



OPEN ACCESS

EDITED BY

Xiang Hu,
Renmin University of China, China

REVIEWED BY

Wenjun Zhao,
Sichuan Normal University, China
Kaity Prieto,
University of Southern Mississippi, United States

*CORRESPONDENCE

Meg C. Jones
✉ megan_jones4@uri.edu;
✉ mjones@champlain.edu

RECEIVED 30 January 2023

ACCEPTED 02 May 2023

PUBLISHED 17 May 2023

CITATION

Jones MC, Forsythe D, Friedensen R, Vaccaro A,
Miller RA, Kimball E and Forester R (2023)
Disrupting cisheteronormativity in STEM
through humanism.
Front. Educ. 8:1154275.
doi: 10.3389/feduc.2023.1154275

COPYRIGHT

© 2023 Jones, Forsythe, Friedensen, Vaccaro,
Miller, Kimball and Forester. This is an open-
access article distributed under the terms of
the [Creative Commons Attribution License
\(CC BY\)](https://creativecommons.org/licenses/by/4.0/). The use, distribution or reproduction
in other forums is permitted, provided the
original author(s) and the copyright owner(s)
are credited and that the original publication in
this journal is cited, in accordance with
accepted academic practice. No use,
distribution or reproduction is permitted which
does not comply with these terms.

Disrupting cisheteronormativity in STEM through humanism

Meg C. Jones^{1*}, Desiree Forsythe², Rachel Friedensen³,
Annemarie Vaccaro¹, Ryan A. Miller⁴, Ezekiel Kimball⁵ and
Rachael Forester⁶

¹Education and Professional Studies, University of Rhode Island, Kingston, RI, United States, ²Biological Sciences, Chapman University, Orange, CA, United States, ³Educational Leadership & Higher Education, St. Cloud State University, St. Cloud, MN, United States, ⁴Higher Education, University of North Carolina at Charlotte, Charlotte, NC, United States, ⁵Education and Human Development, University of Maine, Orono, ME, United States, ⁶Women's and Gender Studies and Educational Leadership in Higher Education, Nonprofit HR, Washington DC, WA, United States

Cisheteronormativity is prevalent throughout college STEM discourses and classrooms. In this paper, we present findings from a U.S. based study focused on the experiences of collegiate STEM students with minoritized identities of sexuality and gender (MIOsG) as the backdrop for discussing how current harmful ideologies in STEM perpetuate cisheteronormativity through discursive practice. We propose that humanistic classrooms and pedagogy can work to dismantle cisheteronormative D/discourses in STEM and create MIOsG inclusive STEM classrooms and programs. Our findings highlight the ways participants experienced cisheteronormative D/discourses in their collegiate STEM contexts. We discuss how these experiences might be mitigated through humanistic educational approaches in college STEM contexts. Our aim is for readers to gain simultaneous theoretical and pragmatic insights on how cisheteronormative D/discourses operate in collegiate STEM classrooms and educational programs.

KEYWORDS

STEM education, LGBTQIA+, critical discourse analysis, grounded theory, MIOsG

Introduction

Language and practice work reciprocally to create shared reality through beliefs, views, and values (Gee, 2010; Fairclough, 2013b). The combination of language and practice creates D/discourses which re/produce the accepted norms of a community, space, or group of people (Gee, 2010). The D/discourse found in collegiate science, technology, engineering, and mathematics (STEM) contexts often re/produces cisheteronormativity (Kersey and Voigt, 2021; Miller et al., 2021) and creates a hostile environment for students with minoritized identities of sexuality and/or gender (MIOsG; Vaccaro et al., 2015). D/discourses of heteronormativity situate heterosexuality as a normalized or default sexuality and privileges heterosexual couplings, while D/discourses of cisnormativity position being cisgender as the default and assumed gender identity and privileges being cisgender in society (Schilt and Westbrook, 2009). These hostile cisheteronormative environments results in STEM students with MIOsG feeling unsafe and at a higher risk for dropping out (Cech and Waidzunas, 2011; Trenshaw et al., 2013; Hughes, 2017; Forbes, 2020; Mattheis et al., 2020). An examination of how cisheteronormative D/discourses show up in collegiate STEM contexts is needed to address the ways in which these D/discourses affect students with MIOsG and impact their ability to inhabit these spaces authentically (Vaccaro et al., 2021). This work is vital because all members of a D/discourse community are

affected by the D/discourses within that community and contribute to D/discourse re/production and/or interruption (Gee, 2010; White and Lowenthal, 2010).

While the body of literature examining experiences of students with MIO SG in STEM fields is growing, there is still a paucity of research that critically examines the complex ways cisheteronormativity shows up in collegiate STEM contexts. This paper presents experiences of participants in ways that honor the interwoven contexts in which these phenomena take place through overlapping and sometimes counterintuitive retellings, always pointing towards the systemic nature of cisheteronormativity in collegiate STEM spaces. We hope readers will sit with the complexity of addressing nuanced examples of cisheteronormativity and build from our recommendations to create more humanistic classrooms and programs in STEM.

Discourse

In this paper, we use Gee's (2010) concepts of D/discourse and critical discourse analysis to highlight how cisheteronormative STEM D/discourses affect collegiate STEM students with MIO SG. We represent the reciprocal and mutually constitutive nature of "little d" discourse and "big D" Discourse by using D/discourse throughout to signify the inseparability of these social practices. Gee (2010) defines "Big D" discourses as "ways of combining and integrating language, actions, interactions, ways of thinking, believing, valuing, and using various symbols, tools, and objects to enact a particular sort of socially recognizable identity" (p. 29), and "little d" discourse is how everyday language is used in ways which create and reinforce "Big D" discourses. We also frame our work here as a form of critical discourse analysis "since all language is political and all language is part of the way we build and sustain our world, cultures, and institutions" (Gee, 2010, p. 10). Discourse analysis is often used to "demonstrate the impact of power, oppression, and privilege in educational spaces, practices, and policies" (Hakkola, 2021, p. 15).

D/discourses are actions which re/produce structures (Fairclough, 1985). STEM programs serve as structures which maintain or modify D/discourse, and are co-constitutive with the social D/discourses of power (Foucault, 1971) found within STEM. As Gee (2003) points out, "Discourses recruit specific social languages (ways with words) and cultural models (taken-for-granted stories), which in turn encourage people to construct certain sorts of situated meanings -- that is, encourage them to read context in given ways" (p. 41). Cisheteronormativity is an example of a D/discourse of power. It's important to note that while D/discourses of cisheteronormativity and heteronormativity intersect and are often experienced together as cisheteronormativity, they represent two distinct aspects of identity and experience. In our writing, we both use the term cisheteronormativity and also work to purposefully separate heteronormativity and cisheteronormativity when appropriate to identify these two distinct examples of D/discourses of power and to avoid contributing to the conflation of sexuality and gender.

D/discourses are dynamic productions of communities with shared beliefs, values, and practices (Gee, 2010). D/discourses "have no discrete boundaries because people are always, in history, creating new Discourses, changing old ones, and contesting and pushing the

boundaries of Discourses" (Gee, 2010, p. 37). Additionally, D/discourses of power serve as significant barriers in achieving representation and equity across all social and political contexts (White and Lowenthal, 2010). Cisheteronormative D/discourses are reinforced through repetition and normalization, oftentimes in ways which render these practices invisible to many who are complicit in their recreation (Foucault, 1971).

D/discourses of power and MIO SG STEM students

Research on students with MIO SG in STEM is still a growing area of scholarship. Recent researchers have shown disparities in experiences and outcomes for STEM students with MIO SG. Hughes (2018) found LGBTQ students are less likely to persist in STEM. Linley et al. (2018) found LGBTQ students had negative interactions with other students in their STEM courses, although they were also positive about their interactions with faculty members. The presence of cisheteropatriarchy, which privileges "the experiences and identities of cisgender, heterosexual men, the resultant social order affords social, cultural, political, and economic power" (Miller et al., 2021, p. 341), and the pressure to compartmentalize their STEM and sexual and/or gender identities makes MIO SG students feel isolated, unsafe, and like they do not belong (Cech and Waidzun, 2011; Trenshaw et al., 2013; Hughes, 2017; Mattheis et al., 2020). Cech and colleagues (2017) found LGBTQ students in engineering feel depressed and marginalized in their chosen fields of study. Students notice the lack of MIO SG representation in STEM and have to navigate these environments carefully in order to assess whether they can be out or not (Cech and Waidzun, 2011; Hughes, 2017; Mattheis et al., 2020) and what, if any, protections might be afforded to them by educational policy (Meyer and Quantz, 2021). Additionally, college STEM students with MIO SG who seek affirming spaces through STEM clubs or organizations must navigate the fore fronting and/or backgrounding of multiply marginalized identities as they seek belonging and community, as well as the presence or absence of such spaces, on their campuses (Forsythe et al., 2023).

The research briefly summarized above highlights how common exclusionary cisheteronormative STEM D/discourses are. D/discourses of power result in contexts where social goods are always at stake for minoritized students. Gee (2010) describes social goods as "the stuff of politics" (p. 7), where "who gets what in terms of money, status, power, and acceptance" (p. 7) is always at stake. College STEM students with MIO SG must navigate cisheteronormative D/discourses in order to receive the social goods of inclusion and affirmation in collegiate STEM contexts, as well as broadly across college campuses (Forsythe et al., 2023).

Methods

This paper draws from a larger constructivist grounded theory study (Charmaz, 2014) that explored: How do students with MIO SG majoring in science, technology, engineering, math (STEM) experience and navigate campus learning environments and their disciplines/fields? Through interviews, we asked participants about their experiences on campus as STEM students with MIO SG. Through

constant comparative analysis (CCA; Charmaz, 2014) we found profuse data which illuminates how cisheteronormative D/discourses in collegiate STEM contexts perpetuate power, privilege, and oppression of people with MIO SG. Similar to Johnson (2014), we infused critical discourse analysis (Gee, 2010) into the CCA process (Charmaz, 2014). Constant comparative analysis is the iterative analytic process of making comparisons between codes, emergent categories, and researcher reflections and memos. Critical discourse analysis involves examining language and D/discourses for evidence of power, oppression, and privilege. In the CCA process for this paper, we engaged with this specific focus on how language and discourse created and/or reinforced the normalization of cisheteronormativity within the data. We also draw from previous grounded theory research designs which use specific methods of analysis to further interrogate initial findings (e.g., Pullen Sansfaçon et al., 2015; Forbes, 2020). These initial findings and overarching grounded theory model from the larger study can be found elsewhere (Vaccaro et al., 2021).

Setting and sample

Participants consisted of students enrolled at three public and one private university in the United States. Aligned with grounded theory, we used purposive sampling (Charmaz, 2014) to identify a diverse pool of students with MIO SG. Eligibility criteria included: “Any student majoring in a STEM field whose gender and/or sexual identity is minoritized within American society. Having a minoritized gender and/or sexual identity means at least one of the following two statements accurately describes you: (1) you do not identify as a cisgender woman or man or (2) you do not identify as heterosexual.” We accepted all students who met these criteria to participate in the study.

The final sample of 56 participants included five graduate students and 51 undergraduates. Participants self-reported their gender identities as: man (24), woman (18), cisgender (14), transgender (7), genderqueer (6), non-binary (5), female (4), male (2), and agender (1). Participants listed their sexual identities as: gay (22), bisexual (18), pansexual (11), lesbian (7), asexual (4), queer (4), questioning (3), gray-asexual (2), dyke (1), gynophile (1), homoromantic (1), panromantic (1), straight (1), and woman-loving-woman (1). Due to overlapping self-reported descriptors, the numbers above do not total 56. The racial demographics of the predominantly white institutions where data were collected were reflected in our sample and included: 4 Latinx, 4 Black, 2 Asian American, 1 Arab/North African, 2 bi/multiracial, 2 Native American, 1 South Asian, and 45 white students. Participant majors/fields included engineering (29), computer science (9), biology (5), nutrition and dietetics (4), environmental science (2), marine science (2), neuroscience (2), kinesiology (1), mathematics (1), and natural resources (1). Pseudonyms are used throughout this paper to protect participant confidentiality.

Data analysis

In accordance with constructivist grounded theory (Charmaz, 2014), we employed a constant comparative analysis (CCA) process, first assigning initial codes to data then organizing data into manageable segments. Next, we selectively coded to synthesize initial

codes into larger meanings which are grounded in participant narratives. Finally, we used grounded theory focused codes to identify important segments of data which required further theorizing. At this stage, grounded theorists often use focused analyses to compare their works to pre-existing concepts and theories (Charmaz, 2014, p. 305). In alignment with this, we arrived at the findings in this paper by theorizing how cisheteronormative collegiate STEM D/discourses are experienced by participants with MIO SG. While we do not use a formal critical discourse analysis (CDA) framework (e.g., Fairclough, 2013b), we do align our work with a critical approach to power, privilege, and oppression as it shows up in the D/discourses of collegiate STEM contexts. This intermixing of critical discourse analysis with grounded theory methodology has been used by others (e.g., Johnson, 2014; Fairhurst and Putnam, 2019). Our findings explicate how D/discourses of power perpetuate cisheteronormativity in collegiate STEM contexts.

To ensure trustworthiness and credibility we used numerous qualitative research strategies including expert reviews, discrepant case analysis, member checking, and scholar reflexivity on identity and power (Jones et al., 2014). We invited experts to review our conclusions for trustworthiness and credibility. We also employed discrepant case analysis to ensure all voices were included and overarching theorizing about the data accurately described all of our diverse participants. Additionally, we used member checking with participants electronically and through focus groups where we shared emergent findings and invited feedback. Finally, we engaged in ongoing reflexivity about our social identities, positionality, power relationships, and pre-understandings to address relational competence (Jones et al., 2014). As noted by Jones et al. (2014), relational competence is a combination of “what researchers bring to the research process (social identities, researchers positionality, power relationships, researcher pre-understanding) [and] the relationship researchers have with participants” (p. 38). Five of the six authors of this paper self-identify as people with MIO SG. We assume those identities likely influenced the sizable response to our call for participants as well as the level of depth shared by students. During the interviews we noticed that students shared deeply personal narratives, often more so when the interviewer shared a similar gender and/or sexual identity. Moreover, students sometimes admitted in communications before and/or during the interview that they had never (or rarely) shared such personal stories with others on campus—but they felt comfortable given the LGBTQ identities and scholarship of our research team. For a more in depth discussion of the benefits, challenges, and nuances of being a queer (insider/outsider) researcher see our prior writing (Jones et al., 2023). In terms of our own positions of power, we made sure none of the interviewees had a direct power-laden campus relationship with students (e.g., professor, advisor, supervisor). We also utilized an ongoing process consent before, during, and after the interview (e.g., thank you emails, member checking) to mitigate any potential power differentials.

Data collection

Aligning with grounded theory methods (Charmaz, 2014), we used semi-structured, audio-recorded individual interviews (Rubin and Rubin, 2011). We began the interview protocol with questions about participants’ backgrounds. We also included questions about student

perceptions and experiences related to gender and sexuality in college generally, and STEM fields specifically. We asked questions such as: “I’d like to ask you to tell me a little bit more about what it’s like to be [Gender/Sexuality] on this campus and in your field” and “Can you tell me about a time in your major/field of study when you felt included or affirmed positively in your gender/sexuality?” At the end of each interview, we asked participants to provide any additional information they felt we should know about their experiences with MIOsG in STEM.

Findings

Participant responses revealed how cisheteronormative D/discourses show up through unspecified and collective actors, as reinforcement of the in/visibility of gender and sexuality in STEM, and through interpersonal communication and expectations. Participants also described their own responses to cisheteronormative D/discourses through practices of avoidance and/or focusing on their STEM identity. As with all things related to gender and sexuality, these findings push back against the norms of categorization, and we wrestled with how to represent the experiences of participants in a way that honors the interwoven contexts in which these phenomena take place. We believe the approach below is one of many ways to authentically represent how cisheteronormative D/discourses affect collegiate STEM students with MIOsG while simultaneously providing clear evidence of the systemic nature of cisheteronormativity in STEM.

Unspecific and collective actors

Many participants used language which positioned other social actors, or those who use and contribute to the creation and maintenance of discourses (Fairclough, 2013a), as unspecific and collective. In this section, we share examples of how participants gestured to broad groups of social actors as monolithic collectives who create and reinforce cisheteronormative STEM D/discourses. Jamie, a neuroscience major who is asexual, panromantic, transgender, genderqueer, and “genderfluid between androgynous, agender, and fuck-it-autism-is-my-gender” discusses their experience in collegiate STEM classrooms:

Sometimes when people are talking about perfect matchings in graph theory ... you have a bunch of dots on one side, a bunch of dots on the other.... Sometimes people like to talk about dots on one side being men and dots on the other side being women, and matching them up, and I’m like, “No!”

Jamie’s use of *people* indicates a collective D/discourse community in which others are perpetuating cisheteronormative D/discourses. Camila, a lesbian, dyke, queer, gay, woman, and female neuroscience major, demonstrates a similar experience as she describes her STEM courses:

Professors say, “Your mom and your dad.” ... Some people don’t have a mom and a dad, so that’s annoying.... That is very heterosexual. They didn’t really acknowledge that there’s other ways to reproduce, because I guess it doesn’t matter to them.

In this quote, Camila uses the term *professors* to indicate an unspecified and collective group in the cisheteronormative collegiate

STEM D/discourse community. This collective language indicates a recurring experience for Camila; we can assume this has not been a singular experience for her. Camila also describes one specific example of how cisheteronormative D/discourses show up in STEM classrooms:

I think the way that they talk about women and females all in the same way, that’s kind of annoying because they don’t distinguish [between them]. They talk about women as if this is a biological thing, and it’s not... When I see a study, I’m like, ‘Okay, how are you defining women? How are you defining a lesbian? How are you defining all of that?’

Here, Camila adds to the issue of cisheteronormative D/discourses by naming the practice of conflation between sex, sexuality, and gender. Camila’s use of *they* to indicate a broad body of people, including professors, peers, and other university employees, positions her in opposition to those who have the power to shape collegiate STEM D/discourses. Interpersonal communications and expectations

Cisheteronormative D/discourses also get re/created in collegiate STEM contexts through everyday experiences and language, such as expectations directly and indirectly communicated with students related to how they should appear and behave based on their assumed sexuality and/or gender. Ana, an engineering major who is a bisexual, gay, pansexual woman, describes this experience:

When I sit in the front of the classroom ... or let’s say in a networking event, it’s better to dress maybe more feminine. What we’ve been taught to believe is [women should dress] more feminine. You should probably dress like that. I just was never sure how to dress for ... career fairs, you just don’t know. Should I bring out my vest and my tie? Or should I bring out the dress and everything?

Here, Ana exhibits a dissonance between what she wants to wear and what she has learned through cisheteronormative discourse she should wear in professional collegiate STEM settings. Ana uses phrases which indicate expected norms such as *what we have been taught to believe* and *you should probably*. Ana uses language of dissonance in response to implied gender expression expectations and normative binary assumptions: *I just was never sure, you just do not know, and should I*. The repetition of these cisheteronormative STEM D/discourses and expectations of professionalism can lead to dysphoria for students with MIOsG.

Cisheteronormative STEM D/discourses also show up in how family structures are discussed. When asked about the presence of MIOsG in their STEM classes, Crystal, an engineering major who is a bisexual, pansexual woman, shared how familial structures are viewed and communicated through a cisheteronormative lens:

If it does come up, it’s definitely based more on a heterosexual kind of view. They’ll [curricular representations] have the ideal family. It’s always going to be a male and a female. There aren’t examples that are more driven towards the LGBTQ community.

Crystal is able to explicitly notice and name how STEM D/discourse is *based more on a heterosexual kind of view* and goes on to

note the lack of familial representations which include MIOsG. Cherrie, a natural resources PhD student and lesbian woman, shares a similar phenomenon when asked about occurrences of heterosexism in STEM classrooms:

It's subtle....I don't think anybody else notices the "coming out" [in my STEM classrooms] the way I do. When people say, "I got to go pick up my kid," or "My wife is getting out [early to pick up our child]", ... they're coming out. They're coming out as straight. But they don't see it that way, and they don't see that what they're doing is something that I couldn't necessarily do the same way.

The notion of coming out is historically relegated to those with MIOsG, however, as Cherrie points out, this is a result of cisheteronormative D/discourses which position heterosexuality and cisgender identity as the norm. When we queer these hegemonic ideas and acknowledge there is no normed identity of sexuality or gender then people in STEM spaces are regularly coming out as heterosexual and cisgender.

The perpetuation of cisheteronormative D/discourses in the interpersonal communications of STEM contexts affects how those with MIOsG think of identity and what is considered normal in relation to sexuality and gender. When asked about how sexuality shows up in his STEM courses, Titus, a straight male computer science major, states, "Everybody, I think, is straight....I mean, it's just normal, I guess." In this quote, Titus, who holds an identity within MIOsG himself, positions cisgender heterosexual identities as *normal*. This positioning further reinforces a cisheteronormative D/discourse and makes those with MIOsG unknowingly complicit in its re/production. Titus provides an example of how D/discourses of power can affect the perspectives of those who are marginalized through the use and reproduction of these D/discourses.

Participant responses

College STEM students with MIOsG are simultaneously expected to take up STEM D/discourses while being critical of these same D/discourses (Marshall and Case, 2010). Participants in our study often avoided bringing up issues related to MIOsG in response to cisheteronormative STEM D/discourses, perpetuating the apparent invisibility through these avoidant actions. Kennedy, an environmental studies major who is asexual, homoromantic, and genderqueer, states "It never really came up," in response to being asked if professors have been supportive of their MIOsG or if it had even been addressed. Channing, an engineering major and gay cisgender man, also discusses avoidance when he explains why he does not share his sexuality out of fear of making other students in his engineering department uncomfortable. He states, "I do not think they are very vocal about their opposition to my homosexuality. I think it would make them uncomfortable and I hate making people uncomfortable." Channing takes ownership of the heteronormative D/discourse in the STEM spaces he occupies by avoiding discussing his own identity in order to comply with discursive norms. This relates back to Gee's (2010) concept of social goods in discourse communities as discussed above. Channing is receiving a social good of acceptance

through ensuring the comfort of his peers, while simultaneously becoming complicit in the perpetuation of heteronormative D/discourses.

Seemingly invisible cisheteronormative D/discourses create cultural models of invisibility for those with MIOsG within collegiate STEM contexts. Skyler, an engineering major who is asexual, bisexual, pansexual, and transgender, shared multiple examples in her interview of how being a woman affects her experiences in STEM, but when asked specifically if sexuality or gender shows up in any of her STEM courses, Skyler directly stated, "Not really, no." This is evidence of how cisheteronormative D/discourses perpetuate cisheteronormativity to the point that heterosexual and cisgender identities become seemingly invisible, and thus normative, to all members of the D/discourse community, including those with MIOsG.

Not only do some participants overlook the presence of cisheteronormative representations in collegiate STEM D/discourses, they also demonstrate dissonance in their understanding of how sexuality and gender do show up in these D/discourses. Aspen, a computer science major who is grey-asexual and non-binary, shares, "They're just barely trying to do more things, to have more women in computer science. So they are definitely not doing anything with nonbinary students." Aspen's quote reveals gender does come up in collegiate STEM D/discourses, but in a way which allows space for cisgender women to receive explicit naming and representation yet still perpetuates a gender binary.

Students also alter their behavior to align with the norms communicated through language and culture as a result of cisheteronormative STEM D/discourses. Jack, a biology major and gay man, describes this response as he reflects on how he alters his actions and behavior in some professional situations to limit the potential for negative responses in STEM contexts as a result of heteronormative D/discourses:

I do alter my body language to be, I guess, more stiff. I don't use my hands for hand gestures as much....I make my voice a little bit deeper, and I try to get out of my southern accent a little bit more ... I hate that I do that. I hate that I change a little bit of how I act and things. But a lot of that just goes deep into just trying to avoid persecution as much as possible.

The term *persecution* demonstrates the severity of the emotional response experienced by Jack in the moments described. His reflection of *I hate that I do that* indicates a turn inwards in response to heteronormative D/discourses within his collegiate STEM contexts. Jack's language seemingly places the responsibility on himself instead of outside actors in response to these heteronormative D/discourses. Jack goes on to share:

I don't want them to focus on that [sexuality]. I want them to focus on the work that I've done and all of the hard research that I've put in it. I do not want them to focus on, "Oh, well his voice has like a weird little tinge in it." Or, "Oh, he's using his hand motions too much." I don't want to give anybody an excuse to look at me differently, because I know that that does happen all too often.

The heteronormative D/discourses Jack experiences in STEM contexts have altered his understanding of how he is perceived in these

spaces and has increased his awareness of being othered. Luna, a computer science major who is female-aligned/femme and lesbian/woman-loving-woman, sums up this reluctance to share MIOSG in STEM contexts when she says: “To be a lesbian in computer science is to never tell another soul that you are a lesbian.”

It is important to note not all participants communicated a desire to express their sexuality and gender identity in collegiate STEM contexts, and these decisions must be acknowledged as valid ways of being. It is also critical to uphold the right to enter these D/discourse communities through authentic paths should one choose to do so. Jack alludes to this in his quotes above, but Gareth, an engineering major and gay man, shares an even more explicit example of how he does not necessarily want to place his sexuality at the forefront of his narrative: “When you ask who I am, I would probably sit there and say I’m a mechanical engineering major with a concentration on energy and the passion to change the world, but I just happen to be gay.” Gareth’s use of *but I just happen to be gay* signifies how he positions his sexuality in relation to his academic and professional work.

MIOSG-affirming STEM D/discourses

While many participants shared experiences of attempts to erase, omit, ignore, or otherwise invalidate their gender identity or sexuality, it is important to note examples which can serve as models for how collegiate STEM D/discourses can be shifted through purposeful discursive practices which serve to recognize, validate, and normalize MIOSG. Jamie describes an example of how inclusive collegiate STEM D/discourses impacts their collegiate STEM experience:

Some of my classmates in the Math Department are actually somewhat careful about their phrasing, like I was the only non-man in my probability class, and they say it that way, instead of saying that I was the only girl, and I appreciate this because saying that I was the only non-man is completely correct. I’m not a guy. This is true.

This experience of belonging and affirmation is normalized for those who hold privileged positions in current STEM D/discourses, primarily white cisgender heterosexual men, but in invisible ways. Caroline, a nutrition major and cisgender gay woman, describes the difference between two collegiate STEM contexts she occupies. In her classroom context, Caroline shares, “it’s [MIOSG experiences] really not talked about.” However, she also shares an affirming experience in her graduate assistant context:

We’ll talk about our husbands, our wives ... or they’ll talk about their husbands or boyfriends and I’m talking about my girlfriend. It’s totally cool. ... And they’re very supportive, very curious, and right when you walk in the office, there’s a safe zone sticker. And that office kind of allowed me to come out. ... I was so comfortable, one day we were just talking, and I was like, “Yeah, my girlfriend.” And it just fell out of my mouth.

The MIOSG inclusive D/discourse Caroline describes provides a starting point for considering what affirming collegiate STEM D/discourses can look and sound like. The collegiate STEM D/discourse

Caroline experienced reflects an increase in the normalization of MIOSG and a shift away from cisheteronormative D/discourses.

Discussion

STEM is historically rooted in cisheteropatriarchal practices (de Pillis and de Pillis, 2008; Hughes, 2017) and the ways in which this affects collegiate students with MIOSG is only starting to be understood (e.g., Linley et al., 2018; Iskander, 2021; Miller et al., 2021; Vaccaro et al., 2021). Using grounded theory methodology in conjunction with critical discourse analysis, we examined how STEM students with MIOSG experience cisheteronormative D/discourses in their collegiate contexts and how systemic D/discourses of power influence these experiences. Our findings demonstrate how cisheteronormative collegiate STEM D/discourses contribute to the re/production of cisheteronormativity in collegiate STEM contexts. The findings above illustrate not only the experiences of participants, but also the ways in which participants react, respond, and re/produce, often out of an act of self-preservation and protection, the D/discourses which marginalize them in their learning environments.

Power is ubiquitous in the development of STEM D/discourses. The findings in this study highlight the varied ways in which STEM students with MIOSG react, respond, and re/produce the very D/discourses which marginalize them in their learning environments. Participants often found themselves in situations where they were complicit in the re/production of cisheteronormative D/discourses of power often out of an act of self-preservation and protection. The power and privilege of faculty placed participants in positions to consider their own survival and act in ways that were protective and sustaining of their own energy and well-being. These responses must be noted and addressed in the move towards MIOSG affirming D/discourse in collegiate STEM contexts. Participants also alluded to the potential negative academic and career implications of being out and living an identity outside of what was considered normative in STEM. Power as it relates to collegiate STEM D/discourses is situated both within and outside of STEM classrooms. Campus culture and community are also complicit in the re/production of cisheteronormative D/discourses that show up in collegiate STEM contexts. Whether it be classrooms, lab spaces, content specific organizations, sports clubs, etc., disrupting cisheteronormativity is the responsibility of the entire campus. Students rarely, if ever, have the ability to change these spaces on their own.

Through the discursive practices described in our findings, collegiate STEM contexts become ideological-discursive formations (IDFs; Fairclough, 1985) which contain “the capacity to ‘naturalize’ ideologies, i.e., to win acceptance for them as non-ideological ‘common sense’” (p. 739). Fairclough goes on to share, “there is usually one IDF which is clearly dominant” (p. 739). Collegiate STEM D/discourses naturalize, or normalize, cisheteronormativity in STEM contexts. Additionally, D/discourses are not static (Gee, 2010). The individuals involved in collegiate STEM discourse communities have the power to shift D/discourses in these contexts towards more inclusive practices and create new cultural models affirming of MIOSG. This paper contributes to current discussions on the responsibility of those within STEM D/discourse communities to

address prevalent exclusionary D/discourses (e.g., [Takeuchi and Dadkhahfard, 2019](#); [Kersey and Voigt, 2021](#)). STEM self-identity and MIOsG intersect in the process of overall identity formation ([Vaccaro et al., 2015, 2021](#)). However, repeated hegemonic cisheteronormative representations and D/discourses are the current norms of collegiate STEM contexts. STEM scholars and faculty must move towards MIOsG representation and affirmation in collegiate STEM D/discourse. Sexuality and gender identity cannot be reduced to invisible aspects of identity or positioned as inconsequential to the learning outcomes and D/discourses of STEM students.

Everyone involved in a discourse community contributes to the D/discourses that are re/produced through language and actions. D/discourses are dynamic productions of communities with shared beliefs, values, and practices ([Gee, 2010](#)). Shifts in D/discourse happen continuously over time. D/discourses “have no discrete boundaries because people are always, in history, creating new Discourses, changing old ones, and contesting and pushing the boundaries of Discourses” ([Gee, 2010](#), p. 37). Whether implicit or explicit, intentional or unintentional, the actions that contribute to ongoing cisheteronormative D/discourses in collegiate STEM contexts must be addressed. Current D/discourse in STEM presents a well-meaning but imperfect attempt at inclusion. While best-intentioned revised mission statements, program titles, networking events, etc. aim to be more inclusive of women in STEM, they end up perpetuating a D/discourse of cisnormativity through reinforcing binary notions of gender and failing to critically consider what it is to be a woman and how some STEM students with MIOsG might not have access to these spaces even as women. This study contributes to this ongoing examination of the continued marginalization of students with MIOsG in STEM.

Collegiate STEM contexts do not exist in a closed space, but rather are part of a complex system within the university. University administrators are uniquely positioned to amplify and influence D/discourse which serves to interrupt oppressive practices, yet often do not utilize this power in direct ways ([Jones, 2019](#)). Administrators must use their ability to create and support MIOsG affirming initiatives which involve multiple university organizations and systems including campus gender and sexuality centers, and other equity offices. As [Miller et al. \(2021\)](#) state, “Comprehensive culture change can only happen when all campus leaders — across academic affairs, diversity, student affairs, and other portfolios — begin to identify, educate, and devote resources toward deep-rooted challenges,” (p. 349). Campus gender and sexuality centers can help STEM faculty through MIOsG targeted training, helping with curriculum reform, and providing resources for MIOsG inclusive language-in-use. University DEI offices can support STEM departments in completing cultural audits that would help identify systemic invisibility and issues of power within STEM contexts. Lastly, an underused resource on university campuses are colleges of education which specialize in pedagogical practices inclusive of higher education teaching. Education scholars specializing in MIOsG inclusive pedagogy can help university administrators address curriculum reforms, create requirements for course creation and revision, and develop mandatory training on effective pedagogy.

At the department level, MIOsG inclusive D/discourse can be addressed in classroom language and materials, personal beliefs, and in power dynamics which work to prevent students with MIOsG from feeling safe enough to speak up in response to

cisheteronormative D/discourses. Additionally, deans and program directors can create space for faculty to examine personal beliefs in relation to MIOsG and recognize power dynamics which work to prevent students with MIOsG from feeling safe enough to speak up in response to cisheteronormative D/discourses. A shift towards more affirming D/discourse is “required to respect valid identities” ([McEntarfer and Iovannone, 2020](#), p. 14). If faculty language is more inclusive and affirming, students feel more comfortable on campus and in classrooms, which helps students focus on learning ([Miller, 2015](#); [McEntarfer and Iovannone, 2020](#)). Safe Zone trainings, through partnerships with campus gender and sexuality centers, are an area to begin developing self-awareness of biases and inclusive language for faculty members. Lastly, as several participants described, power plays a large role in how students with MIOsG respond to cisheteronormative D/discourses in STEM contexts. Faculty need to be keenly aware of these power dynamics and work towards proactiveness, not reactivity, in shifting towards more MIOsG affirming D/discourses.

We recognize several limitations within this study and note areas for improvement in future research on this topic. First, initial interview questions did not specifically address D/discourse in collegiate STEM contexts. Instead, D/discourses emerged as important categories in our grounded theory CCA process. While participant responses did reveal many discursive phenomena, many of which have been discussed in this paper, framing future studies to directly address D/discourses of power in collegiate STEM contexts may result in more targeted data illuminating the varied and complex ways D/discourses of power affect participant experiences. Also, interviews with other discursive agents in collegiate STEM contexts (i.e., staff, faculty, administrators) might reveal more issues related to power and position within the discourse community. Second, we might learn more about specific discursive moves if we applied a traditional CDA framework (e.g., [Fairclough, 2013b](#)). Participant responses in a more traditional CDA study might help researchers better understand how D/discourse is affected by the interactions between production and interpretation at individual and societal levels in collegiate STEM contexts. While we looked at participant discursive moves with a critical lens in this paper, we applied a broad view of critical discourse analysis and recognize the limitations of this approach. Lastly, while we do provide some examples of MIOsG affirming STEM D/discourse, most of the participant responses we captured still demonstrated acts of avoidance and protection. It would be beneficial to consider acts of resistance in response to cisheteronormative D/discourses in collegiate STEM contexts using more targeted interview protocols and research questions as previously suggested. This paper starts the conversation, but further research with more focused methodology is needed to fully understand the complexity of D/discourses of power in STEM.

In this paper, we demonstrate the presence and effects of cisheteronormative D/discourses of power in collegiate STEM contexts. Future research needs to continue this investigation across diverse STEM contexts and other collegiate areas to identify and make visible D/discourses of power and the implications on students with marginalized identities, including but not limited to MIOsG, as well as make explicit connections with humanistic pedagogy. As [Gee \(2010\)](#) states, “language has meaning only in and through social practices, practices which often leave us morally

complicit with harm and injustice unless we attempt to transform them” (p. 12). We have attempted to make visible how collegiate STEM contexts reinforce cisheteronormativity. STEM administrators and faculty must be purposeful in moving away from their complicitness in these D/discourses and towards more inclusive and affirming social practices.

Data availability statement

The datasets presented in this article are not readily available because participant data remains confidential to those on the original IRB application and current research team. Requests to access the datasets should be directed to megan_jones4@uri.edu.

Ethics statement

The studies involving human participants were reviewed and approved by Office of Research Compliance, University of North Carolina, Charlotte. The patients/participants provided their written informed consent to participate in this study.

References

- Cech, E., and Waidzun, T. (2011). Navigating the heteronormativity of engineering: the experiences of lesbian, gay, and bisexual students. *Eng. Stud.* 3, 1–24. doi: 10.1080/19378629.2010.545065
- Charmaz, K. (2014). *Constructing grounded theory*. 2nd Edn. Sage.
- de Pillis, E., and de Pillis, L. (2008). Are engineering schools masculine and authoritarian? The mission statements say yes. *J. Divers. High. Educ.* 1, 33–44. doi: 10.1037/1938-8926.1.1.33
- Fairclough, N. L. (1985). Critical and descriptive goals in discourse analysis. *J. Pragmat.* 9, 739–763. doi: 10.1016/0378-2166(85)90002-5
- Fairclough, N. (2013a). “Critical discourse analysis” in *The Routledge handbook of discourse analysis*. eds. J. P. Gee and M. Handford (New York, NY: Routledge), 9–34.
- Fairclough, N. (2013b). *Language and power*. 3rd Edn. New York, NY: Routledge (Original work published in 1989).
- Fairhurst, G. T., and Putnam, L. L. (2019). An integrative methodology for organizational oppositions: aligning grounded theory and discourse analysis. *Organ. Res. Methods* 22, 917–940. doi: 10.1177/1094428118776771
- Forbes, T. D. (2020). Queer-free majors?: LGBTQ+ college students’ accounts of chilly and warm academic disciplines. *J. LGBT Youth* 19, 330–349. doi: 10.1080/19361653.2020.1813673
- Forsythe, D., Vaccaro, A., Jones, M. C., Friedensen, R. E., Miller, R. A., Kimball, E., et al. (2023). Negotiated involvement in STEM organizations by students with minoritized identities of sexuality and/or gender. *J. Women Minorities Sci. Eng.* 29, 21–43. doi: 10.1615/JWomenMinorScienEng.2022037432
- Foucault, M. (1971). Orders of discourse. *Soc. Sci. Inf.* 10, 7–30. doi: 10.1177/053901847101000201
- Gee, J. P. (2003). “Discourse analysis: what makes it critical?” in *An introduction to critical discourse analysis in education*. ed. R. Rogers (New York, NY: Lawrence Erlbaum Associates), 19–50.
- Gee, J. P. (2010). *An introduction to discourse analysis: Theory and method*. 3rd Edn. New York, NY: Routledge.
- Hakkola, L. (2021). “The secret knock”: a critical discourse analysis of how recruiters exercise power and privilege in admissions. *Race Ethn. Educ.*, 1–18. doi: 10.1080/13613324.2021.1924140
- Hughes, B. E. (2017). “Managing by not managing”: how gay engineering students manage sexual orientation identity. *J. Coll. Stud. Dev.* 58, 385–401. doi: 10.1353/csd.2017.0029
- Hughes, B. E. (2018). Coming out in STEM: factors affecting retention of sexual minority STEM students. *Sci. Adv.* 4, 1–5. doi: 10.1126/sciadv.aao6373
- Iskander, L. (2021). Nonbinary beginning teachers: gender, power, and professionalism in teacher education. *Teach. Coll. Rec.* 123, 199–222. doi: 10.1177/01614681211052007
- Johnson, L. (2014). Adapting and combining constructivist grounded theory and discourse analysis: a practical guide for research. *Int. J. Mult. Res. Approaches* 8, 4120–4141. doi: 10.5172/mra.2013.4120
- Jones, V. (2019). Discourse within university presidents’ responses to racism: revealing patterns of power and privilege. *Teach. Coll. Rec.* 121, 1–32. doi: 10.1177/016146811912100402
- Jones, S. R., Torres, V., and Arminio, J. (2014). *Negotiating the complexities of qualitative research in higher education: fundamental elements and issues*. New York, NY: Routledge.
- Jones, M. C., Vaccaro, A., Forsythe, D., Friedensen, R., Forester, R., Miller, R. A., et al. (2023). “Who are we to do this research?: Duoethnographic reflections on the insider/outsider paradox in queer research” in *Queerness as doing in higher education: Narrating the insider/outsider paradox as LGBTQ+ scholars and practitioners*. eds. A. Duran, T. J. Jourian, R. A. Miller and J. Cisneros (New York, NY: Routledge)
- Kersey, E., and Voigt, M. (2021). Finding community and overcoming barriers: experiences of queer and transgender postsecondary students in mathematics and other STEM fields. *Math. Educ. Res. J.* 33, 733–756. doi: 10.1007/s13394-020-00356-5
- Linley, J. L., Renn, K. A., and Woodford, M. R. (2018). Examining the ecological systems of LGBTQ STEM majors. *J. Women Minorities Sci. Eng.* 24, 1–16. doi: 10.1615/JWomenMinorScienEng.2017018836
- Marshall, D., and Case, J. M. (2010). D/discourse in the learning of physics: the design of an introductory physics curriculum. *Afr. J. Res. Math. Sci. Technol. Educ.* 14, 15–27. doi: 10.1080/10288457.2010.10740679
- Mattheis, A., De Arellano, D. C. R., and Yoder, J. B. (2020). A model of queer STEM identity in the workplace. *J. Homosex.* 67, 1839–1863. doi: 10.1080/00918369.2019.1610632
- McEntarfer, H. K., and Iovannone, J. (2020). Faculty perceptions of chosen name policies and non-binary pronouns. *Teach. High. Educ.* 27, 632–647. doi: 10.1080/13562517.2020.1729722
- Meyer, E. J., and Quantz, M. (2021). Who is (not) protected by title IX? A critical review of 45 years of research. *Teach. Coll. Rec.* 123, 1–42. doi: 10.1177/016146812112300203
- Miller, S. J. (2015). Why schooling must move into a trans*/post-trans* era. *J. Lang. Literacy Education*
- Miller, R. A., Vaccaro, A., Kimball, E., and Forester, R. (2021). It’s dude culture: students with minoritized identities of sexuality and/or gender navigating STEM majors. *J. Divers. High. Educ.* 14, 340–352. doi: 10.1037/dhe0000171
- Pullen Sansfaçon, A., Robichaud, M. J., and Dumais-Michaud, A. A. (2015). The experience of parents who support their children’s gender variance. *J. LGBT Youth* 12, 39–63. doi: 10.1080/19361653.2014.935555
- Rubin, H. J., and Rubin, I. S. (2011). *Qualitative interviewing: The art of hearing data* 3rd Edn. Thousand Oaks, CA: Sage.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

The reviewer KP declared a past co-authorship with the author RM to the Handling Editor.

Publisher’s note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Schilt, K., and Westbrook, L. (2009). Doing gender, doing heteronormativity: gender normals, transgender people, and the social maintenance of heterosexuality. *Gen. Soc.* 23, 440–464. doi: 10.1177/0891243209340034

Takeuchi, M. A., and Dadkhahfard, S. (2019). “Rethinking bodies of learners through STEM education” in *Critical, transdisciplinary and embodied approaches in STEM education*. eds. P. Sengupta, M.-C. Shanahan and B. Kim (Cham, Switzerland: Springer International Publishing), 199–216.

Trenshaw, K. F., Hetrick, A., Oswald, R. F., Vostral, S. L., and Loui, M. C. (2013). “Lesbian, gay, bisexual, and transgender students in engineering: climate and perceptions” in *2013 Frontiers in education conference: Energizing the future, FIE 2013- proceedings* (Oklahoma City, OK: IEEE), 1238–1240.

Vaccaro, A., Miller, R. A., Kimball, E. W., Forester, R., and Friedensen, R. (2021). Historicizing minoritized identities of sexuality and gender in science, technology, engineering, and mathematics (STEM) fields: a grounded theory model. *J. Coll. Stud. Dev.* 62, 293–309. doi: 10.1353/csd.2021.0026

Vaccaro, A., Russell, E. I., and Koob, R. M. (2015). Students with minoritized identities of sexuality and gender in campus contexts: an emergent model. *New Dir. Stud. Serv.* 2015, 25–39. doi: 10.1002/ss.20143

White, J. W., and Lowenthal, P. R. (2010). Minority college students and tacit “codes of power”: developing academic discourses and identities. *Rev. High. Educ.* 34, 283–318. doi: 10.1353/rhe.2010.0028