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## **Mathematics Teaching: Putting Research into Practice at All Levels**

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In *Scholarship Reconsidered: Priorities of the Professoriate*, Boyer (1990) identified four kinds of scholarship corresponding to discovery, integration, application, and teaching. Though Boyer's work caused much controversy by calling for the university professoriate to rethink how research, teaching and service are considered, it does provide a framework for thinking about putting research into practice at all levels, including in the mathematics classroom. As a creative, if imperfect, means of organizing this monograph, we have attempted to draw parallels between Boyer's four categories and the scholarship presented by our fourteen authors.

Boyer's first category, the *scholarship of discovery*, characterizes the type of small-scale research often conducted in the classroom setting. The discovery scholarship recounted in this section seeks to directly influence teaching and learning through experimenting with classroom practice—in this context, the practice of teacher educators. Kosko, Norton, Conn and San Pedro describe an experiment designed to enhance a mathematics content course. Lenges, and van den Kieboom and Magiera explore instructional stances that may enhance preservice teachers' mathematical understanding. Arbaugh, Lannin, Jones, and Barker extend discovery scholarship to the context of professional development.

In Boyer's terms, the *scholarship of integration* deals with "making connections across the disciplines, placing the specialties in larger context, illuminating data in a revealing way" (1990, p. 18). Mathematics and education meld in the process of integrating scholarship, allowing researchers to interpret their findings in a broader intellectual context. In this volume, integration is represented by the blending of teaching and research as discussed by van Zoest, Stockero and Edson; the interactions between authority and practice outlined by Mewborn; and the strategies to embed reading in a mathematics course provided by Thompson.

The *scholarship of application* supports the use of knowledge and research to seek solutions for significant issues, including the need for more, and more adequately prepared, mathematics teachers. Benken and Gomez-Zwiep investigate the content component of an alternative certification program in mathematics. Lee, Ives, Starling, and Hollebrands explore the implementation of curricular advances in teaching statistics with technology. Miriti and Mohr-Schroeder demonstrate how technology can be used to enhance the supervision and mentoring of prospective mathematics teachers.

The remaining articles in this monograph—and perhaps all of them—fit best in the category termed the *scholarship of teaching*. In Boyer's words (1990), teaching "not only means transmitting knowledge, but transforming and extending it as well"; it promotes "active, not passive, learning and encourages students to be critical, creative thinkers, with the capacity to go on learning" (p. 23). Finally, "pedagogical procedures must be carefully planned, continuously examined, and relate directly to the subject taught" (p. 24). Chapters by Santagata and van Es, and Suh and Parker describe how they introduce preservice teachers to structured, disciplined, and content-focused analysis of instruction. Leatham and Peterson document their deliberate efforts to redesign the student teaching experience to be more reflective, while Cwikla investigates how classroom video can be used to transform the teaching of college faculty.

It is also possible to draw parallels and distinctions between Boyer's composite view of scholarship and more traditional

research practices. As we have learned—sometimes painfully—in mathematics education, research that is not the result of randomized controlled trials has often been viewed as inadequate in federal guidelines, or discounted in reports published by federal offices and organizations (see *randomized clinical trials* at <http://ies.ed.gov/ncee/wwc/help/glossary/#gr>). The American Statistical Association (ASA) takes a broader view of the efforts of the mathematics education research community, even while urging researchers toward a more cohesive and connected body of work:

If research in mathematics education is to provide an effective influence on practice, it must become more cumulative in nature. New research needs to build on existing research to produce a more coherent body of work. Researchers in mathematics education are, of course, and should continue to be, free to pursue the problems and questions that interest them. In order for such work to influence practice, however, it must be situated within a larger corpus. School mathematics is an excellent venue for small-scale studies because mathematics learning has many facets, and the classroom is a manageable unit that can be studied in depth and detail. Such studies can cumulate, however, only if they are connected. Studies cannot be linked together well unless researchers are consistent in their use of interventions; observation and measurement tools; and techniques of data collection, data analysis, and reporting. (2007, pp. 4–5)

Clearly, not all of the research referenced in this quote is of the formal experimental variety. Many small-scale studies using the classroom as a manageable unit do not lend themselves to randomization or a control-treatment approach. However, as noted by the ASA, mathematics education will be advanced if, as researchers, we focus on consistent implementations and well-documented, replicable measurement practices that serve to merge, rather than disperse, our knowledge about mathematics teaching and learning.

As a collection of fourteen articles in the Association of Mathematics Teacher Educators monograph series, this volume seeks to promote the implementation of research into practice in classrooms of the mathematics education field. Few of the studies reported in this monograph involve randomized, controlled research designs. They tend to take advantage of existing classrooms, programs, or bodies of students as convenience samples; and as a result, they are more real. While these studies may not report broadly generalizable results, most were developed in a research context and supported by research literature in ways that allow for future replication and extension. They are presented with an understanding that they provide models to be used by others in the field. It is our hope that by building on the contents of this monograph, with similar data collection methods and empirical approaches to teaching, other researchers will add to the cumulative knowledge that is becoming the foundation for excellent mathematics education.

### References

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