forming communities of practice around CS with similar peers and mentors.

**Keywords**— *Latinos, Relationships, Informal learning environments*

## I. INTRODUCTION

Latinos are the fastest growing ethnic minority population in the United States. They accounted for over half the growth of the U.S. population between 2000 and 2010 [1]. Despite the growing numbers, Latinos are vastly underrepresented in computing-related fields; in 2010, they made up only 4.6% of computer and information scientists in the labor force [2]. Latinos are 16% of AP test takers, but only 8% of the AP CS test takers; those that took it scored far below their peers [3]. Although Latinos make up 19% of all US college students ages 18-24 [4], they earned just 6% of CS bachelors degrees; less than 2% of students who enrolled or completed a PhD in CS were Latino/a [5]. The term “Latino” includes a heterogeneous group of people in the US; in this paper we focus on a population that has low levels of formal education and retains strong ties to Mexico.

Most efforts to build the computational skills of Latino/a youth to enter and persist in a computing pathway lack a cultural and contextual perspective. They are often self-contained classes or programs that focus on skill building, rather than an ecological and relational approach that recognizes the factors that are most salient in the lives of Latino/a youth [6]. These factors include identity exploration, navigating challenges associated with balancing future goals with family and cultural values, pressures to assimilate, and friendships and romantic relationships [7]. Cultural values common in Mexican-descent families include a high priority on education and responsibility for financially supporting one’s family rather than self advancement [8,9].

Despite their interest in computing fields [10], few pursue them, perhaps due to a perceived mismatch between student cultures and the values widely associated with CS. Increasing Latino/a students’ motivation and capacity to pursue CS requires strategies that respond to culture [11] and make connections to students’ values [12]. Examples include helping students see the relevance of a computing career [13], building connections to their identity and culture, and addressing the economic needs of their family and community [14]. Thus, efforts to engage Latino/a youth in CS would be strengthened by helping youth navigate relationship challenges and opportunities to gain the skills and experiences that will prepare them to pursue computing-related courses and careers while maintaining their cultural identity.

Efforts to engage K-12 students from underrepresented minority groups in computer science typically focus on the individual, rather than on the relational and institutional factors that play a significant role in decision making. However, decades of research have identified the importance of relationships in Latino/a students’ educational pathways. For example, successful college-bound Latino/a students establish relationships with cultural brokers, often slightly older youth, that provide direct guidance and resources needed to meet their

academic and career goals [15]. Despite the importance and pervasiveness of relationships during this time period, the role of peers and mentors in Latino/a high school student pathways to CS education has not been investigated.

In this paper we propose that efforts to increase equity and inclusion in CS require a better understanding of how relationships influence the pathways of Latino/a youth into CS education in K-12. The paper builds on theoretical frameworks that show how learning and engagement are a result of interactions with one's environment and relationships [8]. Qualitative and quantitative data collected at a community technology center are used to show how relationships with mentors, peers, and family play a role in how Latino/a high school students enter and whether they persist on a CS pathway.

### A. The Role of Informal Settings in CS Education

Community technology centers (CTCs) are a key resource in the effort to prepare youth for CS education and careers because they increase access to technology in low-income communities that have few high tech classes or role models. Their community-based and sustainable model offers more than the typical "outreach" (e.g., one-time presentations or a week-long class or camp for highly motivated and resourced students). In addition to technology access and experience, they foster social capital by expanding their networks (with peers, mentors, and other adult community members), and offer opportunities to design, create, and contribute to their communities [16]. To promote learning that is connected to the local values and culture, CTCs must provide opportunities for creative production; build sustained social relationships with peers and mentors; provide ongoing learning opportunities for mentors and youth leaders; disrupt patterns that favor one group of learners, and use research to inform cycles of revision [17]. Despite the large body of research on how informal settings create opportunities and supports, little is known about their role in students' decisions to pursue computer science.

### B. Theoretical Perspectives.

This study is informed by two theoretical perspectives. The first, the Contextualized Model of Learning, has been applied primarily in out-of-school settings [18]. It suggests that learning and engagement in STEM (science, technology, engineering, and math) fields are the result of the complex interactions between the personal, social, and physical contexts. In this model, those interactions are influenced by the student's identity, interests, and perceived abilities [18]. The second set of theoretical perspectives includes social constructivism and communities of practice. These models suggest that learning is fundamentally social, and occurs in the context of a community that has its own set of goals and expectations [19]. These interactions take place as part of a community that involves participants from different ages and skill levels. Research suggests that meaningful participation in learning communities may be a more important part of education than the acquisition of knowledge or facts [20], and thus there is a need to understand how youth move from being peripheral or less engaged members of a community of practice to become more active members who develop an identity as someone that knows or likes to do a particular activity [19].

These frameworks are relevant to the field of CS education in several ways. First, efforts to broaden participation would benefit from understanding the structures and processes that scaffold CS learning and identity formation in informal environments. Thus, we need to go beyond knowledge of individual level learning to also measure who they interact with, their identities or beliefs about their capacities and possible futures, and group and community-level processes for sharing knowledge and skills. These include the relational supports and barriers that can drive or undermine students' interest and confidence in CS. The current study of a community technology center (CTC) is designed to address this need. The following research question is addressed: What is the role of relationships in high school students' CS interest?

## II. METHODS

### A. Sample

The CTC is a non-profit entrepreneurship and technology workforce development center located in a low income and rural community in Central California. It provides primarily Latino/a youth and young adults with the resources and supports to develop the motivation and skills needed to pursue and succeed in the technology workforce. It offers free access to computers and other technology, wifi, food, and a variety of classes and events. It is organized into six core member groups (e.g., Tech Squad, Connect Crew, Media Creators), which are each overseen by an adult staff member. Over the period of one year, the high school aged members were invited to participate in a study that included taking three surveys and possibly a one-on-one interview. A total of 97 high school aged members completed the first survey, which is the focus of this paper. Most (89%) identified as Hispanic/Latino, 93% speak another language at home besides English, 42% were female, and one third have a mother who did not complete a high school education.

A subset were invited to participate in an interview about their experience at the CTC. They were selected based on being moderately or highly involved in the CTC; the goal was to get an equal representation of male and female members and a distribution across core member groups. Twenty students were interviewed; 40% were female, 75% were Latino/a, and they ranged in age from 15-18 years old. The six primary line staff members participated in a one-on-one interview. All identify as Latino/a, and four identify as female. They range in age from 24-30 years old. Four grew up in the local community, none have a CS degree, and they had worked at the CTC between 1-4 years.

### B. Measures & Analyses

*Survey data on the role of relationships in CS motivation.* Data used in this paper include four scales that were based on prior research. They include the CS Motivation scale [21], the Perceived Support for CS scale [22], and the Family Support and Friend Support scales, which were adapted from an existing survey [23]. The items and reliability information are summarized in Table 1.

TABLE 1. SURVEY SCALES

| Scale                    | Items   | Response Range                              | Alpha |
|--------------------------|---|---|-------|
| CS Motivation            | <p>Developing computing or technology skills will help me achieve my career goals.</p> <p>Knowledge of technology will allow me to secure a good job.</p> <p>My career goals require that I learn computing skills.</p> <p>Knowledge of computing skills will help me secure a good job.</p> <p>I am comfortable with learning computing concepts.</p> <p>I have self-confidence when it comes to computing courses.</p> <p>I can learn to understand computing concepts.</p> <p>I can earn good grades in computing courses.</p> <p>I am confident that I can solve problems by using computer applications.</p> <p>I can solve problems by using computer applications.</p> <p>I would take computer science courses if I were given the opportunity.</p> <p>I hope that my future career will require the use of computer science concepts.</p> <p>I like using computer science to solve problems.</p> <p>The challenge of solving problems using computer science appeals to me.</p> <p>I think that computer science is interesting.</p> <p>I would voluntarily take additional computer science courses if I were given the opportunity.</p> | Strongly agree (1) to Strongly disagree (4) | .87   |
| Perceived Support for CS | <p>There is a mentor or staff person who encourages me to learn about computers and technology.</p> <p>My friends are interested in the work I do with computers and technology.</p> <p>Other students at the CTC have encouraged me to learn about computers.</p> <p>Other students at the CTC are interested in what I know about computers and technology.</p>   | Strongly disagree (1) to Strongly agree (5) | .80   |
| Family Support           | <p>People in my family want me to learn more about computers and technology</p> <p>My family is enthusiastic about what I am learning at the CTC.</p>   | Strongly disagree (1) to Strongly agree (5) | .87   |

|                |   |   |     |
|----------------|---|---|-----|
|                | <p>My family has encouraged me to come to the CTC.</p> <p>My family is interested in what I am doing at the CTC.</p>  |   |     |
| Friend Support | <p>My friends think it's cool to learn more about computers and technology</p> <p>My friends are enthusiastic about what I am learning at the CTC.</p> <p>My friends have encouraged me to come to the CTC.</p> <p>My friends are interested in what I am doing at the CTC.</p> | Strongly disagree (1) to Strongly agree (5) | .86 |

*Interviews with members about the role of mentors and friends.* One-on-one interviews were conducted with 20 high school age members. The questions related to this paper are: When you first heard about the CTC, what did you hear? Why did you decide to become a member? Have you thought about studying computer science or engineering? What types of help have you gotten from the CTC to reach your future goals? Are there important people in your life that you talk to regarding your future, including school and your future career? Do you have a mentor at the CTC?

*Interviews with CTC staff on their mentoring strategies.* One-on-one interviews were done with six staff members who work directly with the youth at the CTC. Questions included: What are your goals for working with your mentees? How do you know whether or not you have been successful? How would you describe the strategies you use when you mentor? How do you adapt your approach for different kinds of youth?

*Data analyses.* Survey data were analyzed using simple correlations. Both sets of interviews were analyzed using the constant comparison method [24]. The analysis was guided by theory but allowed for the emergence of other factors. First, open-coding of responses for each of the interview questions was used to name the conceptual categories into which the words or phrases seem to be grouped. Second, each response was coded for more specific, word-level replies; specific examples were grouped by key factors, such as the different ways that mentors support youth. As new codes emerged, the coding scheme was revised and transcripts were reread and coded according to the new structure. Saturation was achieved when no new codes were identified; similar codes were moved into categories, then developed into themes, and finally a matrix of themes was analyzed across all interviews [24].

### III. RESULTS

Responses to the survey questions are summarized in Table 2. They show that levels of CS motivation varied, but on average the students reported low interest in pursuing computer science. They reported partial agreement that others support their learning about computers and technology. And on average, the students somewhat agree that their family and their friends support their interest in computers and technology

TABLE 2. SCALE STATISTICS

| Scale                    | N  | Min  | Max  | Mean | St Dev |
|--------------------------|----|------|------|------|--------|
| CS Motivation            | 95 | 2.06 | 4.00 | 3.05 | .39    |
| Perceived support for CS | 94 | 1.00 | 5.00 | 3.39 | .75    |
| Family Support           | 97 | 1.00 | 5.00 | 3.46 | .91    |
| Friend Support           | 96 | 1.00 | 5.00 | 3.37 | .81    |

Simple correlations of data in the student surveys show several significant results. Students are more motivated to pursue CS when they perceive greater support from other students, friends, and a mentor to learn about computers and technology ( $p < .01$ ). CS motivation was also significantly correlated with perceived support from family members ( $p < .05$ ) and from friends to come to the CTC and learn about computers and technology ( $p < .05$ ). Correlations between CS motivation and support from a romantic partner were also explored but were not significant; this may be due to having only 22 students who reported having a boy/girl friend or equivalent.

Interviews with six staff members were used to understand the roles that these mentors play in students' CS pathways. The results suggest a great deal of variation in staff members' confidence or interest to support students' interest in computer science, and in the ways that relationships influence students' CS-related decisions. Among those members that did talk about how they support CS pathways, there were a range of strategies to: 1) increase access to experiences that build CS knowledge, 2) support the development of a CS identity, 3) build their confidence, and 4) inform them of education and career pathways. These included telling the students how it is possible to work in tech even if they are not programming, as well as taking them on field trips to see different kinds of tech work environments and to meet people who work in a range of computing fields. Some staff members described how they use their own experiences (e.g., not earning a CS degree) to motivate youth, and providing "emotional support and more cheerleading for them to stick with a program or to learn on their own because it takes a lot of self-discipline to learn a programming language. It takes a lot of 'oh you failed and now you have to try again' those things I think are the most important things to have." Other staff say they do not personally know anything about computer science, but that they help youth understand that working in the tech industry does not always require a college degree. By introducing alternative pathways, their goal is to give options to youth who cannot afford college or cannot leave their family.

Interviews with youth reinforce these findings by showing how they perceive the benefits of relationships with mentors. Students said that their mentors helped them prepare for college, gave them opportunities to take on leadership roles and have real-world experiences, and provided them with connections to professionals (e.g., game designers). Some students also talked about receiving emotional support and help dealing with challenges.

Two case studies show the different ways that high school students develop an interest in CS, and the role that relationships play in sustaining that interest. The first case is 16-year old Juan (not his real name) who talked about how he first started coming

to the CTC because it was a safe place to do homework, there was free access to a laptop and wifi, and it was a place he could do volunteer hours. His interest in CS grew with the opportunity to take classes in game programming and development. He has since talked to the CTC teacher about additional opportunities, such as participating in or attending video game competitions. He describes staff as mentors that give him encouragement to stay on his chosen path, create opportunities for him to meet people who do coding, provide information about what college is like and how game programming could fit into it, and give him something to strive for by being the kind of successful and open minded people he can look up to. Juan also cited his family as playing an important role in his future goals, and wanting to outdo his brothers as a motivation to succeed.

Another case study shows a different entry point into CS. Sixteen year old Carmen (not her real name) first came to the CTC for the free computers and wifi, and the free food. She eventually joined the core member group that plans events and does not focus on building technical skills because she felt a strong connection to the staff member leading that group. As a result of her involvement, she learned how to work with different types of people and how to express herself. Over time, as she built confidence and leadership skills, she took some workshops at the CTC that gave her technical skills, such as making a customized filter on Snapchat. At the time of the interview, she talked about wanting to major in business in college, but was interested in studying computer science or engineering because she sees those skills as essential for the future. She described the staff mentor as someone who tells her about different pathways and talks about the importance of diversity in tech. This relationship has shaped her desire to take a leadership role in the tech industry to get more Latinos and women into technology: "...that's why I said...that I want to change diversity and empower women in technology."

#### IV. DISCUSSION

Efforts to engage Latino/a youth in computer science typically focus on building their knowledge or increasing their interest and motivation. The findings from this study show the important role that relationships can play in whether and how Latino/a youth in a community technology center enter and persist in computer science-related activities. The data suggest that CTCs can play an important role by providing the opportunities and supports that some young people need in order to develop an interest in the field of CS. Relationships with mentors and peers help Latino/a youth experiment with a CS identity that is consistent with their cultural values and show them how CS is connected to the real world. In addition, relationships with mentors, family, and friends provide opportunities and encouragement, and the support to form communities of practice.

This study is unique in its exploration of how relationships and informal learning settings can play a role in getting students from underrepresented minority groups on a computer science pathway. The results can inform efforts to broaden participation in CS by calling attention to the social factors that influence individual decision making. More research is needed to understand the role that informal learning settings that are not staffed by adults with computer science expertise can support

youth to pursue CS. In addition, more research is needed to understand how relationships can undermine interest or persistence, particularly for women and underrepresented minorities.

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