

adhere and contribute to identity-based disparities within the broader society. The call this time, however, is even broader and includes the following corollary: *The responsibility for redressing these deep inequities should not be relegated to a small, impassioned group of reformers but shared by the entire community of faculty members and academic researchers who steward the undergraduate mathematics education corridor.* Simply put, the responsibility for redressing injustice belongs to all of us.

As Kilpatrick (2013) argues, we need more research and more researchers within this community toward “seeing our work whole” (p. 173)—that is, toward seeing the whole of undergraduate mathematics education collectively and fully serve all learners and, ultimately, toward contributing to the advancement of our society. This volume represents considerable, yet ultimately incremental, progress toward that goal.

This volume also represents an invitation—an invitation to engage. No matter what your particular area of focus may be, it is necessary to consider how your work can connect to and expand the imperatives of greater diversity, equity, and inclusion. The authors of this volume are working toward this goal and offer all of us evidence that this work is not just possible but vital and crucial.

Justice through the lens of calculus as an evolving framework seeks to unify a vision for calculus programs that are diverse, equitable, and inclusive while critically examining how they are situated within current power structures and levels of enactment. Drawing on the joint vision from *TODOS: Mathematics for ALL*¹ and the National Council of Supervisors of Mathematics (NCSM), “A social justice stance requires a systemic approach that includes fair and equitable teaching practices, high expectations for all students, access to rich, rigorous, and relevant mathematics, and strong family/community relationships to promote positive mathematics learning and achievement. Equally important, a social justice stance interrogates and challenges the roles power, privilege, and oppression play in the current unjust system of mathematics education—and in society as a whole” (todos-math.org). Toward that end, our collective work must expand and include fervent attention to how our students and colleagues are experiencing not only mathematical content and processes writ large but also critically analyzing longstanding legacies of exclusion, tracking, and gatekeeping practices; status-laden hierarchies; and a variety of implicit practices that all-too-often inveigle individuals to shed parts of their identities in order to belong.

References

Kilpatrick, J. (2013). Needed: Critical Foxes. In K. R. Leatham (Ed.), *Vital Directions for Mathematics Education Research* (pp. 173–187). New York: Springer.

¹*TODOS: Mathematics for ALL is an international professional organization that advocates for equity and excellence in mathematics education for ALL students—in particular, Latina/o students.*

Introduction to this Volume

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Preface

The idea for creating this volume emerged from an NSF-funded research project entitled “Progress through Calculus” (DUE I-USE #1430540). The focus of the Progress through Calculus (PtC) project was to examine the Precalculus through Calculus II course sequence and associated supports in United States (U.S.) colleges and universities. The project consisted of two phases of data collection and analysis. In the first phase, a national census survey was sent to mathematics departments offering a graduate degree (master’s or Ph.D.) in mathematics. The survey gathered information to better understand the characteristics of successful calculus programs. In the second phase of the project, in-depth longitudinal case studies were conducted at 12 colleges and universities. The case studies investigated models of the Precalculus through Calculus II sequence, their implementations, and their impact on student outcomes. More details about the entire project are located at: <https://maa.org/ptc>.

As a result of this research, Editors Hagman, Voigt, and Gehrtz formed a thematic research team examining issues of diversity, equity, and inclusion (DEI) across the national census survey data and the 12 case study universities. It became clear that while many of the members of mathematics departments valued issues of DEI, most did not yet have actionable ideas or strategies for addressing these ideas locally within their departments. Additionally, many departments pointed towards broader university-wide programs for addressing issues of DEI, with only a select few having local initiatives within the purview of the mathematics department.

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As such, the Editors saw a clear need to gather a multitude of ideas, works in progress, and creative solutions to systemically and centrally address topics of diversity, equity, and inclusion in mathematics programs.

Through generous support from the National Science Foundation, we were able to address this need through the development and creation of a resource attending to DEI in Calculus programs that could be made available to the broader mathematics community. This volume began with a call for individual case studies (see Figure 1) from math departments attending to DEI issues, which became the 30 case studies of this volume. The case study submissions were generally written by mathematics faculty engaged in teaching and administering the Calculus programs.

Upon analysis of the case studies, we identified salient topics within the submissions and invited Mathematics Educators to author cross-cutting thematic chapters. We asked this group of thematic authors to read the case studies, situate them in extant literature, and create a future vision

Scope: The MAA Notes Volume on Diverse Equitable and Inclusive (DEI) Issues in Calculus Programs encourages a broad array of submissions that highlight issues of DEI in introductory mathematics programs with special attention to precalculus, differential calculus, and integral calculus and surrounding departmental programs to support students in these courses. For this volume we are soliciting “illustrative case studies” that showcase ways in which departments and instructors are attending to promoting diverse introductory mathematics programs, achieving, or monitoring equitable student outcomes and experiences, and promoting inclusive teaching practices. Achieving and promoting DEI issues in introductory mathematics programs is not an easy undertaking so we encourage submissions of models in progress, discussions of potential obstacles, challenges, and what departments/instructors have done to overcome barriers to address these issues. We also encourage collaborations between mathematics department members and people outside the department involved in programs, such as individuals in administrative positions or working with student support centers. Submissions might address (but are not limited to) the following topics: a) How coordination can support fairness and also justness b) How placement procedures can value multiple ways to demonstrate readiness c) How professional development (for faculty, instructors, and GTAs) can address DEI d) How changes to the curriculum respond to an increasingly diverse student population e) How departments/universities collect and use data to inform changes related to DEI f) How centers or programs operate to support inclusion and student success in STEM.

Figure 1. Call for Case Studies included in this volume.

for a more diverse, equitable, inclusive, and justice-oriented field of mathematics. The thematic authors also pose questions to the readers of this volume to allow for further exploration and insights into local contexts. In addition to the cross-cutting thematic authors, we recruited an author team to bring in student voices and another author team to share relevant data to problematize how we measure DEI efforts and to situate this volume in its historical period. The authors and Editors met several times to choose and discuss the cross-cutting theme chapters of interest that were relevant to the ideas discussed in the case studies.

We want to acknowledge our own struggles as we curated a collection of voices, the concurrent privilege and burden of doing this work, and all the power dynamics that can come into play. Our goal was mindful, respectful, and collaborative work. At the same time, during the development of this volume, we were challenged to think about our positionality and how to ensure the presence of diverse voices within this volume. Even with the best intentions of promoting diversity, equity, and inclusion, our push to develop the volume needed to be balanced and paused at times to ensure that multiple perspectives were being given space. As such, we began a re-envisioning of our project. We altered authorship and editorial teams, included student voices in authorship, and explicitly reframed and changed how we presented the case studies and chapters in this book to promote an anti-deficit framing.

Our work on this volume occurred during some extraordinary moments of national focus on race, violence, disinformation, and the disruption caused by a global pandemic. Many of us experienced personal trauma and loss while we were in the process of creating this work. The Editors feel grateful that this community has been a source of hope, support, and friendship. We hope that you will find ideas, solace, and discomfort in this book as you engage on a journey of supporting issues of diversity, equity, and inclusion in your own context.

Acknowledgments and Dedication

The Editors would like to acknowledge support from the National Science Foundation (DUE-1432381), the Mathematical Association of America, and the American Mathematical Society. In addition, we would like to thank the MAA Notes Volume Editor and Reviewers, the Progress through Calculus research team, and the case study and chapter author teams. We would also like to thank each other as well as our families, friends, and colleagues who have walked this road with us. A special thank you to Kiera Edwards for her expertise in preparing the grant supplement, Victoria Barron for her support in updating references and citations, and Destinee Cooper for her assistance in formatting and reviewing the volume.

We dedicate this volume to anyone who has received the message that mathematics was not for them. We dedicate this volume to anyone who felt they did not belong in

mathematics. And finally, we dedicate this volume to you, the reader, for taking the time and energy to engage with these issues.

CALCULUS: Crossing the Bridge to Success in STEM

Elaine A. Terry

Introduction

A private Jesuit Catholic university, Saint Joseph's is located in Lower Merion and Philadelphia counties. Founded in 1851 as Saint Joseph's College for men today the university is a coeducational institution with a student population of approximately 8,300 including undergraduate (day and evening), graduate and doctoral degree students. The undergraduate day program is approximately 77% white and 14% from an underrepresented group which includes African-American and Hispanic (non-Black). In any one academic year more than one hundred first-year students declare a STEM (natural sciences, mathematics, computer science) major. Many first-year STEM students experience difficulty handling the challenges of taking a college mathematics course (pre-calculus or calculus) and one or two lab science courses simultaneously. By the end of their freshman year some of them have made the decision to switch to a non-STEM major. Those that remain in STEM have the false belief that low and even failing grades will not prevent them from entering medical, professional or graduate school. While these are issues that may affect all STEM students, it is especially a difficulty for underrepresented students, who represent a small but significant number of STEM majors. Studies suggest that with early intervention underrepresented students can successfully complete an undergraduate STEM program. *CALCULUS: Crossing the Bridge to Success in STEM (CB-STEM)* was developed in order to equip first-year underrepresented students with the tools necessary for success in a STEM major. CB-STEM is a four-week summer pre-college non-residential program. It is the first intervention program at the University to address the gap in STEM education specifically for underrepresented (African-American, Hispanic (Non-Black) and First-Generation) students at the pre-freshman level. As a multi-faceted program, the primary goal is to provide incoming underrepresented students with the tools and resources that are beneficial for their first year in college as a STEM major.

To be considered for the program, students must meet the following criteria:

- Be admitted as a full-time student to the University.
- Be a first-time incoming college freshman with a declared STEM major.
- Be classified as a member of an underrepresented group which includes African-American, Hispanic, and First-Generation college students.
- Have completed pre-calculus or calculus in high school.

Students that are accepted into the program are expected to participate in academic and informational workshop classes. There is no cost to students to participate in the program.

The primary objectives of CB-STEM are:

- To increase participants' chances of passing their first college calculus course.
- To introduce students to: lecture format, classroom technology, laboratory class, faculty expectations, and college-level exams.
- To help students gain an understanding of good study habits, techniques, and skills.
- To introduce students to STEM faculty.
- To expose students to available academic resources at the University.
- To help students to connect with and build community with other first-year STEM students.

There are three academic workshops that are designed to make students aware of the rigorous requirements of the Saint Joseph's STEM major. The foundation of the program is the mathematics workshop, which uses *Previews to Calculus* worksheets to help teach and reinforce early calculus concepts including the limit and the derivative. More information about the mathematics workshop as well as a brief overview of the biology and chemistry workshops follow. A fourth seminar is designed to give students information that will be beneficial to them socially, academically, and professionally.

Natural Science and Informational Workshops

The three one-week academic workshops introduce students to the rigorous course expectations of the Saint Joseph's STEM curriculum. The workshops were organized in conjunction with two University professors from the departments of biology and chemistry. The three of us met to discuss the program and agree upon its structure. Each workshop met for sixty-minutes for four consecutive days. We discussed the difficulties that many students have with these courses as first-year STEM students. It was agreed that students would benefit by learning about course expectations, how to take notes, homework, and write lab reports. Students were also given information about studying for tests and test taking strategies. We all cited the lack of these skills as the primary reasons for lack of success as a first-year STEM student.

A fourth workshop is conducted by a University administrator who has experience working with underrepresented

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