Transforming Mathematics Teacher Education

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Editors

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An Equity-Based Approach

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To the six moms

Preface

This book is intended for all mathematics educators committed to transforming mathematics teacher education with an explicit focus on equity. We (the editors) provide guidance and examples to those working with prospective and practicing teachers of mathematics who want to create positive, culturally responsive, and equitable mathematics experiences for our nation's youth. The ideas and approaches discussed in this book build on the Teachers Empowered to Advance Change in Mathematics (TEACH Math) project,[1] which had specific goals focused on developing a new generation of preK-8 mathematics teachers to connect mathematics, children's mathematical thinking, and community and family knowledge – or what we have come to call children's *multiple mathematical knowledge bases* – in mathematics instruction. Part of our work in the TEACH Math project included the development of three instructional modules (for mathematics methods courses[2]) to support the project's goals (see Chap. 2 for details about the modules). The TEACH Math project leaders, who are the editors of this book, used and refined these modules over eight semesters, after which, in Fall 2014, a dissemination conference was held to share our material with other mathematics teacher educators from a variety of universities across the United States.

The ideas for this book emerged at the TEACH Math writing conference in June 2016. This conference brought together the mathematics teacher educators who had attended the dissemination conference and who had used and adapted the modules in their own contexts (including, but not limited to, mathematics methods courses). The authors represent diverse programs and geographical contexts and teach prospective and practicing teachers from a variety of socioeconomic and ethnic backgrounds. This book shares the experiences of these mathematics teacher educators.

[1] The TEACH Math project was funded by a grant from the National Science Foundation (Grant No. 1228034). Any opinions, findings, conclusions, or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

[2] Mathematics methods courses in the United States tend to be one or two quarters or one semester in duration as part of one's undergraduate teacher education program, with a specific focus on the teaching and learning of mathematics.

The authors provide accounts of supports, challenges, and tensions that they have encountered in implementing equity-based mathematics teacher education. We view these chapters as providing rich evidence and illustrative examples for how other mathematics teacher educators and professional developers[3] might make the modules work for their unique practices, courses, workshops, and teachers.

Part I of the book includes three chapters written by TEACH Math project leaders, and we see these three chapters as providing a foundation for understanding the work described in the rest of the book. Specifically, Chap. 1 describes the story of the TEACH Math project and highlights the project's conceptual and theoretical underpinnings. Chapter 2 describes each of the three modules in detail, including each module's goals and distinct activities. Chapter 3, then, draws on our experiences as TEACH Math project leaders to highlight various decisions mathematics teacher educators may likely need to make as they prepare to use the modules in their own contexts.

Part II focuses on work around the Community Mathematics Exploration (CME) module. This section begins with Crystal Kalinec-Craig and Maria del Rosario Zavala (Chap. 4) sharing the ways they used the CME in their own contexts and identifying important entry points and scaffolds for prospective teachers across various moments during their courses. In Chap. 5, Craig Willey and Weverton Ataide Pinheiro share their experiences in implementing the CME in their urban elementary teacher education program and describe its impact on prospective elementary teachers' outlooks on culturally relevant mathematics teaching with urban youth. Considering other ways the CME might impact prospective teachers, Kathleen Stoehr (Chap. 6) examines prospective teachers' reflections after engaging in a CME, demonstrating that the CME can be a valuable tool to support their understanding of how to make connections in their mathematics teaching to their student's home and community experiences and practices. Concluding this section, in Chap. 7, Zavala and Stoehr analyze prospective teachers' CME work to better understand how they bring forth ideas of social justice into mathematics tasks that have strong connections to students' communities.

The chapters in Part III center on work with activities in the Classroom Practices Module. In Chap. 8, Amy Parks and Anita Wager describe how the video lenses tool in the module can support teacher educators preparing PK-3 teachers, providing suggestions for extending the video lenses tool with questions particular to early childhood contexts. In Chap. 9, Julie Amador and Darrell Earnest consider the Curriculum Spaces Analysis tool as a support for prospective teachers' curricular noticing, particularly with respect to analysis of curriculum materials in ways that enable the integration of students' mathematical and community resources.

Part IV considers ways that identity and positionality work shape our praxis as mathematics teacher educators. In Chap. 10, Crystal Kalinec-Craig, Theodore

[3] Although the modules were developed for mathematics methods courses, we have used the materials with practicing teachers in graduate courses and in professional development contexts. We encourage the readers to consider and adapt the modules for other teacher learning and development courses and workshops.

Chao, Luz Maldonado, and Sylvia Celedón-Pattichis analyze their own and their prospective teachers' work with a Mathematics Autobiography assignment (an activity we used in TEACH Math as a precursor to the Mathematics Learning Case Study Module) as a means of supporting more mathematics teachers and teacher educators to adopt a humanizing stance toward mathematics education. In Chap. 11, these same authors describe various activities they use to engage prospective teachers in critical reflection on their identities and positionalities before they engage in specific TEACH Math module activities. These activities include Photovoice Interviews (Chao), *Numbers about Me* Posters, and *Instagram* Math Trails (Maldonado), exploring Rights of the Learner (Kalinec-Craig), and Mathematics Autobiographies (Celedón-Pattichis). Finally, Gladys Krause and Luz Maldanado (Chap. 12) analyze and use scenarios shared by bilingual prospective teachers to consider the implications for teacher preparation programs as they strive to provide prospective teachers with situational awareness and instruction attuned to bilingual students' needs.

This book is the product of the experiences and expertise of 19 individuals who are committed to the improvement of mathematics teacher education. We are indebted to the authors who have contributed to this book, and we appreciate their willingness to share their work.

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Julia M. Aguirre is associate professor of Education at the University of Washington Tacoma. Her research interests include equity and social justice in mathematics education, teacher education, and culturally responsive mathematics pedagogy. A primary goal of her work is preparing the new generations of teachers to make mathematics education accessible, meaningful, and relevant to today's youth. She is coauthor of the book *The Impact of Identity in K-8 Mathematics: Rethinking Equity-Based Practices.*

Julie M. Amador is associate professor of Mathematics Education at the University of Idaho. She is interested in the integration of technology into mathematics education for prospective and practicing teacher learning. Her research centers on professional noticing, specifically around curriculum, students' mathematical thinking, and the use of technology. She also researches methods to provide mathematics professional development to rural teachers via distance technologies. She is coeditor of a department for *Mathematics Teaching in the Middle School.*

Tonya Gau Bartell is associate professor of Mathematics Education at Michigan State University. Her research focuses on issues of culture, race, and power in mathematics teaching and learning with particular attention to teachers' development of mathematics pedagogy for social justice and pedagogy integrating a focus on children's multiple mathematical knowledge bases. She is a coeditor of the *Journal of Teacher Education* and editor of the monograph book *Toward Equity and Social Justice in Mathematics Education.*

Sylvia Celedón-Pattichis is senior associate dean for Research and Community Engagement and professor in the Department of Language, Literacy, and Sociocultural Studies at the University of New Mexico. Her research interests focus on studying linguistic and cultural influences on the teaching and learning of mathematics, especially with emergent bilinguals, and on preparing teachers to work with culturally and linguistically diverse students. She serves on several advisory boards for National Science Foundation-funded projects and on the Editorial Boards

for the *Journal of Latinos and Education* and the *Bilingual Research Journal*. Her most recent work includes *Access and Equity: Promoting High Quality Mathematics in Grades PreK-2 and Grades 3-5.*

Theodore Chao is assistant professor of Mathematics Education in the Department of Teaching and Learning at The Ohio State University. His research agenda involves empowering all students and teachers regardless of social identity (race, gender, socioeconomic status, etc.), to learn and teach mathematics, particularly through technology. He uses photovoice interviews to explore how mathematics teachers of color connect their mathematics teacher identities with racialized social identities. He also builds mobile app technology to help children share mathematical strategies with each other, opening up windows for teachers to listen to children's mathematical thinking. He has published in journals such as *Investigations in Mathematics Learning, Contemporary Issues in Technology and Teacher Education, Mathematics Teacher Education and Development, Digital Experiences in Mathematics Education,* and *Education Sciences.*

Corey Drake is professor and director of Teacher Preparation at Michigan State University. Her research interests include teachers learning from and about curriculum materials, as well as the roles of policy, curriculum, and teacher preparation in supporting teachers' capacity to teach diverse groups of students. Her work has been funded by the National Science Foundation and the Spencer Foundation and is published in venues including *Educational Researcher, Journal of Teacher Education,* and *Journal of Mathematics Teacher Education.*

Darrell Earnest is assistant professor of Education at the University of Massachusetts, Amherst. His research focuses on cognitive development in mathematics and the relationship of learning with culture and power. In particular, his research explores the role of representations and tools in learning and instruction. In addition to his focus on elementary mathematics teacher education, he currently is involved in investigating the teaching and learning of time and the development of time literacy among students from elementary to undergraduate years.

Mary Q. Foote is professor emerita of Mathematics Education from the Department of Elementary and Early Childhood Education at Queens College, City University of New York. Her research attends to equity issues in mathematics education and broadly examines issues in mathematics teacher education. More specifically, her interests are in cultural and community knowledge and practices and how they might inform mathematics teaching practice. She is currently involved in researching and developing/facilitating two professional development projects: one supports teachers to teach mathematical modeling using cultural and community contexts in Grades 3–5, and the other supports teachers to develop more equitable instructional practices through action research projects that incorporate an examination of access, agency, and allyship in mathematics teaching and learning.

Crystal Kalinec-Craig is assistant professor of Curriculum and Instruction at the University of Texas at San Antonio. Her research examines issues of (in)equity in mathematics education and teacher education. As a graduate student who worked with the TEACH Math project, she uses children's mathematical thinking and funds of knowledge as the cornerstones to her teaching and research in elementary and middle grades contexts and the notion of children's Rights of the Learner to help teachers adopt democratic, strength-based practices that interrupt issues of unequal status and participation among students. As the co-director of the Support and Enrichment Experiences in Mathematics (SEE Math) project, her prospective teachers use the TEACH Math Case Study Module to elicit and support children's thinking as it relates to their home and community knowledge.

Gladys H. Krause is assistant professor of Mathematics Education at William & Mary College. Her research centers on teacher knowledge and children's mathematical thinking and how these two areas interact in classroom settings which involve multilingual and multicultural dynamics. She focuses on creating a consistent and robust framework for conceptualizing teacher knowledge of children's mathematical thinking, situated in the practice of anticipating student strategies for fraction problems, and how teachers select numbers for problems to support fraction understanding. Her work also extends to work with bilingual parents and communities to support the development of a more equitable mathematics pedagogy.

Luz A. Maldonado is assistant professor of Bilingual Mathematics Education at Texas State University in San Marcos. She earned her PhD in Mathematics Education with a doctoral portfolio in Mexican American Studies from the University of Texas at Austin. She conducts professional development sessions on Cognitively Guided Instruction with elementary teachers from Texas, Arkansas, and Florida. Her primary research interests follow the mathematical learning experiences of the bilingual learner, from elementary student to prospective teacher, in particular, documenting empowering teaching and learning practices. She is currently interested in understanding translanguaging in the bilingual elementary classroom, in which students are encouraged to develop their bilingual identities and utilize their entire linguistic repertoires to engage in mathematics.

Amy Roth McDuffie is professor of Mathematics Education and associate dean for Research for the College of Education at Washington State University. Her research focuses on teachers' professional development with attention to teachers' practices related to equitable pedagogies and curriculum use in mathematics education. In addition to TEACH Math, she has served as co-PI on two other National Science Foundation-funded projects: *Developing Principles for Mathematics Curriculum Design and Use in the Common Core Era* and *Mathematical Modeling with Cultural and Community Contexts*. She was the series editor for the National Council of Teachers of Mathematics' *Annual Perspectives in Mathematics Education* (2014–2016).

Amy Noelle Parks is associate professor of Early Childhood Education in the Department of Teacher Education at Michigan State University and author of *Exploring Mathematics Through Play in the Early Childhood Classroom* (Teachers College Press). She has recently worked on parent education videos about early childhood mathematics. These can be seen at http://video.wkar.org/show/wkar-specials/shorts.

Weverton Ataide Pinheiro is a second year PhD student and associate instructor of Mathematics Education at Indiana University Bloomington. His research is focused on Critical Mathematical Studies (MathCrit), with an emphasis on mathematical identity. More specifically, his interests are in understanding how students majoring in mathematics construct their mathematician identity, focusing on the phenomenon in the United States leading to the majority of mathematicians being straight men. He is also interested in understanding how the intersectionality between race and gender influences students' mathematical identity development. Currently, he is involved in a research project investigating how college level students generalize in advanced mathematical domains and how teachers learn to design and implement specific curriculum that supports secondary students' generalization.

Maria del Rosario Zavala, PhD is assistant professor of Elementary Education at San Francisco State University, specializing in mathematics and bilingual education. Her research focuses on mathematics identity development of students and teachers, the role of racial and linguistic identities in learning mathematics, and racial justice in mathematics.

Kathleen Jablon Stoehr is assistant professor of Mathematics Education at Santa Clara University. Her research interests include issues that relate to prospective and early career teachers' processes and understandings of learning to teach mathematics. Using narrative inquiry, she has explored equity and social justice issues of language, race, culture, and gender that occur in the mathematics classroom. Her current research designs and studies a model of parental engagement in mathematics that is based on a two-way dialogue between home and school. Her work is published in journals such as the *Journal of Teacher Education, Journal of Urban Mathematics Education, Journal of Mathematics Teacher Education,* and *School Science and Mathematics.*

Erin E. Turner is professor of Mathematics Education in the Teaching, Learning, and Sociocultural Studies Department at the University of Arizona. Her research focuses on issues of equity and social justice in mathematics education, with particular attention to language, culture, and community in mathematics teaching and learning and to teachers' understandings and practices related to children's multiple mathematical knowledge bases. Her current research examines the teaching and learning of mathematical modeling with cultural and community contexts in Grades 3–5.

Anita A. Wager is professor of the Practice at Vanderbilt University's Peabody College. She also serves as the associate chair of Teacher Education and director of Elementary Education in the Department of Teaching and Learning. Her research focuses on teacher education that supports culturally relevant and socially just mathematics teaching in early childhood and elementary school. She works with prospective and practicing teachers to develop mathematics pedagogy that draws on children's multiple mathematical resources, including mathematical thinking, mathematics (and other) experiences in homes and communities, and mathematics children engage with in play. The recent publications are in journals such as the *Journal for Research in Mathematics Education*, *Journal of Teacher Education,* and *Journal of Early Childhood Teacher Education.* She is coauthor of the book *Young children's arithmetic: Cognitively guided instruction for preschool and kindergarten* and coeditor of the book *Teaching Mathematics for Social Justice: Conversations with Educators.*

Craig Willey is associate professor of Mathematics Education and Teacher Education at Indiana University-Purdue University Indianapolis, as well as coordinator of the Urban Elementary Education program. His research focuses on the following: (a) the teachers' design and implementation of mathematics discourse communities with urban students, primarily students who are Latinx; (b) the ways teachers mine and leverage children's community and cultural knowledge to make sense of math; (c) the development and incorporation of curricular features that provide bilingual learners better access to mathematical ideas and opportunities to engage meaningfully; and (d) the limitations and affordances of a school-university partnership model of urban teacher development. In addition, he is editor of the journal *Teaching for Excellence and Equity in Mathematics (TEEM)* and associate editor of the *International Journal of Qualitative Studies in Education.*