Contents

Foreword xiii
David M. Bressoud
Preface xv
Jacqueline M. Dewar and Curtis D. Bennett

Part I. Getting Started in SoTL as a Mathematician

1. Understanding SoTL and Its Potential Benefits 3
Jacqueline M. Dewar and Curtis D. Bennett
- The Origins of SoTL in Higher Education 3
- Distinguishing SoTL from "Good" and "Scholarly" Teaching 4
- Forging Disciplinary Connections for SoTL 4
- SoTL's Emergence in Mathematics 5
- SoTL and RUME 6
- Evaluating and Valuing SoTL 8
- Special Considerations for Junior Faculty Members 8
- The Benefits of SoTL 9

2. Initiating a SoTL Investigation 13
Jacqueline M. Dewar and Curtis D. Bennett
- A Typical Starting Point 13
- A Taxonomy of SoTL Questions 14
- Using Disciplinary Knowledge to Narrow a Question 15
- Undertaking a Literature Search 16

3. Gathering and Analyzing Evidence 19
Jacqueline M. Dewar
- Triangulating Data 19
- Challenges that Educational Research Design Presents for SoTL 19
  - Dealing with the Lack of a Control Group 20
  - Aligning the Assessment Measure with What Is Being Studied 22
  - To Seek Statistical Significance or Not? 22
  - Which Measure of Change? 23
- Quantitative versus Qualitative Data 23
- Data Sources Familiar to Most Mathematicians 24
  - Survey Design Considerations 25
    - Essential Steps in Designing a Survey 25
- Data Sources Less Familiar to Mathematicians 27
  - Knowledge Surveys 27
  - Think-Alouds 31
    - Advice for Conducting a Think-Aloud 32

- Focus Groups 33
  - Model for Conducting a Focus Group 34
- Analyzing Qualitative Data 35
  - Rubrics 36
    - How to Create a Rubric 36
  - Coding Data (Content Analysis) 39
    - Process for Coding Data 40
    - Assessing the Quality of Content Analysis 41

4. Resources for Pursuing SoTL and Going Public 45
Jacqueline M. Dewar
- Human Subjects Considerations 45
- Finding Collaborators and Support 46
- Going Public with Results 47
  - Conferences 47
  - Journals 47

Part II. Illustrations of SoTL Work in Mathematics

Theme 1: Experiments with Approaches to Teaching

5. Assessing the Effectiveness of Classroom Visual Cues 51
Gretchen Rimmasch and Jim Brandt

Can instructor use of visual cues improve student performance in recognizing and correctly applying procedural rules? Specifically, do the cues help students to simplify exponential expressions and calculate derivatives?

SoTL Process—Pilot study; Control group; IRB; Evidence: pre- and post-tests and surveys; use of a rubric.

6. (Re)discovering SoTL Through a Fundamental Challenge: Helping Students Transition to College Calculus 59
Rann Bar-On, Jack Bookman, Benjamin Cooke, Donna Hall, and Sarah Schott

Can algebra review and study group sessions improve student retention and performance in beginning calculus?

SoTL Process—Evolution of the intervention and the study; Collaboration between faculty members and academic support staff; IRB; Evidence: participation rates, course grades.

7. A Quantitative and Qualitative Comparison of Homework Structures in a Multivariable Calculus Class 67
Lynn Gieger, John Nardo, Karen Schmeichel, and Leah Zinner

How does the use of online homework affect student attitudes, motivation, and performance? Will it lead students to study more frequently, be more engaged and responsible for their learning, and lead to improved homework grades, test grades, or course grades?

SoTL Process—Collaboration across multiple disciplines; Evidence: pre- and post-surveys, focus group, homework grades; Coding qualitative data.

8. Playing Games to Teach Mathematics 77
Edwin Herman

Does the use of games in class for practice or review result in better learning or improve student attitudes and satisfaction?

SoTL Process—Evolution of the intervention and the study; Quasi-control group experiment; Evidence: student evaluations, chapter exam grades, final exam grades.

9. Investigating How Students' Linking Historical Events to Developments in Mathematics Changed Engagement in a History of Mathematics Course 87
Pam Crawford

Does the guided discovery teaching technique of having students investigate links between historical events and developments in mathematics improve students' engagement with historical material when compared with my previous teaching methods?

SoTL Process—IRB, including previously collected data; Evidence: pre- and post-course surveys, exam essay questions; SoTL compared to RUME.

Theme 2: Crafting Learning Experiences around Real-World Data or Civic Engagement

10 Using SoTL to Assess the Outcomes of Teaching Statistics Through Civic Engagement 99
Cindy Kaus

Will incorporating civic engagement into a general education statistics course increase retention and student confidence in their ability to do and communicate statistics?

SoTL Process—Control groups and ethical concerns; Evidence: pre- and post-course surveys, student evaluations, course grades; Survey response rates.

11. A Pedagogical Odyssey 107
Michael C. Burke

A vision of the possible: How would a mathematics course that used data-based integrative writing assignments affect students?

SoTL Process—Evolution of the intervention and the study; Evidence: systematic analysis of essays, student reflective writing, final exams.

12. Presenting Evidence for the Field That Invented the Randomized Clinical Trial 117
John Holcomb

A vision of the possible: Can team writing projects using real data lead to individual acquisition of desired data analysis skills?

SoTL Process—Control groups and ethical concerns; IRB; Evidence: take home data analysis components of midterm and final exams, surveys; Survey response rates; Survey design issues; Coding qualitative data.

Theme 3: Using Assigned Reading Questions to Explore Student Understanding

13. Conceptual or Computational? Making Sense of Reading Questions in an Inverted Statistics Course 127
Derek Bruff

In an introduction to statistics course for engineering majors, what are students able to learn by reading their textbooks before class? What kinds of pre-class reading assignments, including questions about the reading, might help students learn more from reading their textbooks before class?

SoTL Process—Quasi-control group experiment; Shifting from a *What works?* to a *What is?* investigation and back again; IRB, including previously collected data; Evidence: pre- and in-class quizzes, survey, whole class interview; Coding qualitative data; Bloom's taxonomy.

14. An Investigation Into the Effectiveness of Pre-Class Reading Questions 137
Mike Axtell and William Turner

What types of pre-class reading questions best facilitate independent learning, and the retention of the material learned, in our students?

SoTL Process—Narrowing a research question**;** Literature search; Evidence: pre-class reading questions, in-class reading quizzes.

Theme 4: Exploring Student Understanding of the Nature of Mathematics

15. Liberal Arts Mathematics Students' Beliefs About the Nature of Mathematics: A Case Study in Survey Research 145
Stephen D. Szydlik

What do students enrolled in a problem-based general education mathematics course believe about the nature of mathematics? Do these beliefs change from the beginning to the end of the course?

SoTL Process—IRB process and Informed Consent Form; Evidence: pre- and post-survey; Survey development, validity, and reliability; Coding qualitative data; Choosing a publication venue.

16. The Mathematics of Symmetry and Attitudes towards Mathematics 157
Blake Mellor

How does a course on the mathematics of symmetry change the perspectives on and attitudes towards mathematics in a class for students majoring in the liberal arts?

SoTL Process—Evidence: pre- and post-surveys, student teaching evaluations; Survey response rate and administration issues; Coding qualitative data.

17. Mathematics Research Experiences for Preservice Teachers: Investigating the Impact on Their Beliefs 171
Wendy A. O'Hanlon, David D. Barker, Cynthia W. Langrall, John A. Dossey, Sharon M. McCrone, and Saad I. El-Zanati

Prior to a Research Experience for Undergraduates (REU) what are the beliefs of the preservice teacher participants about the teaching and learning of mathematics and how do their beliefs change after participating in the REU experience?

SoTL Process—Evidence: pre- and post-surveys; Survey development and reliability.

Theme 5: Tackling Large Questions

18. The Question of Transfer: Investigating How Mathematics Contributes to a Liberal Education 183
Curtis D. Bennett and Jacqueline M. Dewar

How does mathematics contribute to liberal learning?

SoTL Process—Narrowing a research question; Evidence: surveys, interviews with students and faculty members, focus group; Coding qualitative data.

19. Using SoTL Practices to Drive Curriculum Development 191
Rikki Wagstrom

How might integrating civic issues into a college algebra prerequisite course improve quantitative reasoning, algebraic skill development, and student confidence and interest in studying mathematics?

SoTL Process—Refining a question; Control groups and ethical concerns; Pilot study; Literature search; IRB; Evidence: pre- and post-test questions, surveys; Choosing a publication venue.

Epilogue

20. Synthesis of the Value and Benefits of SoTL Experienced by the Contributors 203
Curtis D. Bennett and Jacqueline M. Dewar

Index 207