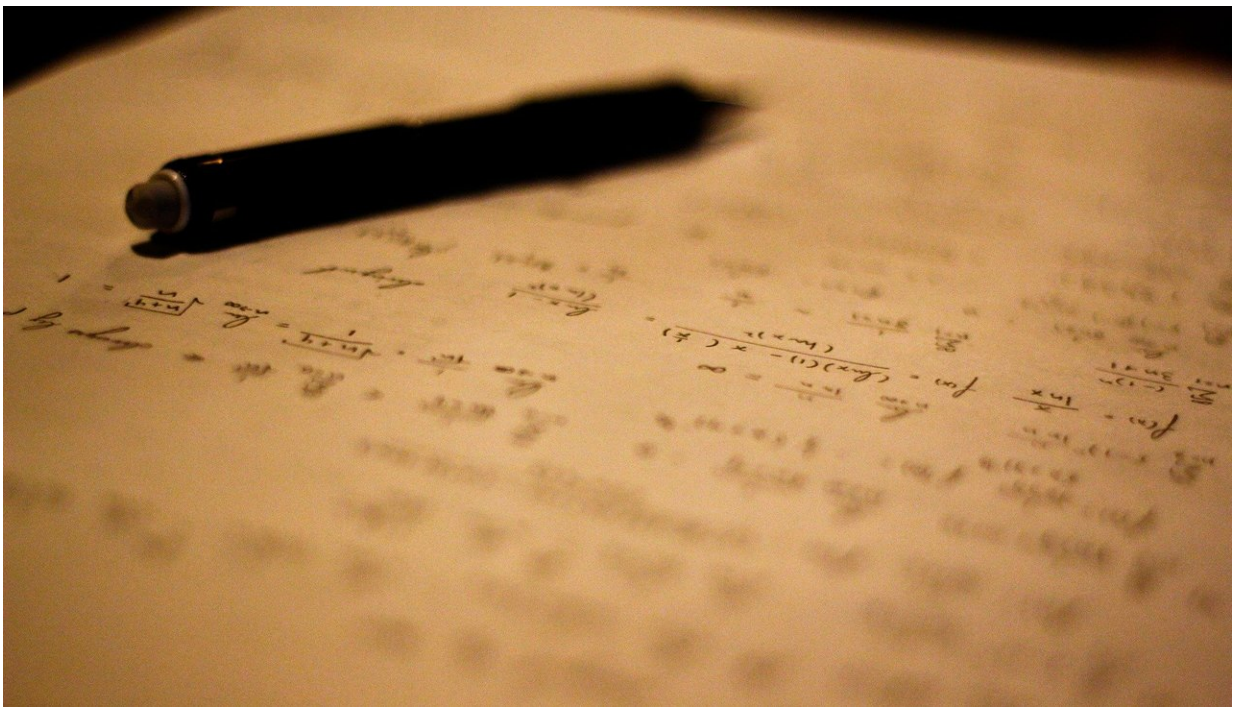
Calculus instruction methods reveal mechanisms that discourage BIPOC participation in STEM

March 5 2021, by Evan Curran



Credit: CC0 Public Domain

Luis Leyva, assistant professor of mathematics education at Vanderbilt University and director of PRISM (Power, Resistance & Identity in STEM) at Peabody College, led a research team that recently identified mechanisms in undergraduate calculus instruction that contribute to the

function of introductory mathematics as a gatekeeper to STEM majors among Black students, Latin students and white women.

Findings from this research are presented in a paper, "Detailing Racialized and Gendered Mechanisms of Undergraduate Precalculus and Calculus Classroom Instruction," published in the January 2021 edition of *Cognition and Instruction*. This research is part of a larger project for which Leyva serves as principal investigator. The project, COURAGE (Challenging, Operationalizing, and Understanding Racialized and Gendered Events) in Undergraduate Mathematics, received funding from the National Science Foundation's Division of Undergraduate Education (Improving Undergraduate STEM Education).

Leyva and fellow researchers at Rutgers University conducted a study that examined underrepresented students' perceptions of calculus instruction in a large, public, and historically white research university in the northeastern United States. Using individual interviews with 20 undergraduate students underrepresented in terms of race and gender, the research team explored features of calculus instruction that contributed to experiences of racial and gender oppression.

The team centered interviews around stimulus prompts of instructional events collected through study participants' journaling of calculus classroom experiences. One event called "course drop," for example, features an instructor advising an entire class to consider dropping down a course level or not continuing onto Calculus 2 if students could not solve a problem quickly. Participants perceived this type of event as frequently occurring in calculus instruction. Leyva and his team documented how participants' awareness of Black people, Latin people and white women as underrepresented in scientific fields contributed to questioning their sense of belonging and ability as aspiring STEM majors.

In addition to activating narrow ideas of who belongs in STEM, Leyva found another common mechanism across underrepresented students' perceptions of calculus instruction as an oppressive experience. This mechanism occurred during instructional moments when students' contributions are dismissed or neglected in calculus classrooms. Underrepresented students perceived such instances as aligning with racial and gender stereotypes of mathematics, which limited their comfort level for asking questions or sharing their ideas in calculus classrooms.

Taken together, the discouraging mechanisms that Leyva and his team documented reveal that stereotypes, underrepresentation, and other broader influences of oppression are often unchallenged in traditional forms of calculus instruction. Leyva suggests that instructors of these courses need to approach instruction with awareness of how these influences uniquely impact underrepresented students' classroom experiences, which have major implications for diversifying STEM fields.

"With greater awareness of how stereotyping shapes instructional mechanisms," Leyva said, "instructors can develop norms of engagement with their students to avoid inadvertently perpetuating racial and gendered hierarchies of mathematical ability that produce inequitable learning opportunities in calculus."

More information: Luis A. Leyva et al. Detailing Racialized and Gendered Mechanisms of Undergraduate Precalculus and Calculus Classroom Instruction, *Cognition and Instruction* (2020). DOI: 10.1080/07370008.2020.1849218

Provided by Vanderbilt University