

Learner-Centered Pedagogies for Equity and Inclusion in K-12 Introductory Programming

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Abstract—Computer Science for All brings an incredible opportunity for broadening participation in computing and ensuring that all learners learn new age skills like programming. This timely panel features experienced CS education researchers who are leveraging education research and socio-cultural theories of learning to design varied environments attending to race, gender, interest, disabilities, and community in learning. Through discussions and examples, this panel showcases ideas that curriculum designers and educators can use to attend to equity and inclusion by centering the learner in the learning process. Key takeaways include an appreciation of the plurality of pedagogies for achieving equitable and inclusive ‘CSForAll’.

Keywords—K-12 computer science, CS pedagogy, equity and inclusion, learning theory

I. SUMMARY

Even as Computer Science for All becomes a worldwide mantra to support CS education in primary and secondary schools, girls, students with disabilities, as well as Black, Latinx, and Native American and Pacific Islander students continue to experience racial bias and structural inequities both inside and outside of school settings. Programming is seen as a key 21st century skill, and a gateway to introductory CS learning through experiences purportedly aimed at attracting young learners to CS. It is also a skill that is also associated with conceptual complexity and historically difficult for novices to learn. How are researchers pursuing the goal of designing and investigating equitable, inclusive, and engaging ways to teach ALL young learners to program?

According to the seminal work from the learning sciences on ‘How People Learn’, learning environments must be ‘learner-centered’ [1]. Centering the learner includes recognizing the importance of building on both the conceptual as well as cultural knowledge that students bring with them to the classroom. Sensitivity to students’ community and cultural practices [2], [3] as well as their backgrounds, interests, and neurodiversity empowers learners through experiences that foster a sense of belonging.

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This panel will bring together four panelists and a moderator who actively engage in research on pedagogies that put the learner at the center of the learning process. Panelists will discuss how they privilege student interests, voice, and agency. Through examples drawn from their varied research projects, the panelists will discuss their unique experiences in learning settings working with diverse learners, the learning theories they draw on, the challenges they have encountered in implementing their approaches, and how they address them to create inclusive learning spaces. With K-12 educators aiming to address the goals of broadening participation and equitable learning while also striving for rigor, the panel will serve as a timely, informative session on pedagogical ideas that CS educators at all levels can embrace for introducing programming.

II. PANEL STRUCTURE

The panel will open with a brief overview by the moderator describing the session and the need for expanding the research base on varied pedagogies for inclusion and equity related to diverse minoritized groups in K-12 CS (5 mins). Each panelist will be given 5 minutes to briefly present their respective positions, share their work highlighting their approach and pedagogical stance on equity and inclusion in K-12 computing. Following the presentation, the moderator will facilitate a discussion (30 mins) that will address a mix of audience questions as well as pre-planned questions:

What are some tensions, trade-offs, or challenges you have had to address when designing for equity and inclusion in teaching programming? How should teachers be prepared for practicing the inclusive CS pedagogies you design or espouse? What is key messages you have for educators and researchers related to equity and inclusion regardless of context or setting?

III. POSITION STATEMENTS

A. Shuchi Grover (Moderator)

I straddle the learning sciences and computing education research. I view designing learner-centered environments as

an equity issue. My work advocates for expansive learning for motivating learners, balancing scaffolding and exploration for conceptual engagement and “systems of assessments” that provide students with varied opportunities to showcase learning [4]. This panel brings together four female authors of learner-centered pedagogy chapters in a recently published handbook on how to teach programming in K-12 [5], that work to support diversity, equity, and inclusion in K-12 computing classrooms. As moderator, I aim to steer a conversation that will help build an appreciation and understanding of the many ways in which historically marginalized learners can be supported to realize the mission of CS For *All*.

B. Jill Denner

I am a social science researcher who collaborates with schools to engage in cycles of research and implementation. My work foregrounds the social side of learning. Sociocultural theories describe learning as occurring through a process of social interactions within a historical and cultural context [6]. I create K-12 learning environments that can help to broaden participation in computing by affirming values and personal relevance, and creating a community of support that increases expectations for success [7]. This includes instructional approaches to support effective and equitable pair programming[8], and culturally responsive events to engage families with no prior CS experience [9]. I will talk about our Pair Programming toolkit and Spanish Family Code Night Event Kits- and what we are learning from the research.

C. Jakita Thomas

I am a computer scientist and learning scientist who designs for learning to be socially- and culturally-relevant on learners’ skill, CS identity and self-efficacy, especially for groups who have been historically marginalized from and within computing spaces. I also study the impact of spaces that reject deficit models and narratives, and instead leverage the experiential, social, and cultural expertise brought to the learning environment as a springboard for engaging with CS concepts and content [10, 11]. I argue that to broaden participation and sustain engagement for real impact, we have to first ask: “CS for what?” “For whom?” “How?” and “To what end?” [10]; and then design learning to connect to what learners care about, leveraging CS as a tool for exploration, awareness, action, and social justice. I share results from data collected across a seven-year study of African-American girls designing games for social change.

D. Deborah Fields

In my research and curriculum design, I place a strong emphasis on applying constructionism[12] to students’ learning, facilitating their creations of personally meaningful computational objects, especially electronic textiles. However, supporting a creative space for making and coding requires pedagogy that educators may find challenging [13]- focusing on students’ interests, foregrounding aesthetics, celebrating mistakes, creativity with constraints, and facilitating emergent

peer pedagogy [14]. I argue that this type of teaching, which focuses on the design and social norms of the classroom environment is just as (if not more) demanding than traditional teaching-at-the-front pedagogy. I share results from a study of teachers’ implementation of an electronic textiles curricular unit for introductory CS with high school students.

E. Maya Israel

I am a researcher at the intersection of CS education and inclusive education, with an emphasis on how to empower teachers and students (including those with disabilities) with the necessary tools and skills to be successful in K-8 CS education. This work is focused on (a) teachers’ implementation of Universal Design for Learning (UDL)[15] and (b) students’ use of metacognitive strategies to think about their thinking while solving computational problems. I will share results from a series of studies examining teachers’ implementation of UDL as well as challenges and successes of students- with and without disabilities- in inclusive elementary and middle school CS classrooms. Finally, I will share resources and tools developed through these studies intended for use by teachers working in academically diverse CS contexts.

REFERENCES

- [1] J. Bransford, A. L. Brown, and R. R. Cocking. How people learn: Brain, mind, experience, and school, National Academies Press, 1999.
- [2] G. Ladson-Billings. “Toward a theory of culturally relevant pedagogy.” *American educational research journal* 32, no. 3, 1995, 465-491.
- [3] L.C. Moll, C. Amanti, D. Neff, and N. Gonzalez. “Funds of knowledge for teaching: Using a qualitative approach to connect homes and classrooms.” *Theory into practice* 31, no. 2 (1992): 132-141.
- [4] S. Grover, “Assessing algorithmic and computational thinking in K-12: Lessons from a middle school classroom.” In *Emerging research, practice, and policy on computational thinking* (pp. 269-288), 2017. Springer.
- [5] S. Grover, *Computer Science in K-12: An A to Z Handbook on Teaching Programming*, Edfinity, 2020.
- [6] E. Wenger, “Communities of practice and social learning systems: the career of a concept.” In *Social learning systems and communities of practice*, pp. 179-198. Springer, London, 2010.
- [7] D.S.Yeager, and G. M. Walton. “Social-psychological interventions in education: They’re not magic.” *Review of educational Research* 81, no. 2 (2011): 267-301.
- [8] J. Denner, J. Martinez, and H. Thiry. “Strategies for engaging Hispanic/Latino youth in the US in computer science.” *Research Anthology on Instilling Social Justice in the Classroom* (2021): 203-221.
- [9] S. Campe, J. Denner, E. Green, and D. Torres. “Pair programming in middle school: variations in interactions and behaviors.” *Computer Science Education* 30, no. 1 (2020): 22-46.
- [10] N. Joseph and J.O. Thomas “Black Girls as Possibility Models for Changing Hegemonic Narratives and Disrupting STEM Neoliberal Projects.” In *Annual Meeting of the AERA*, 2018.
- [11] J.O. Thomas, N. Joseph, A. Williams, and J. Burge. “Speaking truth to power: Exploring the intersectional experiences of Black women in computing.” In *2018 RESPECT Conference*, pp. 1-8. IEEE, 2018.
- [12] S. Papert and I. Harel. “Situating constructionism.” *Constructionism* 36, no. 2 (1991): 1-11.
- [13] T.M. Nakajima, and J. Goode. “Teachers’ approaches to make (e) ing computing culturally responsive: Electronic-textiles in exploring computer science classes.” In *2019 IEEE RESPECT*, pp. 1-8. IEEE, 2019.
- [14] D. Fields, D. Ann, Y. Kafai, T. Nakajima, J. Goode, and J. Margolis. “Putting making into high school computer science classrooms: Promoting equity in teaching and learning with electronic textiles in exploring computer science.” *Equity & Excellence in Education* 51, no. 1 (2018): 21-35.
- [15] T.E. Hall, A. Meyer, and D. H. Rose, eds. *Universal design for learning in the classroom: Practical applications*. Guilford Press, 2012.