

## EDITORIAL

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# The Intersection of Race, Data, and Learning: Applying QuantCrit to Mathematics Education Research

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Mathematics education is at a critical juncture, shaped by evolving pedagogical approaches, technological advancements, and a growing emphasis on equity and inclusion. While traditional frameworks in mathematics instruction have long prioritized procedural fluency and conceptual understanding (Bay-Williams & San-Giovanni, 2021), contemporary research highlights the need to interrogate the sociopolitical dimensions of mathematics learning (Larnell & Martin, 2021). Scholars have increasingly turned to critical theories to examine how power, identity, and systemic inequities shape students' mathematical experiences. Among these theoretical perspectives, Critical Race Theory (CRT) and its methodological extension, Quantitative Critical Race Theory (QuantCrit), offer powerful tools for uncovering and addressing structural barriers in mathematics education.

Critical theories, including CRT, have been widely applied across science, technology, engineering, and mathematics (STEM) fields to analyze issues of equity and justice. For instance, CRT has been instrumental in examining how racialized barriers impact access to STEM education and careers (McGee & Bentley, 2017). Similarly, Feminist Theory has been used to explore gender disparities in STEM participation, while Disability Critical Race Theory (DisCrit) has shed light on the intersections of race and ability in STEM learning environments (Annamma et al., 2013).

The application of these theories has yielded valuable insights, such as the importance of counter-narratives in disrupting dominant discourses that position students of color as less capable in STEM fields. Studies have also demonstrated the effectiveness of critical pedagogies in fostering inclusive and empowering learning environments. However, mathematics education has been slower to adopt these frameworks in empirical research, particularly in quantitative analyses.

QuantCrit offers a crucial extension by embedding critical perspectives into statistical methodologies, ensuring that data-driven decisions in mathematics education are aligned with equity-focused goals. Lessons from other STEM disciplines

suggest that integrating critical theories into research and practice requires a deliberate shift in methodology, curriculum design, and educator training. Mathematics education can benefit from these insights by incorporating QuantCrit-informed approaches to policy evaluation, curriculum assessment, and student outcome analyses. This editorial argues for the broader adoption of QuantCrit in mathematics education research by bridging the gaps in the existing literature and drawing from critical frameworks across STEM education. Doing so will not only deepen our understanding of systemic inequities but also provide actionable pathways for fostering justice-oriented mathematics learning environments.

The present editorial underscores the necessity of integrating QuantCrit into mathematics education research, policy, and practice. By merging critical race perspectives with quantitative methodologies, QuantCrit challenges the assumed neutrality of data and exposes the ways in which statistical analyses can perpetuate racial and social inequities. Thus, the aim of the present editorial is to explore how QuantCrit can be employed to analyze disparities in mathematics learning outcomes, disrupt deficit-based narratives in quantitative research, and inform equitable pedagogical approaches in mathematics education. As mathematics education researchers, we are responsible for critically examining the structures that shape access, participation, and success in mathematics. This editorial invites scholars, educators, and policymakers to engage with QuantCrit as a transformative framework for advancing justice in urban mathematics education.

### **Overview of Quantitative Critical Race Theory (QuantCrit)**

The pursuit of equity in mathematics education has been an ongoing area of research, with scholars highlighting disparities in access, achievement, and representation across racial, socioeconomic, and linguistic lines. Foundational studies have examined how structural inequalities, such as tracking policies (Oakes, 1985), teacher expectations (Ladson-Billings, 1997), and standardized testing biases (Gutiérrez, 2008), contribute to persistent gaps in mathematics learning outcomes. Research has also explored culturally responsive and asset-based approaches that challenge deficit perspectives in mathematics instruction (Nasir & Cobb, 2007).

Despite these advances, gaps remain in understanding how quantitative research methods themselves reinforce inequities in mathematics education. Many studies rely on traditional statistical analyses that fail to interrogate the racialized nature of data collection, interpretation, and policy implementation. QuantCrit, as an emerging framework, offers a means to critically analyze how mathematical performance data are constructed and used in ways that often disadvantage historically marginalized students. By integrating QuantCrit, researchers can move beyond descriptive statistics to examine the underlying systemic factors that shape mathematics learning and participation (Gillborn et al., 2018).

QuantCrit emerges as a methodological and epistemological extension of CRT in quantitative research. Rooted in the understanding that data and statistical analyses are not neutral but embedded in broader sociopolitical contexts, Historically, the development of QuantCrit can be traced to scholars who sought to reconcile CRT's qualitative insights with quantitative methodologies. Key contributors such as Gillborn, Warmington, and Demack (2018) have emphasized the need for critical perspectives in statistical research, arguing that without such approaches, quantitative methods risk perpetuating inequities rather than dismantling them. QuantCrit challenges the ways in which traditional quantitative methods have historically reinforced systemic inequities. This is best described in the five tenets of QuantCrit: (1) the *centrality of racism*, (2) *numbers are not neutral*, (3) *categories are neither "natural" nor given*, (4) *data cannot "speak for itself"*, and (5) *using numbers for social justice*.

The first tenet emphasizes the *centrality of racism* in understanding social dynamics. This principle asserts that racism is a complex and deeply rooted aspect of society that cannot be adequately captured through traditional quantitative methods alone. According to the first tenet, racism is a structural and endemic factor in mathematics education research. QuantCrit asserts that racism is deeply embedded within educational systems, including data collection and statistical analyses. This aligns with the principle of using data to highlight and challenge racial and social disparities that are often overlooked in conventional quantitative research in mathematics education. Researchers can disrupt narratives that obscure systemic inequities by acknowledging that mathematical outcomes are shaped by structural forces rather than individual deficiencies.

The second tenet posits that *numbers are not neutral*. This principle challenges the conventional belief that quantitative data can objectively represent reality. Instead, it argues that data can reflect and reinforce systemic inequalities and biases, particularly those related to race (Tabron & Thomas, 2023; Gillborn et al., 2017). Traditional quantitative methods often present data as objective and unbiased. However, QuantCrit challenges this notion, arguing that data are socially constructed and embedded within power structures. Recognizing that quantitative research can reflect dominant group biases rather than neutral truths aligns with the need to critically examine the objectivity of data and ensure that methodologies do not perpetuate harm.

The third tenet addresses the idea that *categories are neither "natural" nor given*. This principle invites researchers to critically examine the categories used in quantitative research, particularly those related to race and ethnicity. It suggests that these categories are socially constructed and can perpetuate stereotypes and misconceptions if not carefully analyzed (Wong-Campbell, 2024). Mathematics educational research frequently relies on rigid categories—such as race, gender, or socioeconomic status—without considering their complex, intersectional nature.

QuantCrit critiques these static classifications, emphasizing that they are socially constructed rather than fixed realities. This directly corresponds with the need to prioritize counter-narratives and contextual analyses that incorporate lived experiences, thereby moving beyond simplistic statistical groupings.

The fourth tenet asserts that *data cannot “speak for itself.”* This principle emphasizes the importance of context in interpreting quantitative findings. It encourages researchers to consider the broader social, political, and historical contexts in which data is collected and analyzed, recognizing that without this context, data can lead to misleading conclusions (Tabron & Thomas, 2023). QuantCrit asserts that marginalized communities' voices and lived experiences should be central to research. This principle aligns with the call to elevate counter-narratives that challenge dominant statistical representations. Incorporating qualitative insights alongside quantitative findings allows for a more holistic understanding of educational inequities.

Finally, the fifth tenet advocates for *using numbers for social justice*. This principle underscores the potential of quantitative research to contribute to social change by highlighting inequities and advocating for marginalized communities. A core tenet of QuantCrit is that research should not merely document disparities but actively work toward social justice. Traditional quantitative studies in mathematics education often reinforce deficit-based frameworks by attributing poor educational outcomes to student characteristics rather than systemic inequities. Aligning with this tenet, QuantCrit calls for a transformative approach in which data-driven research serves as a tool for advocacy, policy change, and structural reform. As we review the five tenets proposed by Gillborn et al. (2018), it becomes clear that a shift in quantitative methodologies is necessary for fostering equity in mathematics education. Recognizing the sociopolitical nature of data, challenging traditional statistical assumptions, and centering the voices of marginalized communities are critical steps toward ensuring that mathematics education research serves as a vehicle for justice rather than perpetuating existing disparities.

## **The Intersection of QuantCrit and Mathematics Education**

Mathematics education, long regarded as an objective and neutral domain, has increasingly been scrutinized for its role in maintaining systemic inequities. QuantCrit provides a powerful lens for examining how race, class, and other social factors shape students' experiences and outcomes in mathematics. However, by applying QuantCrit to mathematics education, scholars have an opportunity to flip the script in mathematics education research. Specifically, through the application of QuantCrit mathematics education, researchers can begin to analyze the effects of the racialized nature of mathematics on assessment and achievement. This is important because traditional statistical models often obscure the structural barriers

that disproportionately disadvantage students of color in mathematics learning. Second, mathematics education research can better critique the use of standardized testing as a measure of competence. QuantCrit challenges the assumption that standardized assessments provide an unbiased measure of mathematical ability, instead highlighting how they reinforce racial and socioeconomic disparities. Additionally, mathematics education research can begin to interrogate the role of quantitative research in educational policymaking. Because many policies in mathematics education rely on quantitative data without critically examining the racial and social contexts that shape these numbers. Furthermore, QuantCrit critiques the ways in which traditional quantitative methods in mathematics education research often ignore the voices of marginalized students and communities. By integrating critical perspectives, mathematics education researchers can move beyond simplistic statistical comparisons to uncover deeper structural inequities and advocate for transformative change. In applying QuantCrit to mathematics education, scholars and practitioners are called to rethink how research is conducted, interpreted, and utilized in policy and practice. This framework not only challenges prevailing methodologies but also opens new avenues for pursuing equity and justice in mathematics learning environments.

### **Challenges in Applying QuantCrit in Mathematics Education Research**

The integration of QuantCrit into mathematics education research presents several methodological challenges. Traditional quantitative methods, rooted in positivist paradigms, often fail to account for the sociopolitical contexts that shape students' mathematical experiences. Statistical analyses typically emphasize numerical objectivity, yet they may inadvertently reinforce deficit-based narratives that attribute disparities in mathematics achievement to individual or cultural shortcomings rather than systemic inequities (Gillborn et al., 2018).

One major limitation of conventional quantitative methods is their reliance on standardized metrics, such as test scores and achievement gaps, which can obscure the deeper structural and institutional factors affecting student learning. QuantCrit challenges the assumption that these measures are neutral indicators of ability and instead interrogates how they are shaped by historical and racialized power dynamics.

Beyond methodological constraints, researchers applying QuantCrit must navigate ethical and practical challenges. QuantCrit calls for a more reflexive approach to data collection and interpretation, requiring scholars to critically examine their positionality and the implications of their work. Ethical dilemmas also arise when working with marginalized communities, as QuantCrit necessitates research that does not merely document disparities but actively seeks to challenge and dismantle systemic inequities. Ensuring that findings are not misinterpreted or co-

opted by policy frameworks that reinforce inequitable structures is an ongoing concern.

### **Strategies for Incorporating QuantCrit**

To address these challenges, researchers must adopt methodological strategies that align with QuantCrit's core principles. One key approach is critical data disaggregation, which involves analyzing data in ways that highlight inequities beyond aggregate statistics. Rather than focusing solely on comparative achievement data, researchers can explore how factors such as school funding, teacher expectations, and curricular policies contribute to disparities in mathematics education.

Another strategy is the integration of mixed methods research, where critical quantitative analyses are complemented with qualitative data that capture students' lived experiences. By combining statistical analyses with ethnographic methods, interviews, or counter-narratives, scholars can provide a more nuanced understanding of how inequities manifest in mathematics education (Stage, 2007).

Several studies have successfully incorporated QuantCrit in educational research. For example, Solórzano and Ornelas (2004) used critical quantitative methods to examine the racialized tracking of students in mathematics courses, revealing how institutional policies disproportionately restricted access to advanced coursework for students of color. Similarly, Gillborn et al. (2018) applied QuantCrit to expose biases in educational data reporting, demonstrating how conventional statistical models often conceal the extent of racial disparities in mathematics achievement.

Moving forward, researchers must continue to refine and expand the use of QuantCrit by developing innovative methodologies that challenge traditional paradigms. This includes fostering interdisciplinary collaborations that bring together critical theorists, statisticians, and mathematics educators to reimagine the role of quantitative research in advancing educational justice. By embracing the principles of QuantCrit, scholars can contribute to a more equitable and transformative mathematics education landscape.

### **QuantCrit in Mathematics Education Research**

QuantCrit has increasingly been applied to research on teaching and learning in mathematics education to ensure that mathematics education is equitable and culturally responsive. Several studies illustrate how QuantCrit principles can be embedded in instructional design, teacher preparation, and student engagement. For instance, Apkarian et al. (2024) examine how intersectional, critical, and quantitative methods can be used to analyze instructional practices and their impact on undergraduate students' math affective dispositions. Their study highlights how data-driven curricular changes can support students' confidence and reduce anxiety

in mathematics. Young & Cunningham (2021) repositioned Black girls in mathematics disposition research, arguing that curriculum design must move beyond traditional achievement-focused models to embrace the lived experiences of historically marginalized students. Their findings emphasize the importance of designing mathematics learning experiences that affirm identity and challenge racialized stereotypes. These exemplars demonstrate that embedding QuantCrit principles into curriculum development requires a shift from conventional, skills-based approaches to pedagogies that critically interrogate race, identity, and power within mathematics education.

Assessment remains a key site where QuantCrit can challenge traditional quantitative approaches that often reinforce systemic inequities. The following studies illustrate how QuantCrit-informed research has been used to critique and transform assessment practices in mathematics education. Edosomwan, Young, & Young (2024) analyze the relationship between middle-grade algebra completion and access to advanced Carnegie credits, employing a QuantCrit approach to highlight mathematics placement and advancement disparities. Their study critiques the use of standardized metrics in determining student potential, advocating for assessment models that account for structural barriers. Haskins (2024) examines how stereotype threat and anxiety impact first-year college students' experiences in mathematics. Through a QuantCrit framework, the study deconstructs how assessment practices contribute to students' self-perception and performance, calling for alternative evaluation methods that mitigate racialized anxieties. Rios (2024) applies QuantCrit to multilingual students' experiences in introductory college mathematics courses, analyzing how language, comfort speaking, and collaboration shape assessment outcomes. This study highlights the need for assessment practices that accommodate linguistic diversity and recognize the intersectionality of race and language in mathematics achievement. Vo, Dai, & French (2024) investigate Black girls' mathematics and science dispositions using large-scale assessment data, demonstrating how QuantCrit can be employed to reinterpret standardized testing outcomes. Their findings reveal systemic biases in test design and implementation, supporting the call for alternative assessment frameworks that reflect students' diverse lived experiences. By critically examining how assessment practices reinforce inequities, these studies offer compelling evidence for the need to develop new, equity-centered evaluation methods. QuantCrit challenges the traditional reliance on standardized assessments as neutral measures of ability and instead promotes assessment designs that are reflective of students' sociocultural contexts.

The application of QuantCrit to teaching, learning, and assessment practices represents a transformative shift in mathematics education. By using critical, intersectional, and quantitative methods, these studies illustrate QuantCrit's potential to expose and address systemic inequities that traditional quantitative approaches often overlook. As mathematics education continues to grapple with issues of equity

and justice, these exemplars provide valuable insights into how QuantCrit can be operationalized to foster more inclusive and socially just learning environments.

## Conclusion

The integration of QuantCrit in mathematics education research presents a critical opportunity to address systemic inequities embedded within traditional quantitative methodologies. By acknowledging the ways in which race, power, and structural oppression shape mathematical learning experiences, QuantCrit serves as a transformative framework that challenges deficit-based perspectives and promotes a more just and equitable educational landscape.

As demonstrated, incorporating QuantCrit into curriculum development and instructional practices fosters inclusive learning environments by actively dismantling racialized and intersectional barriers to student participation and achievement. Furthermore, its application to assessment practices reveals the limitations of standardized testing, illustrating how these metrics often reinforce disparities rather than mitigate them. Methodologically, researchers adopting QuantCrit must engage in reflexive practices to ensure their work actively contributes to dismantling inequitable systems rather than reinforcing them.

Looking ahead, the continued expansion of QuantCrit in mathematics education research is imperative. Future studies should explore its integration into large-scale assessment data, teacher preparation programs, and institutional policy evaluations. Additionally, interdisciplinary collaborations between mathematics educators, statisticians, and critical theorists can further refine QuantCrit methodologies, leading to robust, equity-centered research models. Policymakers must also engage with QuantCrit to ensure that data-driven decisions do not perpetuate racial and economic disparities but instead work toward meaningful educational reform.

Ultimately, mathematics education researchers, practitioners, and policymakers must recognize their responsibility in addressing systemic inequities through critical, data-informed approaches. By embracing QuantCrit as both a theoretical and methodological framework, the field can move toward a future where mathematics education is not only rigorous and accessible but also explicitly committed to justice and equity for all learners.

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