

Leveraging Multilingual Students’ Resources for Equitable Computer Science Instruction

1st Sharin Rawhiya Jacob
School of Education
University of California, Irvine
Irvine, USA
sharinj@uci.edu

2nd Sara Vogel
NYU Steinhardt
New York University
New York, USA
sev219@nyu.edu

3rd Rose K. Pozos
Graduate School of Education
Stanford University
Stanford, USA
rkpozos@stanford.edu

4th Patricia Ordóñez Franco
Department of Computer Science
University of Puerto Rico Río Piedras
San Juan, Puerto Rico
patricia.ordonez@upr.edu

5th Jean Ryoo
Computer Science Equity Project
Center X, University of California, Los Angeles
Los Angeles, USA
jeanryoo@ucla.edu

Abstract—Few interventions in K-12 Computer Science (CS) education center on multilingual students who speak more than one language and may be learning English. Emerging research illustrates how multilingual students draw on a range of resources (e.g., cultural, linguistic, semiotic, and embodied) during CS learning activities. Instructional models that leverage these resources can open new possibilities for inclusive CS education. Panel presenters representing four projects working to integrate CS education into multilingual K-12 environments will highlight efforts demonstrating how multilingual students’ resources, and educators’ engagement with them, shape how these students participate in CS education. Each project positions these resources differently with respect to traditional schooling arrangements, CS content and practices, and language goals. This panel will explore those contrasts and the tensions they surface.

Index Terms—equity and inclusion, K-8 schools, multilingual students, computer science education

I. SUMMARY

Efforts in CS education have aimed to broaden participation for students traditionally marginalized in computer science (CS) such as students of color, students with disabilities, and female students. However, few interventions center emergent multilingual students - those who speak more than one language and may be learning English. School systems label multilingual students “English Language Learners” or “Limited English Proficient,” often assuming that students must learn “Academic English” before diving into complex content or topics. This deficit language/model has resulted in fewer opportunities for multilingual students to learn CS.

Broadening participation for multilingual students is critical to providing equitable CS education. The population of students designated as English Learners is projected to reach 25% of the total student population in the US by 2025 [5]. Compared with other groups, there is an alarming underrepresentation of these students in CS education and achievement. High schools with 12% or more students des-

ignated as English learners offer half as many CS courses as other schools [4]. Despite the fact that CS education has not typically offered multilingual students opportunities to engage with complex and relevant CS content and ideas [3], emerging research illustrates how they draw on a range of resources (e.g. linguistic, semiotic, and embodied) during CS learning activities [6], and instructional models that leverage these resources can open new possibilities for inclusive CS education. Furthermore, curricula that leverage multilingual students’ resources to facilitate expression and creativity, when combined with structured instructional approaches, appear to support their development of computational thinking skills and computer science identities [2].

Drawing on research and theory promoting equity in CS education, the learning sciences, and bilingual education, the presenters argue that meaningful, equitable CS education for multilingual students requires understanding and shaping curriculum and practice around students’ and their communities’ varied resources. Presenters represent four projects working to integrate CS education into multilingual K-12 environments. In the panel, they will highlight their driving theories and efforts that explore how multilingual students’ resources – and educators’ engagement with them – shape how these students participate and envision themselves in CS. Each project positions these resources differently with respect to traditional schooling arrangements, CS content and practices, and language goals.

II. PANEL STRUCTURE

Introduction and framing (5 min) – The panel organizers will frame language as a dimension of equity in CS ed. The moderator will prepare audience members for the interactive portion.

Panelist remarks (30 mins) – Each panelist will have 9 minutes to share their research around documenting, noticing and building on multilingual students’ resources in CS education.

The four panelists will be the primary speakers, and the other group members listed will attend the session to be part of the audience conversation (1 min transitions).

Discussant (10 mins) – Dr. Ryoo will reflect on how multilingual students’ resources were positioned in classrooms across the four panelists’ initiatives, drawing on topics of equity, student agency/identity, and pedagogy.

Audience conversation (10 mins) – The moderator will pose prompts for the audience to discuss, and the audience can respond to these questions and ask their own either in the chat or verbally.

Questions and Answers (20 minutes) – The moderator will select questions from the chat and ask audience members to elaborate live for panelists to respond.

III. POSITION STATEMENTS

A. *Sharin Jacob, Mark Warschauer - Identity Development*

Jacob, in collaboration with Mark Warschauer, is working on NSF CSforAll and US Dept. of Ed initiatives aimed at promoting computational thinking (CT) for multilingual students. Jacob will share a study examining identity development of multilingual students as they engage in a year-long CT curriculum, and follow their engagement across multiple settings (i.e., school, club, home, community). She will discuss how tailored instruction provides opportunities for connections to out of school learning environments with friends and family which may shift students’ perceptions of their abilities to pursue computer science and persist when encountering challenges.

B. *Sara Vogel, Chris Hoadley, Christy Crawford - Translanguaging*

Presenters are researchers and practitioners from Participating in Literacies and Computer Science (PiLaCS), a project supporting teachers to integrate CS into multilingual classrooms. They study how students flexibly use language resources, or translanguage [1], in CS activities and how teachers might harness translanguaging for CS learning by taking a syncretic approach – rather than privilege specific English / Spanish or CS objectives, units promote students’ participation in meaningful conversations at the intersection of students’ communities, school disciplines, and computing. Presenters will share experiences from a reflective curriculum design and professional development process in which teachers built on classroom data which surfaced multilingual students’ resources – from the embodied and semiotic to the linguistic.

C. *Rose K. Pozos, Samuel Severance - Computational Thinking, Language, and Agency*

Pozos and Severance collaborate on a research-practice partnership funded by the NSF that aims to create an equitable, integrated computer science pathway for K-8 students in a majority low-income, Latinx community. In this panel, they will present a conceptual framework and set of design principles that leverages computational thinking, sociocultural approaches to language learning, and epistemic agency to support the creation of rich activities where students own

voices and expertise shape the learning experience and engage in computational discourse. To illustrate, Pozos & Severance will draw on work with pre-service teachers who, in collaboration with their cooperating teachers, piloted integrated computational thinking lessons in elementary school.

D. *Patricia Ordóñez and Joseph Carroll-Miranda - Decolonizing Computing*

Patricia Ordóñez and Joseph Carroll-Miranda, co-founders of Computer Science for All Puerto Rico and co-leads for Puerto Rico in Expanding Computing Education Pathways. Drs. Ordóñez and Carroll-Miranda will focus on the NSF funded research-practitioner partnership Exploring Computer Science for Puerto Rico at the University of Puerto Rico Río Piedras examining the cultural and linguistic equivalence of the translation of the Exploring Computer Science curriculum and professional development (PD) into Spanish and its implementation in two high schools near San Juan, Puerto Rico. The building of the RPP and its support network has brought to light several challenges in the adaptation of the curriculum and its PD to Puerto Rican culture and the need for providing more support in terms of content to address digital literacy barriers and to help decolonize computing in Puerto Rico so that more students are able to understand computer science and envision themselves as creators in the field instead of users.

E. *Jean J. Ryoo - Discussant*

Dr. Ryoo has focused on equity, culturally responsive computing, student identity, engagement, and agency in CSed for over a decade. She has worked with the Exploring Computer Science equity-oriented high school course, and currently leads NSF-funded research-practice partnership projects at both the CS high school classroom and statewide level. These projects focus on elevating minoritized CS students’ voices as well as supporting district administrators in scaling equitable CS education. She will bring lenses focused on leveraging students’ cultural funds of knowledge and practices in computing learning to our discussion of multilingualism in CSed, urging participants to consider bi/multilingualism as an asset, and to address the sociopolitical contexts, diverse histories, and power dynamics related to language and its uses in the classroom.

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