WIP: Barriers to Developing Computing Identity in Hispanic-serving Community College Introductory Artificial Intelligence Courses

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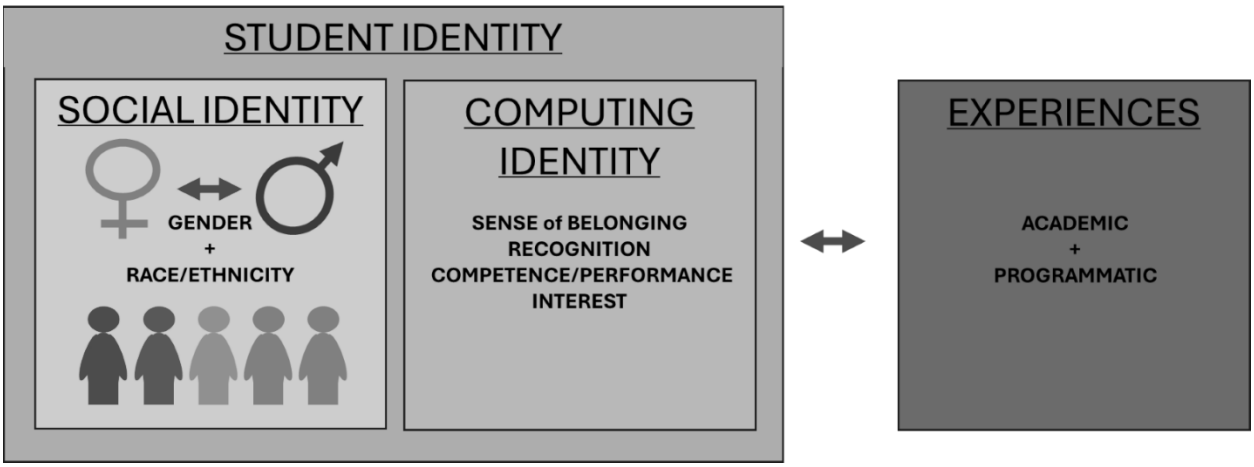
Work In Progress: Barriers to Developing Computing Identity in Community College Introductory AI Courses

As students from diverse backgrounds including different genders, races, socioeconomic status, and ages pursue higher education to enter the computing field, community colleges act as a key point of entry to their education [1], [2]. These programs allow students exposure and experiences relative to the computing field to build their professional computing identities [3], [4]. Students whose identities do not align with the dominant culture may try to align themselves with dominant culture and develop negative perceptions about their own social identities that introduce barriers to developing their computing identities [5]. Identifying and understanding practices that act as barriers to computing identity is key to understanding how students can develop professional identity and persist through their education and into their careers.

The purpose of this study was to explore barriers that inhibited or detracted from a student's ability to develop their computing identity at a Hispanic Serving Community College (HSCC). Lunn et al.'s Computing Identity Model (**Figure 1)** will be utilized to examine how computing and social identities work in combination with academic and programmatic experiences to develop computing identity.

Figure 1: Adapted from Lunn et. Al [6]Computing Identity Model



I. Literature Review & Theoretical Framework

The U.S. is becoming increasingly diverse and it is predicted that a non-Hispanic white population will no longer be the majority by 2050 [7]. As the country continues to diversify, it is important that we change our educational system to create equitable access for the changing demographics. Hispanic Serving Institutions (HSIs) are institutions that work on creating an environment that Latinx students and other marginalized students can thrive [8]. A key component to understanding the success of marginalized STEM students (e.g., working full-time, child-care, other responsibilities) is exploring how they resist discriminatory institutional practices. Understanding how institutional practices influence students and create barriers to their education is important to work towards our shared scholarly and practitioner goal of removing those barriers entirely [9].

To more deeply understand the barriers HSCC students encounter as they develop their computing identities, our work utilized the Lunn et al., [6] Computing Identity Model. This model includes four components of computing identity: (1) Sense of Belonging (e.g., a feeling of security, acceptance), (2)

Recognition (e.g., of oneself as a computing person, being recognized as one), (3) Competence/Performance (e.g., knowing and being able to apply computing concepts), and (4) Interest (e.g., curiosity or wanting to know more about a subject).

II. Methods

This study was conducted as part of a larger NSF funded project to increase interest in computing and artificial intelligence (AI) within a Hispanic serving community college (pseudonym (HSCC) through the development of an AI certificate. HSCC is a large community college in an urban setting, with a wide variety of certificate and degree programs and a diverse student population. This study used a phenomenological approach to capture rich descriptions of the student experience in three AI courses (Discover AI, AI Ethics, and AI for Business)[10], [11]. This qualitative technique aims to explore the meanings and interpretations that the students make of their experiences, and to observe common themes across the participants allows us to capture the "essence" of the phenomenon [12].

Data collection was through pre-interview questionnaires and semi-structured interviews lasting approximately 60 minutes with each of the 19 participants. Interview transcripts were read several times and key portions of each were coded for meaningful units. Memos were created to summarize key points of each interview in order to ease comparison of common essences and to organize demographic data for each participant [12]. Memos were reviewed and discussed among the researchers to coalesce around the common meanings of each participant's experience. Table 1 provides demographic and educational data for our participants.

Table 1. Participant Data Chart

Name	Major	Enrollment	Race	Income	Age	Self-Reported Gender
Adriana	Cybersecurity	Part-time	African American; White; Two or More	< $25K	<30	Woman
Angel	Mechanical Engineering/Mechatronics	Part-time	White	$25K - $50K	<30	Man
Benjamin	Cybersecurity	Full-time	White	$25K - $50K	30-50	Man
Demi	Information Systems Tech./Software Eng.	Full-time	Two or More	< $25K	30-50	Woman
Eli	Data Analytics	N.R.	N.R.	N.R.	N.R.	N.R.
Emmet	Data Analytics	Part-time	White	< $25K	>50	Man
Georgia	Computer Science	Full-time	White	< $25K	<30	Woman
Kim	Data Analytics	Full-time	Asian or Asian American	$50K - $100K	30-50	Woman
Linda Laurel	Cybersecurity	Full-time	Black or African American	$25K - $50K	<30	Woman
Kinsley	Data Analytics	Part-time	Latin*	$140K	>50	Man
Adair	Music Business	Part-time	African American, Caribbean, Hispanic, Native American	< $25K	N.R.	Woman
Natalie	Computer Science	Full-time	Asian or Asian American	N.R.	<30	Woman
Doreen	Supervision and Management	Full-time	White, Hispanic (Cuban and Columbian)	$50K - $100K	<30	Woman
Emma	N.R.	Part-time	White, Hispanic	< $25K	>50	Woman
Ezra	Information Systems Technology	N.R.	Turkish	$25K - $50K	30-50	Man
Florencio	Philosophy	Full-time	Mexican	$25K - $50K	30-50	Man
Julian	Computer Science	N.R.	Asian	< $25K	<30	Man
Maya	Business Intelligence	Part-time	White, Hispanic	$100K - 200K	30-50	Woman
Mia	Business Analytics	N.R.	White, Hispanic	$50K - $100K	>50	Woman

III. Findings

Barriers to computing identity development at the HSCC were identified in course delivery, computing requirements, and pre-requisite knowledge. Academic experiences interacted with the different social

identities of the students to impede their development of competence and/or performance, recognition, or sense of belonging.

A. Course Delivery Method Issues

Several participants experienced challenges to computing identity as a result of course delivery method issues (e.g., timing, expectation of flexibility). One of the courses required an extra class period during working hours which was not indicated during class registration, increasing workload and time in class. Participant code named Benjamin stated "It's because it was supposed to be one class, but instead, it was two classes. So, you have the time maybe for one more class, but not for two more classes." In the case of post-traditional students who work full time jobs, additional class periods during the workday are difficult to accommodate. Several participants noted that many students dropped the class when learning of the additional time commitment. Many computing classes incorporate team-based work to mirror work-force experiences. When students dropped the class, the remaining students were met with an increased workload and were deprived of the opportunity to collaborate with other students and to develop both competence and recognition amongst peers to foster computing identity.

In addition to the high drop rate, several participants were teamed up with students who were attending the "extra" class period, but not enrolled in the HSCC course for credit. Without the accountability of course credit, these students were often less motivated to complete the coursework or attend meetings. This also increased the workload and reduced opportunities for collaboration for our participants, who were all enrolled in the HSCC course. In the words of participant Emma, "My group members bailed. They all bailed. I couldn't get anyone to communicate with me…but I needed to [collaborate]… I couldn't hold back [the] tears because I'm like, 'I can't make people engage with me.'" The isolation this student felt negatively influenced her sense of belonging, one of Lunn's computing identity constructs.

B. Computing Requirements Issues

Computing requirements created barriers to computing identity for some of the students. For one low-income student who had completed previous coursework on her phone and iPad, the requirement to use a PC prevented her from performing computing tasks. Purchasing a PC was not financially feasible and she was able to borrow one from the school, but it took several weeks to obtain and put her behind in the class. Once she obtained the PC, her unfamiliarity with the operating system became another barrier. These resources and skills are often assumed to be universal, but were not present for low-income students like Emma, leaving her to comment, "I'm not stupid, I'm poor, and do not have the money to keep up with the latest technology."

C. Pre-requisite Knowledge Issues

These courses were advertised as introductory AI courses, which did not require previous computing knowledge. Not requiring previous knowledge is important if the courses are to serve as an entry point to the field. However, several participants commented that the courses required coding knowledge, and they had to spend substantial time teaching themselves Python in order to complete the coursework. Even the students who were familiar with coding recognized this difficulty, acknowledging that the course would be very difficult for people without the prior knowledge. Emmett commented "If you don't know what [programming] is all about and where to get all this stuff, you're not going to absorb what you need to learn from the class," indicating a barrier to building competence and performance.

IV. Discussion

Course delivery issues created barriers to developing computing identity at the HSCC in two ways. First, the undisclosed class period that some students were unable to attend deprived them of instructional time and content, disrupting their ability to develop competence with the materials This exemplifies the intersection of programmatic experiences, computing identity constructs and social identities, as described by Lunn [6]. Having peers drop the class or lack similar levels of accountability to participate in meetings influenced competence and performance, but losing out on the opportunity to collaborate also deprives students of opportunities for recognition from their computing peers and the sense of belonging that can come from group interactions. Computing requirements created barriers for low-income students. Even with strong interest in AI, they may not able to develop competence the way other students with more financial resources would. In a community college setting in which there is a higher percentage of low-income students [13], this is likely to present a bigger issue than it would at four-year institutions. The pre-requisite knowledge requirement inhibited computing identity limiting sense of belonging and performance for students without prior coding experience. Many students signed up for these courses as an introduction to AI, with the expectation that no previous knowledge would be required. This turns an entry pathway into a "performance trap," where students see the course as the first steps in the pathway and then find that they are not good enough for the introductory phases of becoming computing people.

V. Implications

By identifying barriers that inhibit or detract from the development of computing identity for students at a HSCC, a better understanding of computing identity development is possible. Connecting how each barrier influences the components of computing identity allows for more nuanced solutions to support students in overcoming institutional barriers or ideally eliminating them altogether. Students experienced barriers related to course delivery method, computing requirements, and pre-requisite knowledge as they developed their computing identities within the HSCC context.

This study has several implications for future research, including those related to how scholars consider course delivery methods, computing requirements, and pre-requisite knowledge for computing identity development at HSCCs. Exploring delivery methods would allow scholars to better understand how to better deliver information while exploring the computing requirements and pre-requisite or prior knowledge need for a student would allow scholars to understand how setting standards, expectations, and course workload can more fully attend to identity development within a computing class.

In addition, this study has several implications for practice and policy at HSCCs, including setting expectations, accessibility to resources, and flexibility. In setting expectations, policies can be put in place to ensure students signing up for classes are aware of the time commitment and requirements. This is to ensure that students can attend to their course without the professor/department being able to make drastic changes to when and how that course is delivered. Another implication is to make sure students have resources needed for the class accessible to them. This can include creating policies that require the institution to either give the resources or fund the resources the student requires to ensure that their biggest barrier is the material and not the lack of accessibility to resources. The third implication of flexibility in a classroom is important to allow the instructor to make changes to the class to benefit the students. This can include changing the grade scale, reducing the amount of material, or having the institution provide academic support to the students when unrealistic expectations of prior knowledge are put on the student. Looking at ways policies and practices can be changed in the classroom or throughout the institution allows for the potential success of more students, particularly those who are marginalized, pursuing computing.

VI. References

[1] J. Ma and S. Baum, "Trends in Community Colleges: Enrollment, Prices, Student Debt, and Completion," College Board Research, Research Breif, 2015. [Online]. Available: www.luminafoundation.org/wp-content/uploads/2017/08/trends-in-community-colleges.pdf

[2] R. D. Cox, "Complicating Conditions: Obstacles and Interruptions to Low-Income Students' College 'Choices,'" *J. High. Educ.*, vol. 87, no. 1, pp. 1–26, 2016, doi: 10.1353/jhe.2016.0005.

[3] R. R. LaSota and W. Zumeta, "What Matters in Increasing Community College Students' Upward Transfer to the Baccalaureate Degree: Findings from the Beginning Postsecondary Study 2003–2009," *Res. High. Educ.*, vol. 57, no. 2, pp. 152–189, Mar. 2016, doi: 10.1007/s11162-015-9381-z.

[4] S. L. Rodriguez and A. R. Stevens, "Exploring computing identity development for Latinx students at a Hispanic-serving community college.," *J. Divers. High. Educ.*, Oct. 2023, doi: 10.1037/dhe0000530.

[5] L. J. Sax, J. M. Blaney, K. J. Lehman, S. L. Rodriguez, K. L. George, and C. Zavala, "Sense of Belonging in Computing: The Role of Introductory Courses for Women and Underrepresented Minority Students," *Soc. Sci.*, vol. 7, no. 8, p. 122, Jul. 2018, doi: 10.3390/socsci7080122.

[6] S. Lunn, M. Ross, Z. Hazari, M. A. Weiss, M. Georgiopoulos, and K. Christensen, "How Do Educational Experiences Predict Computing Identity?," *ACM Trans. Comput. Educ.*, vol. 22, no. 2, pp. 1–28, Nov. 2021, doi: 10.1145/3470653.

[7] J. Vespa, L. Medina, and D. M. Armstrong, "Demographic Turning Points for the United States: Population Projections for 2020 to 2060," United States Census Bureau, Current population report, Mar. 2018. [Online]. Available: https://www.census.gov/content/dam/Census/library/publications/2020/demo/p25-1145.pdf

[8] M. Vela and P. Gutierrez, "The Hispanic Population and Hispanic Serving Institutions," *EJournal Educ. Policy*, no. Fall, 2017, [Online]. Available: https://files.eric.ed.gov/fulltext/EJ1169366.pdf

[9] E. Comeaux, S. E. Grummert, and N. A. Cruz, "Strategies of resistance among racially minoritized students at a Hispanic-serving institution: A critical race theory perspective," *J. High. Educ.*, vol. 92, no. 3, pp. 465–498, 2021.

[10] M. B. Miles, A. M. Huberman, and J. Saldaña, *Qualitative data analysis: a methods sourcebook*, Third edition. Thousand Oaks, Califorinia: SAGE Publications, Inc, 2014.

[11] J. W. Creswell, *Qualitative inquiry and research design: Choosing among five approaches*, 4th edition. Thousand Oaks, California: SAGE Publications, 2018.

[12] C. E. Moustakas, *Phenomenological research methods*. Thousand Oaks, Calif.: Sage, 1994.

[13] J. Mountjoy, "Community Colleges and Upward Mobility," *Natl. Bur. Econ. Res.*, 2022.