

From Summer Institute to Action: Advancing Equity and Inclusion in STEM Classrooms

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Abstract: This Editor's Note provides background on the CUNY Innovative Teaching Academy Summer Institute for Equitable and Inclusive STEM Teaching and Learning and introduces the articles featured in this special issue.

Keywords: Faculty Development, STEM, teaching and learning, pedagogies

For decades, research has demonstrated the persistent barriers faced by women and students of color in Science, Technology, Engineering, and Mathematics (STEM) fields. Socio-economic, cultural, and psychological factors—such as stereotype threat, feelings of inadequacy, and a lack of belonging—continue to contribute to their under-representation and attrition (Beasley & Fischer, 2012). Additionally, systemic challenges, including academic isolation and limited access to mentorship, disproportionately affect first-generation college students, further deepening inequities in STEM education (Choy et al., 2000; McCarron & Inkelas, 2007). These disparities are compounded by classroom environments that often overlook the diverse needs and lived experiences of marginalized students. Addressing these disparities requires institutional transformation, and a commitment to equipping faculty with the tools and strategies needed to create and foster inclusive, and equitable learning environments.

The City University of New York (CUNY) Innovative Teaching Academy (CITA) Summer Institute 2023 featured a week-long STEM-focused workshop designed to directly address longstanding equity challenges in STEM education. The institute, titled *Promoting Equitable and Inclusive STEM Teaching and Learning*, focused on integrating high-impact practices—such as dialogic teaching, culturally responsive pedagogy, active learning, and instructional innovation—into STEM courses. Such implementation sought to foster student engagement and promote inclusive and equitable instruction, among other objectives. Research indicates that such approaches have been shown to improve outcomes, especially when implemented in introductory STEM courses

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(George et al., 2001; Graham et al., 2013). By addressing systemic challenges, the Summer Institute also aimed at advancing the broader goal of diversifying the STEM workforce.

Faculty development is essential to advancing inclusive and culturally responsive teaching in STEM. Research shows that faculty play a key role in fostering inclusion and belonging, and professional development helps build the awareness and skills needed for inclusive teaching (Killpack & Melón, 2016; O’Leary, *et al.*, 2020). Research also shows that professional development is key to scaling high-impact practices and creating institutional changes (Biswas, *et al.*, 2022; Calkins, *et al.*, 2024). A Summer Institute offers dedicated time for faculty to discuss evidence-based pedagogical practices, collaborate across disciplines, and explore equity-focused strategies. Such efforts promise to not only strengthen individual pedagogy but to also support a broader cultural shift toward more equitable and effective STEM education.

Nineteen faculty fellows from 13 different CUNY campuses, representing disciplines such as biology, computer science, engineering, mathematics, medical laboratory science, and physics, were selected to participate in the Summer Institute. Through interdisciplinary collaboration, including a biology-English partnership and a CUNY Start (<https://www1.cuny.edu/sites/cunystart/>) mathematics faculty team, faculty engaged in critical discussions and workshops centered on: Understanding implicit bias; Building inclusive learning spaces: Effective DEI practices; Responsive pedagogy; Social justice curriculum; Experiential learning/Civic engagement; Scholarship of Teaching and Learning (SoTL); and Resources for securing grants.

A defining feature of the Summer Institute was its emphasis on action and accountability. At the conclusion of the institute, each faculty fellow was tasked with designing and implementing a classroom-based project, which integrated the high-impact pedagogical practices discussed during the institute. These faculty-led initiatives, spanning curriculum redesign, inclusive pedagogical strategies, expanded mentorship models, and targeted student support, were intentionally developed to address persistent gaps in STEM education and reimagine the teaching and learning environment. By embedding these innovations into their instructional practices, faculty not only initiated meaningful, immediate change but also collected data to assess effectiveness and inform ongoing refinement.

Faculty participants were not only encouraged to design and implement their projects in the classrooms, but to consider the broader impacts and scalability of their work, with the aim of influencing institutional practices across the CUNY system and beyond. Collectively, these initiatives contribute to a growing cultural shift in STEM education. These efforts highlight the transformative potential of faculty-driven innovation and underscore the importance of professional development in creating learning environments that are inclusive, accessible, and empowering for all students.

A survey administered at the end of the Summer Institute indicated that participants found value in the discussions on designing classroom activities that are inclusive, engaging, and grounded in JEDI (Justice, Equity, Diversity, and Inclusion) principles. They reported the sessions as meaningful and relevant to their teaching and professional development. Several participants shared that learning about opportunities within the Scholarship of Teaching and Learning (SoTL) offered a

new perspective on how to design, document, and collect data to support SoTL work in their classrooms. Participants also expressed strong interest in connecting and collaborating to create more opportunities for future joint work. Overall, they reported that the Summer Institute had a positive impact on their professional growth.

We are delighted to present this Special Issue of the Mathematics Teaching-Research Journal (MTRJ) dedicated to highlighting faculty-led projects across CUNY that have the potential to advance STEM pedagogies and contribute to inclusive STEM teaching and learning. An idea that emerged from the CITA Summer 2023 Institute, this collection showcases the creativity, innovation, and diverse perspectives of educators committed to reimagining pedagogy and fostering equity in STEM education. As guest editors, we are honored to uplift and share the impactful work emerging from CUNY's vibrant academic community.

This special journal issue goes beyond theoretical insights, showcasing practical classroom activities, curriculum redesigns, and pedagogical strategies that reflect the principles of the Scholarship of Teaching and Learning (SoTL) (Felton, 2013). From integrating computing and digital tools to fostering critical dialogue around equity and inclusion, each article offers practical models for making STEM instruction more accessible, relevant, and responsive to the needs of today's diverse student population.

As we continue to navigate and dismantle barriers to access and participation in STEM, this issue contributes to the ongoing dialogue about what meaningful, inclusive, and high-impact education can look like. It is both a celebration of faculty innovation and a call to action—reminding us that sustained professional development, institutional investment, and collaborative learning are key to creating a more just and empowering future for all students in STEM.

We invite you to explore the work presented here, apply the ideas in your own practice, and join us in this collective effort to reimagine and reshape the STEM education landscape.

This special issue opens with three artworks by Urmi Duttagupta, titled “*In Love with Mathematics*,” “*Woman Balancing Math and Work; She Also Has the Most Colorful Mind*,” and “*Geometric Turkey*” which express her deep passion for the discipline. As a mathematician who is a woman, Duttagupta uses artistic expression to explore the meaning of life and the precariousness of balancing different passions and obligations. Her pieces feature intricate patterns that evoke both mathematical elegance and feminine strength, celebrating the presence, resilience, and contributions of women in mathematics.

The article, *Introducing Art into Undergraduate Mathematics Courses at Minority Serving Institutions*, written by Renee Bell, explores the integration of art into mathematics instruction aiming at deepening student engagement and understanding. Through two thoughtfully designed models, a guided museum tour emphasizing mathematical themes across diverse artistic traditions and a student-led art contest centered on mathematical concepts, Bell invites students to see mathematics not only as a technical discipline but as a deeply creative and humanistic pursuit. Bells' instructional approach invites appreciation for the symmetry, structure, and aesthetics that underline both art and mathematics, revealing their shared capacity to illuminate patterns, provoke curiosity, and

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express beauty. By integrating these experiences into the curriculum, she creates inclusive spaces where students can engage meaningfully with mathematics in ways that affirm their identities and broaden their perspectives.

In *Integrating Game Play into an Inclusive Computing Project in Calculus Class: Designing and Analyzing Priority Switches for Competing Devices and Apps*, Malgorzata Marciniak and Yun Ye connect calculus concepts to real-world computing applications through a structured, hands-on project. Centered on the design and analysis of priority switches for embedded devices such as smartwatches and tablets, the project introduces students to game-based learning that models competition for digital resources. Within this framework, students apply their understanding of derivatives in a practical context while also engaging with elements of computational thinking. Designed to be accessible and inclusive, the project incorporates icebreakers, pre- and post-assessments, and collaborative lab work to support student learning and foster interest in STEM fields.

Dmitry Brogun and Emral Devany's article *Metacognitive Discourse Forums as a Way to Engage Biology and STEM Students in Meaningful Discussions*, explore the potential of interactive digital forums to enhance students through reflection and dialogue. By incorporating Metacognitive Discourse Forums (MDFs) and social annotations into STEM assignments, the authors created structured opportunities for students to reflect on their own learning processes and engage in interactive learning with peers. Such forums may support students across various instructional modalities while fostering essential skills such as metacognition, analytical reasoning, and collaborative problem-solving. Brogun and Devany's work demonstrates how intentionally designed digital spaces might promote inclusive learning environments and support deeper engagement and learning.

In *Professional Development Workshops for Faculty on Addressing Implicit Bias in Computer Science Education*, Sandie Han, et al., confront one of the most pressing challenges in Computer Science education today: the persistent gender gap and the subtle, often unrecognized forces that perpetuate it. Through a series of "Understanding Implicit Bias" workshops, the authors engaged faculty in critical self-reflection and meaningful discussions focused on improving classroom practices and fostering equitable and inclusive learning environments. The positive shift in faculty attitudes and increased openness to change, as shown in pre- and post-survey data, underscores the transformative potential of professional development as a driver of systemic change.

In the next article, *Designing Equity-Focused Pedagogy in Mathematics Teacher Preparation with Digital Data Tools*, authors Nadia Kennedy, Boyan Kostadinov, and Sandie Han present a design-based study featuring a course module design, its piloting, and reflection on both the outcomes and the process. The course module which involves data analysis and critical inquiry, invites mathematics teacher candidates to explore pressing social justice issues—such as school segregation, the achievement gap, and educational inequity—by engaging with real datasets from Brooklyn schools. By linking computational thinking with local, lived realities the course module helped teacher candidates see mathematics as a tool for social analysis and civic engagement. This article illustrates how critical dialogue supported by digital tools can help future teachers cultivate the analytical and reflective skills needed for equitable and culturally responsive teaching.

Finally, the article *Using Digital Tools and Real-Life Interactive Activities to Teach Trigonometric Functions* by Lucie Mingla presents a dynamic, student-centered approach to teaching mathematics through technology-enhanced activities designed in Desmos—an open-source online graphing tool. Research conducted over two semesters indicated that incorporating Desmos activities enhanced student performance, particularly in understanding trigonometric functions. The data suggested that early integration of Desmos activities contributed to deeper student engagement with mathematical concepts, and improved overall course outcomes. Mingla’s article highlights the importance of integrating technology into mathematics instruction to design meaningful, student-centered activities that promote sense-making and foster equitable, engaging learning experiences.

Collectively, the contributions in this issue showcase high-impact educational practices that prioritize student engagement, real-world relevance, and interdisciplinary collaboration. Whether through data analysis, interactive technologies, artistic integration, or faculty development, each article highlights innovative approaches that reimagine STEM education in both rigorous and accessible ways. These approaches not only promise to enhance student learning but also to promote a sense of belonging, agency, and purpose, particularly for those historically underrepresented in STEM. By embracing innovation and accessibility as core values, the articles in this special issue reflect a shared vision for a more inclusive and equitable teaching and learning across all STEM disciplines.

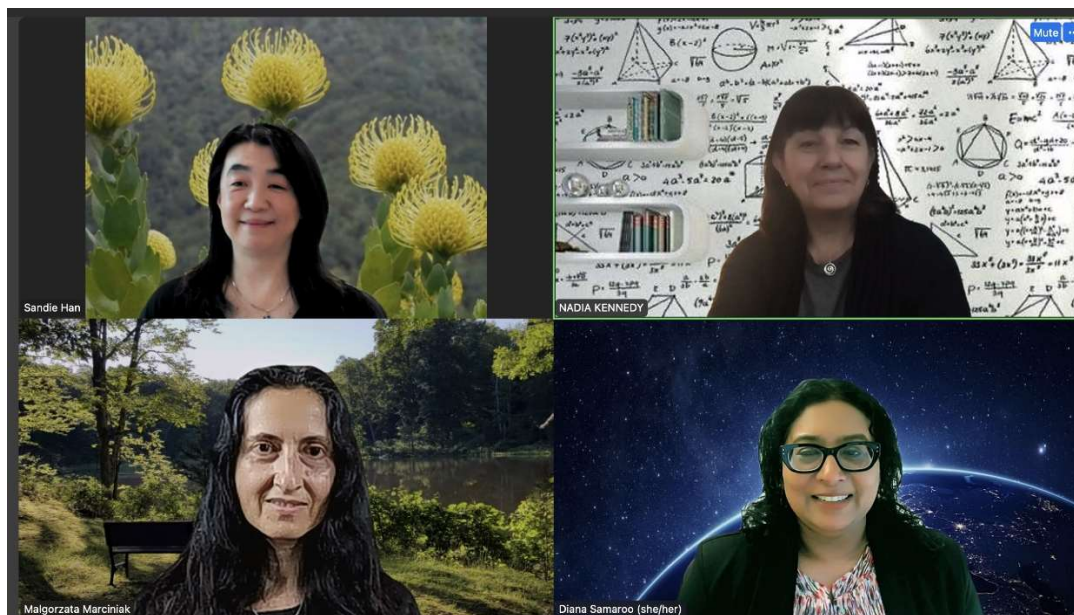
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About the Special Issue Editors

I am deeply grateful and honored to have been invited to work on this special issue alongside such an inspiring group of women co-editors. It has been a true privilege to contribute to and help bring to life the vision of this remarkable team. – *Sandie Han*



Top left to right: Sandie Han, Nadia Kennedy
Bottom left to right: Małgorzata Marciniak, Diana Samaroo

Dr. Sandie Han is the Dean of the School of Science & Allied Health at Medgar Evers College. Dr. Han's illustrious career includes being a Professor of Mathematics for over 30 years. Throughout her distinguished career, Dr. Han has led numerous initiatives, including the CUNY New Lecturer Initiative, a comprehensive onboarding and professional development program for 250 new CUNY lecturers. She has served as Chair of the Department of Mathematics at City Tech, playing a pivotal role in curriculum restructuring, faculty mentorship, and departmental modernization. In addition, she was the PI on a US DOE MSEIP grant and co-PI on NSF S-STEM. She authored more than 30 articles and workbooks including 22 peer-reviewed publications in number theory and mathematics education. Her work on Self-Regulated Learning and mathematics self-efficacy won the 2013 CUNY Chancellor's Award for Excellence in Undergraduate Mathematics Instructions. An ardent advocate for faculty and students, she is committed to fostering a culture of diversity, equity, and inclusion and is one of the co-founders of the CUNY AAMPOWER which

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stands for Asian American Mentorship Providing Opportunities to Women for Empowerment and Resilience.

Nadia Stoyanova Kennedy is Professor in the Department of Mathematics and Program Director of Mathematics Education at the New York City College of Technology of the City University of New York (CUNY). Between completing her master's and doctoral degrees, she spent 15 years as a full-time high school mathematics teacher and a curriculum developer. She serves regularly as a consultant for the International Baccalaureate (IB) program on curriculum, assessment and examiner training. Her research interests center on philosophy of mathematics education, dialogic teaching, teacher professional identity, and teacher professional learning, with a particular emphasis on critical approaches to mathematics education and on the promotion of philosophical dialogue in the mathematics classroom. In addition to authoring numerous articles, and textbooks, she is editor of the anthology, *Dialogical Inquiry in Mathematics Teaching and Learning: A Philosophical Approach* (2022).

Małgorzata Marciniak is an Associate Professor in the department of Mathematics, Engineering and Computer Science at LaGuardia Community College of CUNY. She is an author of multiple publications in pure and applied mathematics, and in mathematics education. She serves as the Managing Editor of the *Mathematics Teaching-Research Journal*, an international journal of mathematics education; as an Acting Editor in Chief of the [Asian American Voices](#), and an Editor for the scientific newsletter, [Ad Astra](#). In 2024 she co-edited a book [Ongoing Advancements in Philosophy of Mathematics Education](#) and in 2025 she published a book [Creativity in STEM Fields: a View from and Eclectic Mind](#) about creative projects in collegial mathematics classes. Dr. Marciniak is interested in theories of creativity and in seeing mathematics “everywhere.”

Dr. Diana Samaroo is a Professor of Chemistry at New York City College of Technology (City Tech), CUNY. Her profile highlights a strong blend of administrative and research expertise, and a deep commitment to faculty development, student success and diversity. Dr. Samaroo has held several administrative positions at the college: Chairperson of the Chemistry Department; Director of the Dr. Janet Liou-Mark RISE Program, administering a program funded by the Robin Hood Foundation that serves first year students, and Associate Director of Undergraduate Research. She is a 2024-2025 University Faculty Leadership Fellow in the CUNY Office of Faculty Affairs. Dr. Samaroo serves/d as co-principal investigator on several National Science Foundation (NSF) grants. In 2025, she co-organized the CUNY wide Teaching and Learning Conference and in 2023, the inaugural NSF HSI CUNY-Wide Conference, and previously the SENCER Mid-Atlantic Regional Conference and the 13th Annual Black Male Initiative Conference. In 2024, as a co-principal investigator, she received a three-year award from the National Endowment for the Humanities for a project on “Enriching the Humanities Curriculum to Embrace Cultural Relevance,” which focuses on curriculum development, faculty professional development workshops, and partnerships with Hispanic Studies departments across CUNY. As a biochemist, Dr. Samaroo’s

productivity as a researcher earned her City Tech’s “Scholar on Campus” award for 2022-2023. Her dedication to advancing students, faculty, and the institution’s mission is a common thread woven through all her work.