A Feminist Approach to Mathematical Modeling: Using Data Feminism for Task Design

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Feminist pedagogy allows for connecting "to our roots, our past, and to envision the future" (Shrewsbury, 1987, p. 6). By recognizing individuals as unique contributors within the social, cultural, and intellectual contexts, feminist pedagogy helps motivate students to learn about themselves and the diverse experiences of others (Torres, 2014). Feminism in education may involve exploration of social-justice issues (e.g. Louie et al., 2022, Gutstein, 2003) or integration of feminist theories into classroom norms (e.g. Abrahamson et al., 2020, Raven, 2014). One relevant feminist perspective is Data Feminism (D'Ignazio & Klein, 2020). The framework provides a way of thinking about data science and data ethics through considering seven core principles: examine power, challenge power, elevate emotion and embodiment, rethink binaries and hierarchies, embrace pluralism, consider context, and make labor visible (p. 17-18). Despite the invaluable nature of feminist pedagogy, the intersection of feminism and mathematics has rarely been crossed (Damarin, 2008), prompting the question: *How can feminism be incorporated into mathematics education?*

Mathematical modeling (MM) offers a viable avenue for including feminism. First, as modeling "uses mathematics to represent, analyze, make predictions" about real world phenomena (GAIMME, p. 8), students can draw on their funds of knowledge and experiences (Moll et al., 1992). This approach aligns with feminist ideal of positioning the scientist within the study (Rubel et al. 2022), enabling students to integrate new learning while modifying past understandings (Shrewsbury, 1987). Second, scholars have found that students have high interest and enjoyment with little boredom when solving real-world problems (e.g., Hartman & Schukajlow, 2021). Thus, modeling has the capacity to engage students emotionally, echoing D' I'ganzio and Klein's (2020) assertion that data is neither neutral nor objective but should instead embrace "the knowledge that comes from people as living, feeling bodies in the world" (pg. 73). Prior research has incorporated students' lived experiences (e.g., Toor & Mgombelo, 2016), emotion (e.g., Azevedo et al., 2017), and embodiment (e.g., Sinha & Malhotra, 2022) in STEM education; but more work can be done in including feminism to mathematics. Specifically, there remains a gap in understanding how Data Feminism can be integrated into MM curricula. This study will employ Data Feminism principles as a heuristic to (a) design two MM tasks and (b) discuss why the tasks are characterized as "feminist modeling." The question guiding this research is *How can feminism be incorporated into the design of mathematical modeling task?*

Our task design intentionally integrates compatible theoretical frameworks, such as the MM process diagram (e.g., Anhalt et al., 2018), Data Feminism (D' Ignazio & Klein, 2020), and Rubel et al.'s (2022) re-envisioning problem contexts. These frameworks will guide the selection of appropriate context for the tasks (e.g., personal, occupational, societal, and scientific). Tasks will be outlined and compared with "non-feminist" modeling tasks and assessed for their potential in engaging students beyond just the mathematics (e.g. personal experiences, social justice). Through highlighting Data Feminism as a design framework, we stand to help educators create an environment where students are not only equipped to "read the world with mathematics" (Gutstein, 2003, p. 44) but also to develop "mathematical power" (Gutstein, 2003, p. 45). Additionally, this study could influence how modeling tasks are designed and executed.

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