

Theorizing Anticolonial Praxis in Undergraduate Mathematics Education

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Mathematics is frequently presented as a universal and objective discipline. Yet these claims of universality are culturally framed by whiteness and limit the possibilities for relational and ethics-driven approaches to mathematics that align with Indigenous knowledge systems. This theoretical report synthesizes insights from Indigenous perspectives, anticolonial theory, and critical mathematics education to critically examine the colonial underpinnings of mathematics. Leveraging these insights, we present a three-dimensional framework for anticolonial praxis addressing axiology, epistemology, and ontology, and seed an illustrative curricular possibility. We conclude with a call to action, urging instructors and researchers to negotiate the complexities of actualizing anticolonial praxis in institutions governed by colonial traditions.

Keywords: settler colonialism, indigeneity, curriculum, epistemology, ontology

Mathematics lags behind other disciplines in its readiness to radically reimagine the subject as just and liberatory (Gutiérrez, 2017a). At the undergraduate level, the lack of clarity about how mathematics may be reformed to advance equity can stifle broader institutional efforts. Consider Hispanic-Serving Institutions (HSIs) as an example. The rise of HSI designations has led to a wave of university efforts to decolonize curricula to provide course experiences that embrace Latin* ways of thinking, knowing, and being (e.g., Garcia, 2018). While equity-oriented research in mathematics education at HSIs has deepened our understanding of classroom social dynamics (e.g., Leyva et al., 2024), less attention has been given to how mathematical content itself is framed; HSI instructors continue to teach mathematics curricula that they believe to be culture-free (Shultz et al., 2024). In this way, the undertheorization of anticolonial approaches to mathematics may stand in the way of HSIs' progress towards truly serving Latin* students.

This theoretical report synthesizes anticolonial theory, critical mathematics education, and Indigenous perspectives to conceptualize anticolonial curricula and praxis in undergraduate mathematics. We open by challenging the myth that mathematics is universal, examining how its codification has been shaped by global power structures that reproduce white, imperial values (Bishop, 1990). Afterwards, we review relevant scholarship, emphasizing how more robust decolonial work in K–12 mathematics education and other postsecondary disciplines signals a pressing need for similar engagement in research in undergraduate mathematics education (RUME). Drawing on Indigenous and decolonial theories, we distinguish anticolonial praxis from common framings of decolonization and offer our conceptualization in the undergraduate mathematics context. We end with a call to action, urging mathematics educators to grapple with complexities of enacting anticolonial praxis within institutions rooted in colonial legacies.

The Colonial History of Mathematics

Mathematics is often viewed as neutral and objective (Bishop, 1990; Shahjahan et al., 2022). However, closer examination reveals cultural bias in narratives about mathematics. For example, mathematics curricula often highlight figures like Pythagoras in discussions of trigonometry,

while overlooking non-white contributors—such as the African architects of the Great Pyramids, whose achievements predate Pythagoras by millennia (McNeill & Gresalfi, in press; Raju, 2017). Such differences in recognition signify cultural power relations governing who controls the narrative of mathematics and, relatedly, which forms of mathematical knowledge are constructed as legitimate or worthy of preservation (Osibodu, 2024). These exclusions are not incidental; they function as mechanisms that uphold colonial and racialized hierarchies within the discipline.

The mathematics taught in Western education—which is governed by axiomatic logic and idealized notions of objectivity (Gutiérrez, 2017b)—is made possible only when a society has sufficient surplus to enable intellectual pursuits that serve no utilitarian or survival-based purpose (Zaslavsky, 1999). Exploitive labor structures and access to trade (Coates, 2011; Diamond, 1999) contributed to the development of such privileged forms of mathematics in Europe while mathematics in other areas of the globe remained deeply contextual and tied to social needs (Zaslavsky, 1999). These socially contextualized forms of mathematics were positioned as lesser by Europeans (Hottinger, 2016). European mathematics, along with the narrative that valuable mathematics is abstract, became globally dominant through settler colonialism (Bishop, 1990).

While the ontological distance between mathematics and social realities—a characteristic of European mathematics (Bishop, 1990)—is often cited as evidence that mathematics is neutral, it may actually enable mathematics to serve oppressive functions. Decontextualization allows mathematics to be engaged without ethical considerations and can operationalize imperialist values of commodification and control (Bishop, 1990; Ernest, 2018). Indeed, mathematics has played an important part in racial dehumanization (e.g., the three-fifths compromise; Ratliff, 2023), genocide (e.g., Israeli military strategy in the occupation of Palestine; the pseudo-science of the Holocaust; Alshwaikh, 2024; Ernest, 2018), capitalistic ecocide (Fúnez-Flores et al., 2024), and authoritarian governance (e.g., homeland security; Grewal, 2017).

Anticolonial Praxis as an Emerging Site of Inquiry in Undergraduate Mathematics

While decolonial and anticolonial scholarship has gained momentum across many educational fields, engagement with these conversations in RUME is nascent. For example, in a systematic review of 126 articles related to decolonization in higher education curriculum and pedagogy, Shahjahan and colleagues (2022) identified only one with a disciplinary focus in mathematics. Similarly, in reviewing engagements with decolonial theory in mathematics education Fúnez-Flores and colleagues (2024) identified only a single study from Bhattacharya and colleagues (2024) addressing postsecondary contexts. The study's project-based curriculum critiques dominant power structures and centers students' lived experiences, which the authors argue exemplify a decolonized curriculum. This curriculum engages Indigenous epistemology and ontology, which often proposes an environmental focus and relational ways of thinking (e.g., Kulago et al., 2021, Garcia-Olp et al., 2019). While this curriculum represents valuable progress, it does not match the depth of Indigenous engagement found in K-12 mathematics education.

This limited consideration of Indigeneity also appears in scholarship presented at the RUME conference—a venue that often reflects emerging priorities in the field. Within the last five years of RUME proceedings, we identified one theoretical report that engaged an Indigenous research paradigm and three other reports drawing on adjacent frameworks. Among these, it is notable that attention to instructional settings remains limited. For example, Hagman and colleagues (2024) use the Nahuatl term “Nepantla” to describe and theorize the tensions and instability inherent in equity-oriented departmental change efforts. The use of Nepantla to theorize such tensions in mathematics education research was first introduced by Gutiérrez (2008), drawing from Anzaldúa's (1999) original conceptualization of Nepantla as a liminal space of rupture and

transformation, where new forms of consciousness and resistance can emerge. Nepantla, as a space, disrupts Western dichotomies by embracing fluidity, multiplicity, and the coexistence of seemingly contradictory ways of being. Although Hagman and colleagues theorize with this Indigenous concept, its connection to instructional practice is remote and it is unclear whether the study's participants engaged this way of knowing. Similarly, Luecke's (2022) engagement with decolonial principles, though contextualized by a need to connect Western mathematics to Dakota/Lakota space, language, and culture at Tribal Colleges, focuses primarily on advancing an Indigenous research paradigm—a paradigm of “co-connecting knowledge” that is relational, reciprocal, and that decenters humans as the only source of knowledge. Although these inquiries importantly integrate Indigenous ways of being and knowing into scholarly conversations in RUME, they offer limited guidance to disrupt colonial paradigms in classrooms.

The ontological tensions Luecke (2022) identifies emerge within teaching inquiries in RUME, albeit in limited form. For example, critically examining the Western nature of mathematical representations as static and universal, Abreu (2022) proposes adopting mathematical drawing practices that are indeterminate and embodied. Similarly challenging the supposed universality that underpins undergraduate mathematics content, scholars also propose approaches that contextualize mathematical ideas or acknowledge the real-life limitations of mathematical abstraction. For example, although not published in RUME proceedings, Raju (2012) recognizes the physical impracticality of infinitesimals by advocating for grounding calculus curricula in Indigenous Indian approaches that achieve the major results of calculus without the use of limits. Abreu and Dickson (2024) propose instruction that invites stories that demonstrate isomorphisms and interrogates the topic's colonial underpinnings through questions such as, “Where does the persistent preoccupation for ‘sameness in forms/structures’ in dominant mathematics come from?” (p. 1315). Although these inquiries importantly integrate Indigenous ways of being and knowing into scholarly conversations within RUME, they offer incomplete models to guide anticolonial praxis.

The marginal theorization of anticolonial praxis in RUME exposes the field's complicity with colonial mathematical and instructional traditions (Gutiérrez, 2022; Raju, 2012), demanding reflection on what kinds of mathematical knowledge we validate and what educational possibilities we strive to create. Towards disrupting such complicity, we theorize anticolonial praxis in what follows.

Theorizing Anticolonial Praxis in Undergraduate Mathematics Education

Defining an Anticolonial Orientation

Efforts to critically address the legacy of settler colonialism have largely been framed as decolonization. However, the term decolonization has been co-opted in ways that retain limited connection to indigeneity and colonial violence, which can undermine its radical potential. Tuck and Yang (2012) caution against using decolonization as a metaphor, arguing that decolonization is a specific and material process grounded in the repatriation of Indigenous land and life. While we recognize the importance of preserving this meaning, we also recognize that higher education has been shaped by settler colonialism in ways that extend beyond land (Woldegiorgis, 2021). For example, while Latin* students at HSIs may lack Indigenous ties to the land on which the institution was built, these institutions are still structured by the colonial forces that may have dispossessed their ancestors in Latin America; dismantling those structures remains essential to actualizing justice (Garcia, 2018). Patel (2015) distinguishes between decolonial and anticolonial work noting that anticolonial more accurately reflects engagements that seek to understand and

counter colonial logics while acknowledging that such efforts, particularly within institutions of higher education, do not constitute decolonization. Adopting this perspective, we aim to theorize anticolonial praxis in undergraduate mathematics education as an orientation to curriculum and instruction that confront the epistemological and ontological hegemony that was mobilized through settler colonialism. We adopt an anticolonial perspective not to dilute the stakes of decolonial struggle, but to clarify the limits of our institutional locations and the transformative possibilities within them. We remain committed to disrupting the settler (mathematical) grammars that structure the very terms of legitimacy in education (Calderon, 2014).

A Framework for Anticolonial Praxis

Because mathematics is often perceived as socially neutral, many have not deeply considered how it could diverge from whiteness and colonial paradigms; this constrains radical reimagination of mathematics education as a site of liberation (Martin, 2019). Through a synthesis of decolonial theory, Indigenous epistemologies, and our own lived experiences with alternative pedagogies, we reimagine pedagogies of relationality, holism, and justice. Building on Gutierrez' (2022) theorization of Indigenous futurity, we propose a framework for anticolonial praxis consisting of three dimensions: axiology, epistemology, and ontology. Afterwards, we seed an illustrative curricular possibility to support the practical realization of this framework in undergraduate mathematics teaching.

Anticolonial axiology: centering political and spiritual desire. Axiology relates to ethics and value-driven action. Within anticolonial theory, axiology demands that we interrogate what is valued, who gets to define value, and how values are enacted in mathematics classrooms. We attend to political and spiritual dimensions of mathematics, restoring ethics in curriculum design.



Figure 1. Chalabi's data visualization of genocide and displacement in Gaza

As Martinez et al. (2021) write, “an axiological departure of mathematics focuses on the shared experience lived while creating relationships with and across mathematics.” When we are able to position the spiritual and mathematics as coexisting, “we can envision mathematics as alive, working with us as we engage in rich experiences. ...[and] the experience of learning is no longer an individual task; it becomes a collective experience of knowledge construction” (p. 76). This view stands in opposition to dominant axiologies in mathematics education, where the value of mathematics is rooted in individual gain and the production of “rational and productive citizens” that would contribute to a nation's progress globally (Nikolakaki, 2016, p. 281). Such

framings are inextricably linked to capitalist ideologies, placing value on mathematics education as a tool for economic competitiveness rather than as a site for relational or spiritual engagement.

Embodying anticolonial axiology, Chalabi's (2024) data visualization (Figure 1) resists sanitized, apolitical norms, illuminating the discipline's potential to "live in harmony with values that protect life and enhance understanding" (Fasheh, 2012, p. 103). Visualizing the toll of the ongoing genocide and displacement in Gaza, Chalabi (2024) reveals embodied realities behind the numbers, rendering visible the lives and relationships erased by dominant data practices. In rehumanizing the data, Chalabi challenges capitalist and colonial tendency to quantify suffering for the purposes of policy, profit, or erasure, exemplifying anticolonial witnessing and solidarity.

Anticolonial praxis demands we reshape our views of what mathematics is for and integrate ethics as part of mathematical reasoning. Grounded in political and spiritual desire, anticolonial axiology values the potential for mathematics to foster connection and sustain collective life.

Anticolonial epistemology: honoring partiality and plurality in knowledge production.

Epistemology relates to ways of thinking and constructing knowledge. Gutierrez (2017b) fosters epistemic plurality in her conceptualization of *mathematrix*—a vision of mathematics where "multiple knowledges are valued and sought" (p.16) and such partialities are honored for their contributions to the whole. *Mathematrix* calls on us to be epistemically disobedient—to refuse to recognize dominant forms of knowing as superior and to actively seek alternatives. This perspective intertwines with Anzaldúa's (1999) concept of Borderlands, which theorizes the space between categories, languages, cultures, lands, etc., as liminal, fluid, and inhabitable. The Borderlands are a third space, "greater than the sum of its severed parts," that allows for movement across and beyond imposed boundaries (p. 80). This perspective prompts mathematics educators to reimagine the field not as a bounded discipline, but as a site of possibility shaped by the cultural, historical, and experiential knowledge of those who engage with it.

Theorizing alongside Anzaldúa (e.g., 1999) and Gutiérrez (e.g., 2017b), Yeh and colleagues (2021) similarly call on mathematics educators to engage in acts of ontological and epistemological disobedience. They urge the field to interrogate long-standing borders that define what mathematics is, who it is for, and where it can be done. As an example in secondary mathematics, Yeh et al. (2021) assert that despite contemporary reforms emphasizing problem solving and reasoning "school mathematics is still typically defined as a discrete set of topics taught in a linear progression that ultimately leads to calculus" (p. 200). They ask, "If mathematics educators were no longer forced to guide students along a narrow path to calculus, what else could it mean?" (p. 200). They call for disobedience in the field, suggesting that as computers increasingly handle routine computations, mathematics education should focus on critical mathematical literacies—engaging with data and inquiry in ways that foster learners' community-based reasoning. This shift away from abstract mastery and towards the cultivation of relationally situated and multiple ways of knowing reflects epistemic plurality—one that moves fluidly across, within, and between boundaries.

Anticolonial ontology: mathematics as an interconnected way of being. Ontology relates to the nature of being. Kulago et al. (2021) emphasize how the dualism perpetuated by colonial knowledge systems severs connections between mind, body, spirit, and nature. In contrast, Indigenous epistemologies position knowledge as relational and dynamic—always in connection with others, land, ancestors, and the more-than-human world.

Anticolonial ontology resists the construction of the self as a disembodied knower, which Wynter (2003) names as a form of dehumanizing violence. Specifically, Wynter challenges the overrepresentation of "Man"—a specific, Western, bourgeois conceptualization of humans as

rational and detached from relational or spiritual ways of being. Through coloniality, this figure became the dominant standard through which humanity is defined, creating a *coloniality of being* that erases alternative ontologies. This framing aligns with dominant framing of mathematics as neutral, objective, and disembodied, which excludes ontologies rooted in relationality.

In contrast, an anticolonial ontology invites us to reimagine mathematics as a space of relational being, affirming our interdependence and entanglement with the world through land, community, and story. Rather than treating mathematics as a detached system of logic or symbols, this orientation considers mathematics as entangled with emotional and physical experience, lived histories, and collective futures. Martinez et al. (2021), for instance, describe a way of knowing and being that emerges through spirit, culture, and community. When learners engage mathematics in this way, they are not merely solving problems or mastering procedures. They are entering into a relationship with mathematics that is attentive to memory, land, family, and story. Through this lens, mathematics is part of becoming. This orientation does not seek to insert culture into mathematics as a contextual add-on. It requires a more fundamental shift in how mathematics is conceptualized. Instead of imagining mathematics as something to be applied to external realities, anticolonial ontology asks us to consider how mathematics already lives within those realities. Mathematics is world-making, shaped through embodied participation and connection.

A Curricular Seed: Integrating Light and Lifeworlds

I (the first author) choose to speak to you directly to ground our curricular seed in ontological intimacy, relationality, and ethics, thus embodying the principles of our theorization. Afterwards, I re-assume scholarly norms to analyze its constituent parts.

I credit Jake Morrow for this example—the farm manager at a school with a work program where I once taught. Jake came to me once with a calculus problem. He shared that for some crops, time to harvest depends not on the number of days that pass, but the cumulative amount of sunlight they receive. Locally, daylight hours varied significantly over the year. He wanted a mathematical model that could provide the date of the harvest given the date of planting.

I did not have the wherewithal to teach with this problem at the time, but now informed by Indigenous theories, here is how I envision it as anticolonial praxis. To begin, students would question what forms of mathematics would be needed; the answer is uncertain. It is unclear to me whether this problem might involve integrating a function whose inputs were calendar dates and outputs were the duration of daylight, or whether a more complex model is necessary. For example, could the higher light intensity near the summer solstice, when the sun is more directly overhead, influence growth in ways not explained by daylight hours alone? How do you account for days being discrete when a function for daylight over the year would likely be sinusoidal? These questions draw on our knowledge and experiences of the natural world as a guide.

We would have to try a variety of models. Given the local nature of the problem, we would draw on Jake's experience, or others who had a long history working with the land, to assess the utility of our models. In doing this, we would likely learn how harvests have been changing with the climate, and no longer follow their historical patterns. This would be an additional mathematical complexity to work into our model—one that might cause us to grapple with our fears and responsibilities related to an uncertain planetary future.

While this problem's original context was a school farm 1,000 miles away, it is also tied to injustices I witness locally and globally. I remembered this problem while creating a garden for my family. We are tired of eating food that supports corporate profits while degrading our health and we wish for less of our income to support forced labor (Bureau of International Labor

Affairs, 2025). However, we struggle to afford high-quality, ethically-sourced food. Of course, these are systemic challenges that affect many people more severely than they affect us, and inequities in land access make it difficult for some to grow food. I was pleased to learn our city has a number of community gardens that expand opportunities to work with the land, offering a potential site for service-learning if I were to teach around this issue. I am also reminded that our university, as a land-grant institution, was founded to develop agricultural knowledge for the region—knowledge that supplanted what was lost through the genocide and forced removal of Indigenous peoples (American Indian and Indigenous Studies, [masked] University, n.d.). I think of the educative possibilities of bringing this institutional history into a mathematics class, as we together consider what sophisticated forms of mathematics might have grown from that Indigenous knowledge. Perhaps this problem, and others, would have been solved long ago.

Situating the problem in our anticolonial praxis framework. Our curricular seed embodies our anticolonial praxis framework. Pertaining to axiology, our example holds meaning and embodies values of ecological justice and relationality. Students' mathematical engagement does not simply satisfy the requirements of schooling. Rather, it frames mathematics as intimately tied to the foods students grow and eat, food access inequities in their local community, and broader climate concerns. Epistemologically, the task of modeling has no clear "right answer." This invites multiplicity in interpretations and approaches, using lived experience and interconnected knowledge to explore models that are verified by their situated utility. Ontologically, mathematics becomes part of our constant quest to redefine who we are as people, and how we contribute to the world. Our experiences, embodiment, and intuition are inseparable from the mathematical endeavor, the outcomes of which have bearing on our ways of life.

Call to Action

The curricular possibility seeded here, and the larger anticolonial framework it represents, are not easily implemented in undergraduate mathematics classrooms as they currently stand. We teach and research within institutions that remain active sites of settler colonialism and are held accountable for reproducing colonial forms of knowledge therein. However, justice (in undergraduate mathematics education) cannot be achieved through incremental changes that do not fundamentally threaten these white paradigms (Martin, 2019; McNeill & Gresalfi, in press).

Our curricular possibility requires time investment in the relationships between ourselves, community members, and the ecosystem. Such reflective time is often limited when instructors are expected to cover the full range of computational and theoretical skills required for the next mathematics course; we anticipate instructors may feel concerned that their students would be "behind" in their mathematics learning as a result. We validate this concern. However, the first author is also reminded of their mathematics dissertation on symmetry groups of topological surfaces and of the limited hope they place in that work's capacity to yield spiritual, social, or planetary benefits. Indeed, it is difficult to imagine this would constitute the highest level of mathematics learning through Indigenous perspectives. When we consider how anticolonial praxis may impact students' preparation, we must ask what we hope to prepare students for. Are we preparing students to engage mathematics in supposedly ethics-free ways for advancement in a white supremacist, capitalist system, or to solve pressing social and global problems?

Informed by Gutiérrez' (2015) call for mathematics educators to nest in *nepantla*, we do not attempt to reconcile these conflicting instructional imperatives. An anticolonial vision cannot be squared with the status quo of postsecondary institutions. Still, in every lesson taught and every inquiry pursued lies the possibility of reimagining mathematics otherwise. We invite educators to embrace this possibility and carve pathways toward an ethical future (Gutiérrez, 2022).

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