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A Call for Queer Inclusivity in 21st Century Global STEM Curricula

Written by:

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Abstract

As the first quarter of the 21st century comes to a close, academic institutions worldwide continue to operate within traditional, exclusionary frameworks, particularly in STEM (Science, Technology, Engineering, and Mathematics) education. Despite growing emphasis on diversity and inclusion, most STEM curricula remain insufficiently responsive to the needs and perspectives of LGBTQ+ individuals. This is further exacerbated in countries like the USA, where diversity, equality/equity and inclusion programmes in education and research are facing serious threats. We call for a global transformation of STEM education, urging institutions to embrace queer inclusivity as an integral part of their systems and curricula.

Queer-inclusive education is not just about increasing representation but about fundamentally rethinking how STEM subjects are taught, framing scientific inquiry and technological development through a lens that values fluidity, diversity, and interdisciplinary approaches. By incorporating queer perspectives, institutions can foster more innovative, ethical, and socially responsible STEM education, better equipped to address the complex challenges of the 21st century. This requires structural and pedagogical reforms that prioritize critical engagement of queer voices, redefining success in STEM, and challenging traditional binaries that limit creativity and innovation. Through these reforms, global academic institutions can create more equitable learning environments, producing a generation of STEM professionals who are not only technically proficient but also deeply committed to social justice and diversity.

Keywords: Queer theory, equity, curriculum reform, education, STEM

Introduction

As we approach the midpoint of the 21st century, global education systems are grappling with the pressing need to address issues of equity, representation, and inclusivity. Within the realm of STEM education, the traditional paradigms remain largely untouched by the social and cultural revolutions that have transformed other fields of knowledge. We argue that queer inclusivity in STEM curricula is not only a moral imperative but also a transformative approach to fostering innovation, diversity, and ethical responsibility. By integrating queer perspectives into STEM education, academic institutions can pave the way for more holistic and socially-attuned scientific and technological advancements.

STEM education today continues to be dominated by a rigid, linear framework that prioritizes objectivity, neutrality, and hard facts. While these characteristics are essential to scientific rigor, they often perpetuate exclusionary practices by failing to acknowledge the social and cultural contexts in which science and technology operate. LGBTQ+ individuals frequently encounter barriers in STEM fields, ranging from hostile learning environments to the erasure of queer contributions in curricula. This marginalization not only deters talent but also limits the breadth and depth of perspectives that can enrich STEM disciplines.

Despite increasing awareness of diversity and inclusion in academia, efforts to integrate queer perspectives into STEM have been sporadic and insufficient. Most initiatives focus on representation—increasing the visibility of LGBTQ+ individuals in STEM—rather than embedding their experiences and insights into the core of scientific inquiry and pedagogy. This limited approach undermines the transformative potential of queer inclusivity, which goes beyond representation to challenge and redefine the foundational assumptions of STEM education. As a collective of scholars and practitioners from diverse disciplines, career stages, and personal backgrounds, we bring our own experiences to this manifesto. Some examples we present emerge directly from our lived realities within STEM, offering concrete illustrations of the stakes and possibilities of queer-informed approaches.

Queer inclusivity in STEM is about more than fairness or representation; it is a paradigm shift that emphasizes the value of diversity in fostering creativity and innovation. Queer perspectives challenge binary thinking, a dominant feature of traditional STEM disciplines, and offer alternative frameworks that embrace complexity, fluidity, and interdisciplinary approaches. For example, queer theory's emphasis on dismantling binaries can inspire new ways of thinking about biological sex, gender, and identity in medical and life sciences, leading to more nuanced and inclusive healthcare solutions.

Furthermore, queer inclusivity promotes ethical responsibility by encouraging scientists and engineers to consider the social implications of their work. By integrating LGBTQ+ experiences and perspectives into STEM education, institutions can produce professionals who are not only technically proficient but also attuned to the societal impact of their innovations. This holistic approach aligns with the growing demand for ethical considerations in fields such as artificial intelligence, biotechnology, and environmental science.

Why Queer?

We draw inspiration from Queer Theory to call for a need to question and challenge existing (social) structures that underpin STEM education. Queer Theory grew in prominence alongside rising activism in the 1990s at the peak of the AIDS crisis. Riding the wave of postmodern and post-structuralist scholarship, Queer scholarship seeks to challenge heteronormative assumptions that govern societal (and patriarchal) structures and marginalise minority voices in the lesbian and gay communities (nowadays expanded to include LGBTIQA+). In *Gender Trouble*, Judith Butler questioned the binary categories of male and female by arguing that such clear distinctions are deeply entrenched in political representations and language, and that socially-normative practices serve to reproduce such distinctions. Butler rejects essentialist ideas of gender and instead argues that gender is performative, thus introducing the idea that our (bodily) behaviour shapes our gender. Thus, Queer scholars question the clear boundaries in gender categories and instead focus on how gender is enacted and played out. In so doing, Queer scholars seek to broaden engagement and inclusion of diverse voices beyond mere identity politics.

In engineering education, the dominance of positivistic methods and pursuance of an apolitical position in the name of scientific independence and meritocracy has its roots in nationalist and racist ideologies (Kellam and Jennings, 2021). Therefore, Queer scholarship seeks to engage with the diversity of colours, voices and abilities to dismantle the very societal structures that lock us in such ways of thinking and acting. The dominance of the existing world order is also, arguably, resulting in lock-ins that are creating the economic, ecological and social crises of our times. Attempts to scale up transitions into more sustainable ways of living are also threatened, in part because of the stubbornness of existing political, economic and social structures. Queer scholarship thus provides an opportunity to challenge these structures.

In *Bodies That Matter*, Judith Butler emphasises the materiality of our bodies in our performative acts. By implication, taking the materiality

of our bodies seriously also means that we move beyond talking the talk to walking the walk. Here, the embodiment of knowledge is a critical point. Engineering knowledge is not only about the analytical, but also understanding what this means and how the analytical translates into performative actions in practice.

Globally, there is a shortage of qualified engineers. This is where diversity and inclusion matters. By engaging with the queer movement, we also seek to empower those who do not fit in within the heteronormative discourse of society.

How are we proposing to do that?

- Queer scholarship as a means to question existing structures of professional knowledge and engineering curriculum.
- Queer methodologies as a means to embrace active listening to diverse voices.
- Queer approaches as a means to enable more political action, particularly in the context of societal and sustainability transitions.
- Curricular reform to integrate LGBTQ+ histories, contributions, and perspectives within STEM disciplines.
- Inclusive pedagogy that moves beyond representation to actively challenge heteronormative assumptions.
- Queering as a method to reimagine the future of work and build resilience in the future labor market and personal well-being.

Case Studies and Success Stories

Following are two of our personal contributions in the realm of queering STEM curriculum.

Impact of Rainbow Roads in Road Engineering Courses

One of the more tangible examples of queer inclusivity in STEM education is the integration of LGBTQ+ representation into traditionally rigid engineering disciplines. A case in point is the inclusion of “rainbow roads” in road engineering courses, both as a symbol of visibility and as a way to challenge conventional infrastructure design. Rainbow-colored crosswalks and road markings, increasingly adopted in cities worldwide, serve not only as public affirmations of LGBTQ+ presence but also as opportunities for engineering students to engage in conversations about inclusivity, urban design, and community engagement (Bain & Podmore.

2023, Savela. 2024).

From a technical standpoint, incorporating discussions about rainbow roads into civil engineering curricula allows students to analyze the structural, material, and safety considerations involved in such projects. Questions around visibility, road friction, weather resistance, and accessibility intersect with broader discussions about who public spaces are designed for and how infrastructure can reflect diverse identities. By embedding these conversations within engineering education, institutions can challenge the traditional perception of infrastructure as neutral and instead encourage students to think critically about how engineering choices impact marginalized communities.

Moreover, this approach disrupts the assumption that STEM disciplines must remain asocial. It demonstrates how engineering can be used as a tool for social change and how embracing inclusivity leads to innovative, community-centered design solutions. The case of rainbow roads underscores the importance of embedding queer perspectives into STEM curricula—not as peripheral discussions but as integral components of engineering education that shape the future of inclusive urban development.

Trans and Nonbinary Inclusion in AI Data Training

Artificial intelligence (AI) is transforming industries at an unprecedented pace, yet its development remains deeply entangled with biases that disproportionately affect marginalized communities, including trans and nonbinary individuals. Most AI systems are trained on datasets that reflect existing societal norms and biases, often reinforcing rigid gender binaries and excluding nontraditional gender identities. This results in real-world consequences, such as misgendering in facial recognition software, exclusionary identity verification systems, and healthcare AI models that fail to account for gender-diverse experiences.

Queer-inclusive STEM education must address this issue by ensuring that AI curricula incorporate trans and nonbinary perspectives at every stage of development (Fosch-Villaronga & Malgieri. 2024). This means teaching students to critically assess the datasets they use, recognize and mitigate bias in algorithmic decision-making, and design AI systems that are inclusive of all gender identities. One way to achieve this is by integrating case studies that examine the failures of current AI models—such as misgendering in voice recognition software or the lack of nonbinary gender options in digital identity systems—and challenging students to develop more equitable solutions.

Additionally, the inclusion of queer perspectives in AI training goes

beyond technical fixes; it requires a fundamental rethinking of how gender is encoded in data systems. Queer methodologies encourage an interrogation of binary classification systems — not only around gender and sexuality, but across broader categories such as healthy/sick, able/disabled, natural/artificial, mind/body, human/machine, and social/technical — and push for alternative approaches that embrace fluidity, complexity, and self-identification. By embedding these principles into AI and data science education, institutions can cultivate a new generation of technologists who approach machine learning and AI development with ethical responsibility, ensuring that emerging technologies do not perpetuate existing inequalities.

This case study highlights the broader need for STEM education to actively challenge exclusionary frameworks. By incorporating trans and nonbinary perspectives into AI training, we not only improve the accuracy and fairness of AI models but also advance a more inclusive and just technological future.

Queer thinking doesn't just challenge how we learn—it also helps us think differently about how we work. Today's students are stepping into labor markets that are unpredictably evolving, where clear paths and fixed roles are no longer guaranteed. Queer approaches make space for flexibility, uncertainty, and resilience— emotional and professional competencies that are becoming more crucial. By queering STEM, we're not just adding new voices, we're opening ways of thinking that can help the future engineers accept, appreciate, and actively tackle the complex societal challenges, not just try to solve them.

Conclusion

Queer-inclusive STEM education has far-reaching implications beyond academia. By fostering a culture of inclusivity and diversity, institutions can prepare students to navigate and address the complex challenges of the 21st century. These challenges, including climate change, global health crises, and technological ethics, require interdisciplinary and socially attuned approaches that queer perspectives are uniquely positioned to provide.

Moreover, queer inclusivity in STEM can inspire a new generation of scientists, engineers, and innovators who are committed to social justice and equity. By redefining success in STEM to include ethical responsibility and societal impact, academic institutions can contribute to a more equitable and sustainable future.

Queer inclusivity in STEM is not merely an additive process but a necessary transformation. By embedding queer perspectives into STEM

curricula, we move beyond tokenistic representation toward a radical reimagining of scientific inquiry, education, and practice. We call on global academic institutions to embrace this paradigm shift, ensuring that queer inclusivity, ethics, and social justice are inseparable from STEM excellence.

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Authors' Biographies

Ajayshankar Jagadeesh is a Lecturer of Environmental and Civil Engineering at Delft University of Technology. He earned his PhD from the National University of Singapore and has worked extensively on infrastructure, airport engineering, and environmental impact projects. Passionate about transformative education, he integrates experiential learning, gamification, and interdisciplinary approaches in his teaching. A recognized advocate for diversity, equity, and inclusion, he collaborates on policy initiatives and speaks globally on DEIB matters, including delivering a TEDx talk on queer leadership. Ajay is globally recognized by Involve and Youtube for inclusive leadership, ranked 29th in the Top 100 Empower Future Leaders & Role Model List (2025) and 24th in the Top 100 Outstanding Future Leaders & Role Model List (2024).

Paul Chan is Professor of Design and Construction Management at Delft University of Technology. He has developed a track record of studying how people cope with organisational, social and technological change in addressing societal and sustainability transitions. He is currently leading research projects on transdisciplinary collaboration in sustainable urban environments. He was Editor-in-Chief of Construction Management and Economics, and Past Chair of the Association of Researchers in Construction Management. He has also written on masculinities and sexualities in the construction industry, and is co-author of *Constructing Futures* (2010), a Wiley-Blackwell book on leadership and futures thinking in the construction industry.

Wenyi Chu is a PhD candidate at Delft University of Technology, researching future engineering skills, with particular attention to transdisciplinary collaboration and emotional competencies. With a background in GIS engineering and educational sciences, Wenyi draws on both industry and academic experience. Prior to starting the PhD, they worked in the semiconductor sector. Their research is shaped by an interest in how technical education can better prepare students for complex social and professional environments. Wenyi is also engaged in conversations around inclusion and is interested in how different ways of thinking and being can contribute to more “heart-engaged” engineering practices.

Comments by authors

on the process of writing this manifesto:

Writing this manifesto was both a challenging and energizing experience. We wrote it collectively, and that was essential, not just logistically, but philosophically. Our collaboration was rooted in the very values the manifesto advocates: plurality, queerness as method, and an attentiveness to embodied knowledge and positionality.

Our group came together across disciplines, identities, and institutional roles, which led to moments of discovery, and resonance. The writing process involved a nonlinear dialogue, as we tried to remain true to the critical and constructive voice we were aiming for. There was no single “authorial” perspective; instead, we aimed to write with a collective voice that could hold contradiction and difference, rather than flatten it. That made the process meaningful, and also deeply social.

on the received comments:

We are deeply appreciative of the comments we received, both in their generosity and in their challenge. They helped us see the manifesto not only as an argument but as a relational act: a way of connecting, provoking, and inviting dialogue.

We were particularly moved by the first commentator’s reminder that inclusion should be valued not just for its effects (e.g., creativity, innovation) but for its intrinsic ethical weight. This reflection pushed us to reconsider how we framed certain arguments and prompted a deeper questioning of our own internalized emphasis on impact and productivity, a reminder of the very systems we hope to reimagine.

The second commentator encouraged us to become more visible in the text, to speak not just about experience, but from it. Their suggestion to make the text more declarative and personal resonated strongly with our own ambitions but revealed where we had hesitated. It affirmed the importance of making ourselves present, not only in argument but in voice.

Both sets of comments ultimately reminded us that the manifesto is not just a product but part of an ongoing process of becoming collectively and institutionally.

What this manifesto drove home to me is not just the clear moral imperative of queer inclusivity as a basic matter of inclusivity and human decency, but also the rich analytical frameworks, approaches, and perspectives that Queer Theory has to offer the STEM disciplines – approaches that are sorely needed in the broader struggle to reshape science, technology, engineering, and math into forces for justice and social progress.

Comments by
Bob van Vliet