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Editorial: Centering humanism in STEM education

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Editorial on the Research Topic
Centering humanism in STEM education

Introduction

To understand why this Research Topic exists, it is important to recall the original goal from our call for proposals: to reorient STEM researchers and practitioners to reconsider the actual purpose of the practice of teaching and learning. Bryan Dewsbury often invokes us in his writing and talks to understand our ***why***. As educators, we wish to provide insights, practices, and proposed theories to reflect on our ***WHY*** in STEM education—from one instructor's empathetic approach to understanding the undergraduate student experience in gateway courses to the cultural initiation ceremonies at the disciplinary level. These components of humanism and the lens in which we see the human experience throughout a STEM ecosystem serve to bring humanistic thinking to the pedagogical praxis within STEM. We see this Research Topic as grounded in futures-oriented thinking, proactive scholarship, and equity-minded inclusive practices that will drive new conversations in STEM education toward feasible, meaningful ways to codify equity-minded higher education STEM ecosystems.

This root of this Research Topic is inspired by thought leaders from Septima Clarke (Charron, 2012), Horton (1990), Woodson (1919), Freire (2017), and Givens (2021), to name a few, for whom the process of education was never meant to be untethered from broader questions of social progress and justice. The core "why" of higher education centers on the cultivation of an individual's intellectual growth, socialization, and wellbeing. Yet, a brief reflection on the history of higher education shows that it has not provided this cultivation to all students. Higher education was once reserved for white men and, while *access* has steadily increased over time, students who hold marginalized identities continue to experience harm. The double standards associated with this type of thinking were aggressively pointed out by influential educators listed above who famously worked with marginalized populations.

Within higher education, STEM education undertook its own unique trajectory. STEM research became a formidable and lucrative enterprise for many higher education institutions. Scientists amassed significant financial, social, and political power within and outside of their institutions, becoming gatekeepers to complex knowledge. With this power also came the opportunity to train and educate promising students. It is thus surprising and unfortunate that teaching was (and still is) typically seen as the undesirable responsibility of an individual faculty member. In the US, there were consequences to this divide between research and teaching. American institutions of higher education are still reflective of broader social racial dynamics, and these dynamics have consequences in the classroom. The overall climate around teaching is improving but there is still evidence of instructors and institutions taking a "deficit-minded" view of students, who are asked to burden the proof of ability, in spite of significant social barriers and experiences of marginalization.

Research demonstrates that STEM disciplines continue to perpetuate a legacy of exclusion, particularly for students who have been historically excluded from higher education (Asai, 2020). This poses problems because science permeates every aspect of contemporary American life from the financial to the political. Institutions' repeated failures to disrupt systemic oppression in STEM has led to a workforce that is mostly white, cisgender, men, replete with implicit and/or explicit biases. Education holds one pathway to disrupt systemic linkages of STEM oppression from society to the classroom. Maintaining views on science as inherently objective isolates it from the world in which it is performed. STEM education must move beyond the transactional approaches to transformative environments manifesting respect for students' social and educational capital. We must create a STEM environment in which students with marginalized identities feel respected, listened to, and valued. We must assist students of all identities in understanding how their positionality, privilege, and power both historically and currently impacts their meaning making and understanding of STEM.

We contend that the phrase "low persistence" in STEM classrooms, which is currently used to describe students' ability, is actually a consequence of the environment and traditional teaching approaches that perpetuate the status quo. There is clear evidence that attending to belonging, community and relationship-building makes for successful classroom outcomes, but this evidence is sometimes disciplinarily scattered, leaving the impression that equity-minded approaches to teaching are well below critical mass. These notions of respect for *who* is in STEM classrooms represents humanism as the key element to equity for STEM education. This contributes to our "why" for why this matters now and for the future. In this Research Topic, we sought articles that did not simply address inclusive teaching as an access mechanism, but that sought to rethink the entire notion of what it means to equip our students with knowledge, a sense of confidence, and the dispositions needed in this world. We view this Research Topic as part of the scholarship wave that provides institutions of higher education examples of what is possible for their classrooms and campuses in general.

The editors read all the accepted submissions and engaged in a process of post reflexivity, where in conversation we identified the major thematic areas addressed by the submissions. Submissions addressed topics of humanism at different levels of engagement, supporting practitioners who perhaps are only just beginning to think about humanism in their practice, to individuals considering humanism at a scale involving institutional transformation. At each level, humanism showed up in different and unique ways.

Where humanism exists in the STEM ecosystem

When looking at where and how centering humanism occurs, the range of articles represent a STEM ecosystem through four distinct system levels featured in the four quadrants of Figure 1:

- *Microsystem: Classrooms*
- *Mesosystem: Non-classroom Spaces*
- *Exosystem: Institutions*
- *Macrosystem: Cultural Norms*

This image was inspired by Bronfenbrenner's bioecological systems theory, contextualized in two articles in Research Topic by Google et al. and Yao et al.. This theory stipulates that an individual's development is influenced by a series of interconnected environments, and that these environments are also thus shaped by the individual (Bronfenbrenner, 1979). We adapted this framework to our Research Topic to see how STEM influences the educational ecosystem in which it operates as much as the ecosystem influences the individuals within it, including STEM students, faculty, staff. These spheres of influence or system levels pose potential for locating humanism in STEM:

- ***Microsystem: Classrooms***: The STEM course learning environment shaped by the instructor for students. Instructor perspectives and practices have an impact on how students learn ways of knowing, thinking, and practicing within the discipline.
- ***Mesosystem: Non-classroom Spaces***: Spaces such as labs, clubs, internships, jobs, and undergraduate research experiences that exist outside of the classroom where STEM knowledge is applied.
- ***Exosystem: Institutions:*** Spaces on the university campus that have an impact on STEM communities but are not within any particular discipline (e.g., non-STEM majors and minors; academic services such as tutoring centers, writing centers; policies around registration, enrollment, and requirements, etc.).
- ***Macrosystem: Cultural Norms:*** STEM cultural norms–often tacit rules learned over time—represent underlying assumptions of the disciplines that guide actions, behaviors, and knowledge production.

Given that we know that these systems interact with one another in STEM education, the dotted lines demonstrate the influence of the micro, meso, exo, and macrosystems within each quadrant. As an example, when looking at the classroom microsystem, three dotted lines are present that represent the meso, exo, and macrosystem demonstrating the role of non-classroom spaces, non-STEM spaces, and norms that have an impact at the micro level.

As listed in Table 1, we assigned an icon to each article—a globe, a professor in front of a whiteboard, and a student reading—and placed each icon within one of the four quadrants that best represented where the article's primary focus on humanism existed; each icon sits on a dotted line (.....) representing the secondary

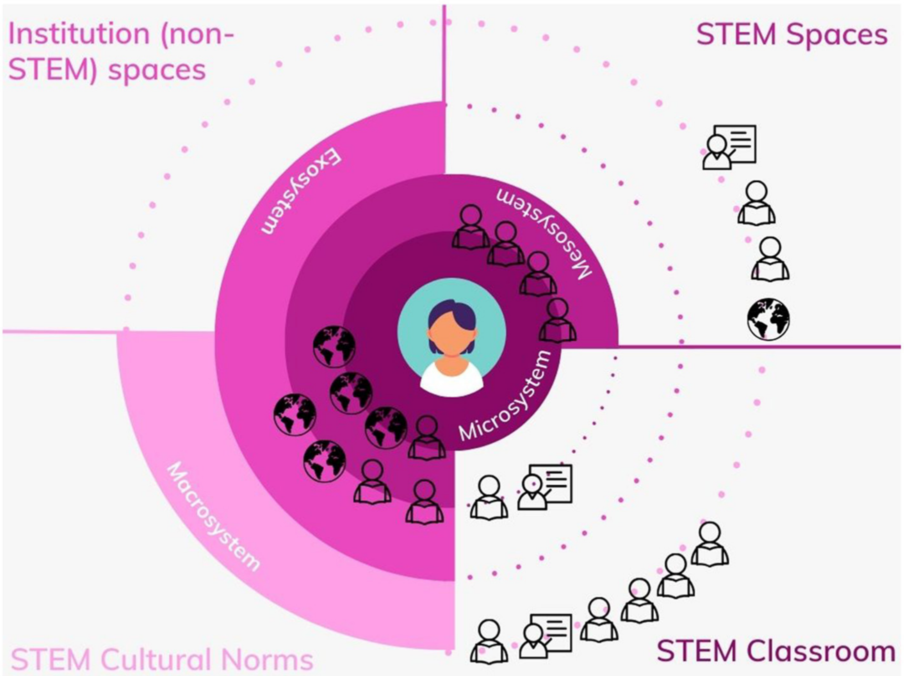

FIGURE 1
Representation of research articles within the STEM ecosystem.

systemic focus of the article; essentially, each article connected to more than one systemic level.

The quest to continue centering humanism: inclusive-curious, hopeful, holistic

This graphical STEM overview brought forth important themes and takeaways as well as areas for further research. In considering one's purpose in STEM whether as an educator, researcher, or graduate student, many articles highlighted the need for understanding one's positionality within ways of knowing and practicing in STEM disciplines in order to embed humanism within STEM. Personal interrogations around one's inner motivations and underlying assumptions on teaching practices and how these practices affect student learning serve as useful starting points for multiple educators within Research Topic. We see Research Topic as an opening for the "inclusive-curious" educators who have seen the growth of inclusion within STEM disciplines, conferences, and federally-funded grant programs. This Research Topic invites educators at any point on their inclusive, humanistic journey to sample various perspectives and practices from three standpoints: individual, collective, and cultures:

Individual: From this self-reflective starting point, authors outlined frameworks for examining one's own context and spheres of influence; other articles examined how and whose expertise is valued and whose is omitted within their own educational contexts. Articles explore frameworks for developing and building relationships that blend classrooms and educational spaces existing within those interstitial spaces of micro and meso. The features of humanism represented from the instructor perspective demonstrate humility, vulnerability, valuing input and expertise from multiple viewpoints, mentoring and mentorships and what collegiality means for educators.

Collective: Moving from individual to collective contexts, some articles explore how learning environments support emerging students' identities as researchers, scholars, and active participants in STEM. The conscious effort to pay attention to identity development—much like graduate schools do implicitly through disciplinary societies—in humanistic ways serves as a pivotal touchstone to transform the way STEM functions in our lives. We see this as embedding hope into holistic structures to support students, instructors, and graduate students' worldview of STEM.

Cultures: Finally, these articles demonstrate opportunities to create new learning cultures with humanism at the center from 1st year courses to shifting STEM norms and practices. Some articles outline ways to leverage resources within campuses to support inclusive pedagogies that in turn support the healthy STEM learning ecosystems for staff, faculty, and students. This Research Topic reflects examinations on power, purpose, and meaning within STEM education. Not only should we interrogate power dynamics within the classroom, departments, and disciplines; for STEM instructors the power exists to make changes within curricula and processes in order to connect students to meaningful, purpose-driven learning experiences.

Implications and next steps

Our STEM graphic allows us to see the world that exists outside any given syllabus or beyond the classroom; instead, STEM students

TABLE 1 List of articles mapped to the STEM Ecosystem.

	References	Title	Primary	Connected to .....
INSTRUCTOR perspectives	Azizi et al.	Humanizing STEM education: an exploratory study of faculty approaches to course redesign	Classroom	STEM Spaces
	Basu	Embodied curriculum mapping as a foundation for critical self-reflection and culture change	Classroom	Cultural Norms
	Cook-Sather et al.	Humanizing STEM education through student-faculty pedagogical partnerships	STEM spaces	Classroom
	Sung et al.	Constructing biology education research identities: a duoethnography	STEM spaces	Cultural Norms
STUDENTS	Audette et al.	Building an inclusive community of learners by centering a strong culture of care in large lecture classes	Classroom	STEM spaces
	Fiorini et al.	Major curricula as structures for disciplinary acculturation that contribute to student minoritization	Classroom	STEM spaces
	Stranford	Fostering student agency and motivation: co-creation of a rubric for self-evaluation in an ungraded course	Classroom	STEM spaces
	Adams et al.	Embracing the inclusion of societal concepts in biology improves student understanding	Classroom	Cultural norms
	Duncan et al.	Creating an equitable and inclusive STEM classroom: a qualitative meta-synthesis of approaches and practices in higher education	Classroom	Cultural norms
	Meuler et al.	Biology in a social context: a comprehensive analysis of humanization in introductory biology textbooks	Classroom	Cultural norms
	Miller and Withers	Small course interventions focused on whole-person development increase aspects of student affect for women, Asian and first-generation students	Classroom	Cultural norms
	Alderfer et al.	Inclusive Science Communication training for first-year STEM students promotes their identity and self-efficacy as scientists and science communicators	STEM spaces	Classroom
	Fleming et al.	Championing awareness of the opioid epidemic through a service-learning module for non-STEM biology majors	STEM spaces	Cultural norms
	Kolodkin-Gal	Underexplored outcomes of learning disabilities and neurodivergence in STEM graduate and post-graduate research	STEM spaces	Cultural norms
	Paul et al.	Stubborn boundaries: the iron ring ritual as a case of mapping, resisting, and transforming Canadian engineering ethics	STEM spaces	Cultural norms
	Negrete et al.	Toward asset-based LatCrit pedagogies in STEM: centering Latine students' strengths to reimagine STEM teaching and practice	Cultural norms	Classroom
	Jones et al.	Disrupting cisheteronormativity in STEM through humanism	Cultural norms	STEM spaces
SYSTEMS	Henrichsen & Keenan	First-generation undergraduate researchers: understanding shared experiences through stories	STEM spaces	Cultural norms
	Imad et al.	Recasting the agreements to re-humanize STEM education	Cultural norms	Classroom
	Lueke and Sanders	Dakota/Lakota Math Connections: an epistemological for teaching and learning mathematics with Indigenous communities and students	Cultural norms	Classroom
	Google et al.	Adopting a multi-systems approach: examining the academic belongingness of first-generation college students with multiple stigmatized identities in STEM	Cultural norms	STEM spaces
	Mudaly and Chirikure	STEM education in the Global North and Global South: competition, conformity, and convenient collaborations	Cultural norms	STEM spaces
	Yao et al.	Humanizing STEM education: an ecological systems framework for educating the whole student	Cultural norms	STEM spaces

and educators exist within larger systemic forces that significantly impact learning and teaching processes. These forces also have an impact on students and ultimately shape their educational experiences and outcomes. Given the forces and movements that influence how we center humanism in STEM, we offer these closing thoughts on further questions and opportunities for research to better understand the STEM educational ecosystems:

Humanism within institutional structures: Most glaring in the STEM world graphic is the lack of articles within the exosystem or the institutional spaces. Again, these spaces have an impact on STEM communities but are not within any particular discipline. These spaces constitute the supporting structure for students that contribute to their overall success as scholars and global citizens.

Diversity of critical voices: Within the Frontiers platform, we would like to see more research on global institutions and frameworks for centering humanism in STEM. Non-western frameworks for education provide ways of knowing and practicing within disciplines that warrant more visibility.

Collaborative leadership: Centering humanism within institutions requires more coordination and collaboration across disciplinary spaces. The traditional faculty-staff divide seen in most institutions inhibits the coordination across spaces. It also requires informed administrative leadership to influence the STEM ecosystem from department chairs to deans to provosts to staff leadership in order to affect access, time, compensation, and wellbeing.

Investigating these underexplored directions will strengthen our ability as educators to individually and collectively center our students' humanity more effectively across the entire STEM ecosystem.

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References

Asai, D. J. (2020). Race matters. *Cell* 181, 754–757. doi: 10.1016/j.cell.2020.03.044

Bronfenbrenner, U. (1979). The ecology of human development: experiments by nature and design. *Harvard Univ. Press* 2, 139–163.

Charron, K. M. (2012). *Freedom's Teacher, Enhanced Ebook: The Life of Septima Clark.* Chapel Hill, NC: University of North Carolina Press.

Freire, P. (2017). *Pedagogy of the Oppressed*. New York, NY: Penguin Classics.

Givens, J. R. (2021). *Fugitive Pedagogy: Carter G. Woodson and the Art of Black Teaching.* London: Harvard University Press.

Horton, M. (1990). *We make the Road by Walking: Conversations on Education and Social Change.* Philadelphia: Temple University Press.

Woodson, C. G. (1919). *The Education of the Negro Prior to 1861: A History of the Education of the Colored People of the United States from the Beginning of Slavery to the Civil War*. Association for the Study of Negro Life and History.