CENTERING DIGNITY IN COMPUTING AND STEM EDUCATION

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THEME:

STEM education in diverse contexts

SYMPOSIUM OVERVIEW

The goal of this symposium is to offer epistemological, methodological, and axiological orientations for challenging technocentric approaches (Papert, 1987) that have primarily defined computing and STEM education (Sengupta et al., 2021). Technocentric approaches center the production of technological artifacts over the complexity of human experience and can lead to further marginalization of learners from non-dominant backgrounds (Margolis, 2017). In contrast to centering the "charisma" of the computer (Ames, 2019), the papers in this symposium offer ways to center dignities of learners from non-dominant backgrounds in computing and STEM education.

Paper 1 (Sanyal et al) offers *marginal computational literacies* as an epistemological lens that stands in contrast to technocentric notions of computational literacies. Sanyal et al. establish how focusing on dignity of learners and computing professionals is essential for countering device-centric approaches for supporting computational literacies. Paper 2 (Dutta & Sengupta) focuses on how focusing on heterogeneity can offer a necessary axiological (ethical and historical) orientation for STEM education, and how this can center learners' dignities in STEM classrooms. Paper 3 (Trehin et al.) offers an empirical analysis of how learners of color "read" computer code of simulations of ethnocentrism through guided facilitation. This paper illustrates the importance of sharing stories of migration and solidarity as an ethically oriented approach to computational literacies. Paper 4 (Chokshi et al.) offers another empirical investigation of how learners and facilitators from non-dominant backgrounds resist code that enacts symbolic violence (Bourdieu, 1990) through ethical listening and solidarity.

STRUCTURE OF THE SYMPOSIUM

The session will begin with introductory remarks by organizers on the importance of centering dignity in computing education (5 minutes). This will then be followed by the four paper presentations (10 minutes each). Then discussant Dr. Ayush Gupta, Homi Bhabha Center for Science Education, India, will offer his comments (10 minutes). The final 10 minutes of the symposium will be reserved for questions from the audience.

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MARGINAL TECHNOLOGICAL LITERACIES

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THEME:

STEM education in diverse contexts

BACKGROUND AND AIMS

Our work arises from the concern that prevelant notions of computational literacies such as regimes of competence (diSessa, 2000), computational thinking (Wing, 2006), and computational participation (Kafai & Burke, 2014) have been positioned in device-centered ways that primarily focus on technological productions of learners, while often invisibilizing the heterogeneity of their experiences and life-worlds (Ames, 2019; Sengupta et al., 2021). In thsi paper, following Philip & Sengupta (2021), we ask the following question: What would it mean for theories of learning in computing education to be connected to theories of society? In this paper, we offer the notion of *marginal technological literacies*, based on a critical review of the literatures on both professional and educational realms of computing, and argue that centering *dignity* (Vossoughi et al., 2020), rather than only *devices* is essential for supporting both diverse learners, as well as resisting politically neutral notions of disciplinary authenticity in computing education.

METHOD

Adopting the interpretive synthesis method, we offer a critical review in two parts that draws upon scholarship in the social sciences and education research. Part 1 of the review consisted of a purposive sampling of scholarship from the social sciences about migration of high-skill tech workers in the US. Part 2 of the review was based on purposive sampling of scholarship focused on issues of marginalization and dignity in learning contexts of computing and making. The findings comprise of themes which are ways in which dignity of workers and learners were represented in these papers.

RESULTS AND CONCLUSIONS

Part 1 (n = 15 papers) makes explicit how immigrants of color to the Global North, whose labor sustains the computing profession (IT industry), and their families are subjected to loss of dignity through oppressive employment practices. Several papers (n = 10) revealed a militarized discourse based on global economic competitiveness that justified such employment practices, while at the same time commodifying people of color as holders of skills of value. Several other papers (n=5) revealed the discrimination and oppression that the workers face at their workplaces and lack of basic rights (e.g., driving licenses) for their families who are not allowed to work. Part 2 (n = 10 papers) highlights how centering non-dominant languages of learners, as well as their emotional and embodied micro-interactions can deepen their engagement in computational modeling.

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Philip, T. M., & Sengupta, P. (2021). Theories of learning as theories of society: A contrapuntal approach to expanding disciplinary authenticity in computing. *Journal of the Learning Sciences, 30*(2), 330-349.

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HETEROGENEITY AS AXIOLOGICAL REORIENTATIONS IN STEM AND COMPUTING EDUCATION

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THEME:

STEM education in diverse contexts

BACKGROUND AND AIMS

Though the idea of heterogeneity in STEM education inheres an epistemological commitment towards equity (Rosebery et al., 2010), it is important to view heterogeneity not only as linguistic and sociocultural diversity but valuing leaners' voices, particularly from the margins of discipline and society (Sengupta et al., 2021). In this work, we present a critical review of the literature in STEM and computing education and argue that centering heterogeneity of learners is essentially an axiological reorientation that goes beyond onto-epistemic shifts.

METHODOLOGY

We offer an interpretive synthesis (Noblit & Hare, 1988) of literature in STEM and computing education published between 2010 - 2021 that explicitly focus on heterogeneity of learners' voices and experiences in classroom and informal educational contexts. We reviewed 35 papers published in peer-reviewed journals. We used critical discourse analysis to identify key themes (reported in the results section) that illustrate how authors defined and operationalized heterogeneity and how their usage contrast with device-centered approaches.

RESULTS

A key insight is that heterogeneous approaches to STEM and computing focus on learners' positioning and identity work, thus reorienting disciplinary experiences toward sociohistorical dimensions. This includes critiques of settled racial, epistemic and linguistic hierarchies of disciplinary ontologies and practices, along with an ethical focus on microinteractional (discursive and embodied) accomplishments in STEM learning spaces. Overall, these findings suggest that a centering heterogeneity amounts to an axiological reorientation that involves (a) contrapuntal (Said, 1991) reorientation toward perspectives, theories and voices from Global South (Philip & Sengupta, 2021) and (b) methodological focus on dialogic attainments of ideologies and ethical perception of embodied actions in disciplinary learning (Espinoza et al., 2020).

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Rosebery, A.S., Ogonowski, M., DiSchino, M., & Warren, B. (2010). "The coat traps all your body heat": Heterogeneity as fundamental to learning. J*ournal of the Learning Sciences, 19*(3), 322–357.

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STORIES WE TELL WHEN *READING* COMPUTATIONAL CODE

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THEME:

STEM education in diverse contexts

BACKGROUND AND AIMS

Literacy practices and computational coding have long been constructed as discrete subjects within classroom discourses. While literacy practices have expanded beyond the page, coding is bound within a disciplinary space reinforcing symbolic violence (Bourdieu, 1991; Sengupta et al., 2022). This study proposes a new perspective – *reading* the code that underlies a graphical model of ethnocentrism, alongside computational models and maps of racial segregation (Hammond & Axelrod, 2003; Sengupta et al., 2021) to examine the implicit messages within the code, and how they may serve to reinforce or overcome societally constructed differences among racial groups.

METHODOLOGY

The context of this study was a public computing environment located at a large university in Canada (Sengupta & Shanahan, 2017). Through guided facilitation, participants interacted with the simulation, including changing variables to adjust population, immigration rates, birth/death rates, effecting graphical changes in populations of different colours of agents over time, contrasting these with reading the underlying code. Participants' interactions were videorecorded and the data was analyzed using constant comparative methods (Glaser & Strauss, 1967).

RESULTS AND CONCLUSIONS

This reading acted as a springboard towards participants' recognition that the computational code contained implicit messages, echoed in their own personal narratives and experiences around some common themes such as racial identity, loss, immigration and colonization. The results of the study demonstrate that code is not value neutral, and that the implicit messages contained within reinforce broader social constructs around minoritization and marginalization.

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HOW DIGNITY AND VULNERABILITY SHAPE INFORMAL COMPUTING DISCOURSE

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THEME:

STEM education in diverse contexts

BACKGROUND AND AIMS

This paper seeks to study how the affective landscape of the participants plays a role in shaping their facilitated computational discourse and interactions in an informal computing environment located at a university in Canada (Sengupta & Shanahan, 2017). Our pervious work identifies how computational models of segregation and ethnocentrism (Schelling, 2006) enact and reify symbolic violence (Bourdieu & Passeron, 1990) on learners of color through implicit assumptions of marginalization. The current paper demonstrates how the facilitator's enactment of dignity supports the participant's subversion of symbolic violence enacted by and through the code.

METHODOLOGY

The context of this study was a public computing environment located at a large university in Canada (Sengupta & Shanahan, 2017). The participants and the facilitator were immigrants of color to the Global North. A total of 5 participants interacted with the simulation, including changing variables to adjust population, immigration rates, birth/death rates, as well as comparing the simulation with a census-based geographical map of racial segregation. Participants' interactions were video recorded and the data was analyzed using constant comparative methods (Glaser & Strauss, 1967).

RESULTS AND CONCLUSIONS

Our analysis reveals that the lens of first, second and third person accounts (Espinoza et al., 2020) can help us recognize potentially significant moments in participants' sense-making that is laden with - and not devoid of - both interpretive uncertainties and affect. In some cases, participants positioned themselves as actors in the simulations, and in doing so, made explicit how implicit assumptions in the code were at odds with their lived experiences of being racially marginalized. This often resulted in facilitators sharing stories in solidarity while also attempting to make changes to the code in order to resist or change the implicit assumptions. Our analysis reveals how the facilitator's ethical listening acknowledges and centers learners' dignities and vulnerabilities in create dignity-affirming ways, which in turn deepens engagement with computational modeling.

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