

Exploring Computer Science Identity Development Among Undergraduate Computer Science Majors

Xornam S. Apedoe, University of San Francisco, xapedoe@usfca.edu

Wen Li, University of San Francisco, wli74@dons.usfca.edu

Sami Rollins, Northeastern University – Arlington, s.rollins@northeastern.edu

Sophie Engle, Alark Joshi, Matthew Malensek, Chris Brooks

sjengle@cs.usfca.edu, apjoshi@usfca.edu, mmalensek@usfca.edu, cbrooks@usfca.edu

University of San Francisco

Abstract: Disciplinary identity may play a significant role in determining one's persistence in a field. This study documents undergraduate computer science major students' evolving computer science (CS) identity as they participate in the CES|CS program. Drawing on data from two identity measures (CUPID and STEM-PIO) and student interviews, we present a case study of two students' evolving CS identities over two years.

Introduction

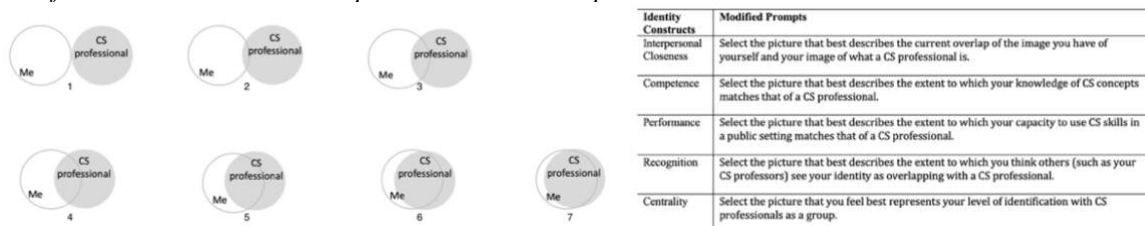
Attrition rates for students in computer science, particularly those from historically underrepresented or minoritized groups, remain high, despite many initiatives to recruit and retain such students (Howles, 2009; Kena et al., 2015; Mahadeo et al., 2020). The Community-Engaged Scholars in Computer Science (CES|CS) program provides diverse, academically talented, low-income computer science (CS) students with scholarships and a comprehensive suite of structured opportunities to learn from and contribute to the computer science community. The program activities are designed to support the development of a strong disciplinary (CS) identity by promoting engagement in the CS community both within and outside the university.

Methods

We draw on prior work on computing identity (e.g., Lunn et al., 2021) to explore CS students' disciplinary identity over time. We use two existing, validated instruments to measure CS identity. A modified version of the Conceptual Understanding & Physics Identity Development (CUPID) (Mahadeo et al., 2020) instrument assessed students' perceived recognition, interest, and performance/competence, with responses based on a 5-point Likert scale (1= not at all; 5 = very much so). Recognition items include: (R1) My family sees me as a computer-savvy person; (R2) My friends/classmates see me as a computer-savvy person; and (R3) My instructors/teachers see me as a computer-savvy person. Interest items include: (I1) Topics in computing excite my curiosity; (I2) I like to peruse forums, social media, or online videos about computer-related topics; and (I3) Computer programming is interesting to me. The Performance/Competence items include: (P/C1) I can do well on computing tasks (e.g., programming and setting up servers); (P/C2) I understand concepts underlying computing processes; and (P/C3) Others ask me for help with software (applications/programs). A modified version of the STEM Professional Identity Overlap (STEM-PIO) (McDonald et al. 2019) instrument, shown in Figure 1, was used to assess perceived recognition, performance, competence, typicality, and centrality. Each instrument was administered to students at the end of their 1st year in the program (Aug 2020); midpoint (December 2020), and end (May 2021) of their 2nd year in the program; and again at the end of their 3rd year in the program (May 2022). Interviews were conducted at the mid-point of their 2nd year in the program (January 2021).

Figure 1

Modified STEM-PIO Pictorial Representations & Prompts



Findings

Based on the interview data and students' responses to the CS identity instruments, preliminary findings provide valuable insight into the evolving nature of Greg and Camila's (pseudonyms) CS identity. Figure 3 provides a snapshot of Greg's identity shifts over time. Greg described his experience in CES|CS: "...it's been a lot more... thoughtful about like design and how you want to proceed, what ways you want to improve on certain things and the people you meet. It's been a lot more positive."

Figure 3

Greg's scores on the CUPID & modified STEM-PIO instruments

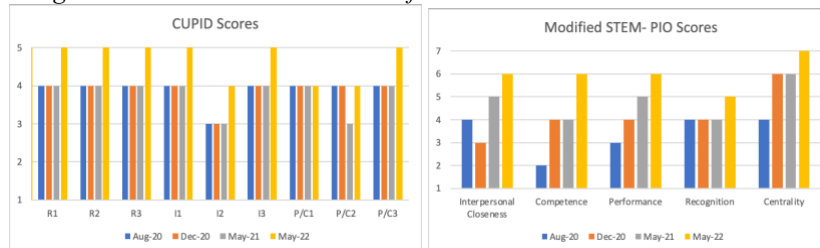
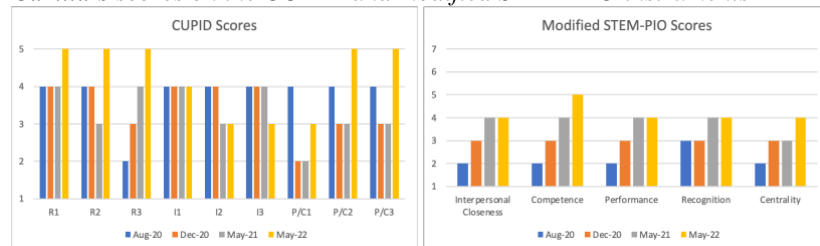


Figure 4 shows Camila's CS identity shifts over time. Camila described her experience in CES|CS: "...it's [CES|CS] definitely made me feel secure, and made me feel like, I'm, gonna be successful as a CS major...."

Figure 4

Camila's scores on the CUPID and modified STEM-PIO instruments



References

- Kena, G., Musu-Gillette, L., Robinson, J., Wang, X., Rathbun, A., Zhang, J., Wilkinson-Flicker, S., Barner, A., & Dunlop Velez, E. (2015). *The condition of education 2015* (NCES 2015). U.S. Department of Education, National Center for Education Statistics. Washington, DC. Retrieved from <http://nces.ed.gov/pubsearch>
- Howles, T. (2005). Community and accountability in a first year programming sequence. *ACM SIGCSE Bulletin*, 37(2), 99–102. <https://doi.org/10.1145/1083431.1083473>
- Lunn, S., Ross, M., Hazari, Z., Weiss, M. A., Georgiopoulos, M., & Christensen, K. (2021). How do educational experiences predict computing identity? *ACM Transactions on Computing Education*, 22(2), 1–28. <https://doi.org/10.1145/3470653>
- Mahadeo, J., Hazari, Z., & Potvin, G. (2020). Developing a computing identity framework. *ACM Transactions on Computing Education*, 20(1), 1–14. <https://doi.org/10.1145/3365571>
- McDonald, M. M., Zeigler-Hill, V., Vrabel, J. K., & Escobar, M. (2019). A single-item measure for assessing stem identity. *Frontiers in Education*, 4. <https://doi.org/10.3389/feduc.2019.00078>

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