Antiracism and the Problems with "Achievement Gaps" in STEM Education

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ABSTRACT

Inspired by the biology education research community's collective reading of Kendi's *How to Be an Antiracist*, I draw together recent articles related to "achievement gaps"—a construct identified by Kendi as perpetuating racist ideas. At the same time, I recognize that, for many in science, technology, engineering, and mathematics (STEM) education, the notion that achievement gaps exist is evidence of a problem that motivates reform. My hope is that this small collection of recent work can stimulate critical reflection on what we mean by "achievement" in STEM, how we can understand the causes of "gaps," and what we might consider to be productive steps toward racial equity and justice.

INTRODUCTION: PROBLEMS WITH ACHIEVEMENT GAPS

This summer, more than 200 members (and colleagues) of the Society for the Advancement of Biology Education Research convened to read *How to Be an Antiracist* by Ibram X. Kendi (2019). This event, and others like it, reflect a growing movement in the science, technology, engineering, and mathematics (STEM) education community toward understanding antiracist ideas and implementing antiracist practices. With the aim of extending that conversation, in this issue of *Current Insights*, I aim to elaborate on a set of critical questions Kendi poses about the phenomenon of "achievement gaps":

> But what if, all along, these well-meaning efforts at closing the achievement gap have been opening the door to racist ideas? What if different environments lead to different kinds of achievement rather than different levels of achievement? What if the intellect of a low-testing Black child in a poor Black school is different from—and not inferior to—the intellect of a high-testing White child in a rich White school? What if we measured intelligence by how knowledgeable individuals are about their own environments? What if we measured intellect by an individual's desire to know? What if we realized that the best way to ensure an effective educational system is not by standardizing our curricula and tests, but by standardizing opportunities available to all students? (p. 103)

In asking these questions, Kendi echoes concerns raised by education scholars over the past two decades about how achievement gaps are understood, talked about, and studied (Ladson-Billings, 2006; Gutierrez, 2008; Milner, 2013). Drawing on Milner (2013), I summarize four interrelated concerns about "achievement gaps":

1. Research on achievement gaps can focus on comparing culturally diverse students with White students without providing compelling or nuanced explanations of the causes of these differences.
2. Such comparisons tend to frame White students as the standard against which all other students should be measured and the forms of achievement valued by White communities (e.g., standardized test scores) as the most important forms of achievement.
3. Descriptions of achievement gaps tend to inspire deficit framings of students and their communities.

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4. Discourse on achievement gaps tends to locate the problem with individual students, implying a need to "fix" students and drawing attention away from systemic problems and solutions (Ladson-Billings, 2006).

I introduce these concerns to provide some critical context that can help readers put the following three articles into a larger conversation.

REPORTING ON ACHIEVEMENT GAPS CAN AMPLIFY RACIAL STEREOTYPES

Quinn, D. (2020). Experimental effects of "achievement gaps" news reporting on viewers racial stereotypes, inequality explanations and inequality prioritization. *Educational Researcher*, *49*(7), 482–492. https://doi.org/10.3102/0013189×20932469

One concern about frequent discussions of "achievement gaps" is that they create an association between students of color and poor achievement, which may feed racist stereotypes about these students and their communities. Quinn examines this possibility experimentally, investigating how viewing a news story about achievement gaps influences measures of implicit or explicit racial stereotyping.

For these experiments, Quinn recruited participants from online survey platforms and randomly assigned them to view one of three short videos. The achievement gap (AG) video was a short TV newscast reporting on "disappointing numbers" showing that "the wide achievement gap … between White and minority students is not getting any smaller." A counter-stereotypical (CS) video showed images of Black students at school, "discussing their academic goals and sharing what they like about their school." Finally, a "control" condition showed participants an instructional video on the Pythagorean theorem.

Quinn found that viewing the AG video increased two measures of stereotyping. The first measure asked respondents to predict the high school graduation rate for Black students (after telling them that the rate for White students was 86%). While respondents across all treatments underestimated the actual graduate rate (78%), those randomly assigned to the AG video reported estimates on average 7% lower (study 1 effect size = 0.30 SD; study 2 effect size = 0.38 SD). The second measure was an implicit bias test for associations between race and competence. Once again, while this test revealed a bias against Black students in all respondents, those who viewed the AG video showed an increase in bias (study 1 effect size = 0.22 SD; study 2 effect size = 0.12 SD, ns).

Quinn argues that these experimental results support the possibility that pervasive achievement gap reporting may perpetuate stereotypes. He proposes two psychological mechanisms that can explain this pattern. One is representativeness heuristic reasoning, which leads people to overweight between-group differences (in this case overinflating differences in high school dropout rates). A second is associative learning, which can exacerbate implicit biases (in this case reinforcing associations between Black students and low competence).

Quinn points out that these mechanisms do not alter people's beliefs. In his study, he found no evidence that the AG video influenced respondents' beliefs about what caused achievement gaps (e.g., racism, school quality, genetics), nor did it affect their beliefs about the importance of addressing educational inequities (positively or negatively). Thus, Quinn suggests that the video acts primarily to exacerbate existing biases (recall that all respondents exhibited negative biases).

In concluding, Quinn states that, "these findings do not mean that we should cease all measuring or reporting on between-group differences in outcomes." However, he does argue that these findings lend support to concerns that achievement gap discourses may reinforce deficit framings of students (as lacking educational competence) and their communities (as undereducated), suggesting that how we talk about these problems needs to change.

TRADITIONAL INSTRUCTION EXACERBATES INEQUITIES

Theobald, E. J., Hill, M. J., Tran, E., Agrawal, S., Arroyo, E. N., Behling, S., … & Grummer, J. A. (2020). Active learning narrows achievement gaps for underrepresented students in undergraduate science, technology, engineering, and math. *Proceedings of the National Academy of Sciences USA*, *117*(12), 6476–6483. www.pnas.org/cgi/doi/10.1073/pnas.1916903117

Theobald and a team of 32 researchers questioned whether the nature of instruction—traditional lecturing or active learning—could be responsible for differential achievement in undergraduate STEM courses.

To study this question, the team conducted a meta-analysis of studies in which the same instructor taught different sections using traditional and active-learning methods. They included only data sets that provided demographic data on students' race and ethnicity or socioeconomic status. The final data set included a total of 41 studies, 15 that reported exam scores and 26 that reported course failure rates. To increase statistical power, the team created a category called "minoritized groups in STEM" (MGS), which combined underrepresented minority students (Black, Latinx, Native American) with low-income students. Comparisons in this study are between this aggregate group and non-MGS students.

The researchers found that, on average, active-learning instruction reduced differences in exam scores by 33% (a difference of 0.62 SD was reduced to 0.42 SD) compared with traditional instruction. Active-learning instruction also increased passing rates by 45% on average (from a 7% difference to a 4% difference in rates). Crucially, the analysis also revealed that the amount of class time devoted to active learning was positively correlated with reductions in gaps and that only classrooms in which active learning accounted for more than 67% of instructional time were able to significantly narrow gaps in exam scores or failure rates. At low levels of active learning, the trends were often reversed, with non-MGS students gaining more benefit from active learning than MGS students.

These findings lead the authors to conclude that "widespread and immediate adoption active-learning instruction should be a high priority in STEM education". Though they caution that such instruction should be "high quality," which these results suggest is at least correlated with the proportion of class time spent on active learning.

In addition, the authors offer two recommendations for educators seeking to further promote equity in their active-learning instruction. The first describes implementing structures and supports that give students opportunities for deliberate, repeated practice with learning desired knowledge and skills. The second calls on educators to treat all students with dignity and respect, for example, by creating a culture of "belonging" in STEM classes.

Kendi's questions help identify a possible tension between these recommendations. A focus on repeated practice, "designed to address specific deficits in understandings or skills," defines success in STEM narrowly, according to traditionally White standards of achievement. Creating a culture of belonging may require, as Kendi suggests, expanding notions of what counts as achievement to draw on and develop students' assets. The next article illustrates how narrow definitions of success in mathematics directly contribute to historically marginalized students' perceptions that they do not belong.

STUDENTS' PERCEPTIONS OF OPPRESSION IN MATHEMATICS INSTRUCTION

Leyva, L.A., Quea, R., Weber, K., Battey, D., Lopez, D. (2020). Detailing racialized and gendered mechanisms of undergraduate precalculus and calculus instruction. *Cognition and Instruction*, *39*(1), 1–34. https://doi.org/10.1080/07370008.2020.1849218

Leyva and his research team approach the question of how and why mathematics instruction contributes to marginalization by studying students' perceptions of day-to-day instruction. To do so, the team recruited 20 first- or second-year undergraduate students who self-identified as either a Black woman, Black man, Latina woman, Latino man, or White woman.

Over a semester, the researchers asked students to journal about their experiences in their math classes. One component of this journaling included describing and reacting to "uncomfortable or discouraging instructional events." Across two semesters of running this study, the team collected 85 such moments from students' journals. For example, one described an instructor communicating to a class that if they could not solve a problem quickly, they should drop down a level or not take Calc 2. Next, the research team chose a small subset (four to five each semester) of these events and edited them to present to students in interviews. Each semester, 10 students were interviewed about their perceptions of and reactions to these events. Transcripts of these interviews then formed the main data set for analysis.

The aim of the analysis was to understand how systemic forms of oppression, such as racialized or gendered stereotyping or institutional barriers, make their way into instructional interactions. To identify these links, the team first coded interviews for evidence that students were perceiving oppressive ideologies or institutional barriers. Next the team coded for instances in which students perceived oppression in specific instructional moments.

Students perceptions revealed two main mechanisms that allow oppression to show up in everyday mathematics instruction. First, students saw racialized and gendered stereotyping playing out when instructors ignored students or dismissed their questions. Second, the institutional effects of underrepresentation (being one of few students from an identity group) left students without the solidarity of within-group peer support, exacerbating feelings of exclusion and leaving students to navigate those feelings alone.

One conclusion of this work is that everyday instructional events, even those that do not explicitly make references to race or gender, can be perceived by students as oppressive. The authors explain that this is because mathematics classrooms are not isolated from sociohistorical contexts. Mathematical ability has long been interpreted according to racial and gendered hierarchies, and students feel these effects in classrooms. Second, classroom contexts are not immune from the consequences of systematic gatekeeping, which keep students isolated from their within-group peers. Leyva and coauthors argue that, because these mechanisms continue to go unrecognized and undisrupted, inequities continue to be reinforced through traditional mathematics instruction.

Leyva and his team offer a few suggestions that instructors can use to attempt to disrupt structures of oppression. First, they ask instructors to develop their own awareness of how racialized and gendered ideologies can make their way into the classroom and to work to actively counter them. For example, by setting norms that value mathematical thinking and curiosity over speed and accuracy and by setting up structures that promote collective understanding over individual success or deficits, instructors can create classroom cultures less likely to evoke racialized or gendered stereotypes. Second, instructors can potentially mitigate isolation by encouraging collaboration and specifically making space for students to form supportive within-group peer connections.

One limitation of this research is that it studied a limited number of students at a single university. Nevertheless, the revelation that students perceive influences of marginalization in traditional mathematics classes suggests the possibility that these mechanisms may occur across traditional STEM instruction and provides a "qualitative baseline" on which future work can build.

REVISITING THE PROBLEMS WITH ACHIEVEMENT GAPS

These articles were sampled from the current state of research and thinking on the persistent inequities in STEM education. With respect to the concerns raised at the beginning of this piece, I offer the following concluding thoughts. First, instruction matters. In different ways, the work of Theobald *et al.* and Leyva *et al.* highlights the inequities perpetuated by traditional, lecture-based STEM instruction. Second, instruction is not immune from society. The racialized stereotypes and structural forces that have created the long-standing "education debt" (Ladson-Billings, 2006) owed to students of color are plainly visible to these students in the day-to-day interactions of instruction. Finally, the way researchers and educators frame discussions about "achievement" matters for how students, educators, and society at large understand what achievement means and who can achieve in STEM.

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