

## Linking Mathematics Education Research and Practice

### A Position of the National Council of Teachers of Mathematics

#### **NCTM Position**

Linking research and practice in mathematics education is necessary to address critical issues of mathematics teaching and learning. All educators, whether in PK–12 settings or higher education, are both researchers and practitioners as they work to identify and examine issues pertinent to the teaching and learning of mathematics. As such, all educators need to consider ways to implement or modify strategies across contexts that build on existing research findings and inform new research avenues. Collaboration provides integrated perspectives for addressing critical issues that lead to enhanced mathematics teaching and learning experiences for each and every student.

#### **Introduction**

Linking research and practice in mathematics education is essential to address critical issues of mathematics teaching and learning. The research knowledge base represents the aggregated understandings about effective mathematics education built from data analysis about mathematics teaching and learning contexts. The knowledge base needed for the day-to-day teaching of mathematics to PK–12 students is built by those who do and support the classroom teaching of mathematics. This includes PK–12 school personnel, teacher educators, community organizations, and other stakeholders engaged in the practice of teaching and learning mathematics.

The outcomes of research can inform and enhance the practice of mathematics teaching and learning in curricular materials, mathematics classrooms, teacher education, professional development, and public policy. At the same time, the inquiries taken up in research can and should “be influenced by ideas that take hold within the practitioner community” (Silver & Lunsford, 2017), as there is a need to focus research on issues important and timely to practitioners. As such, mathematics educators engaged in research must consider the vast array of contexts for teaching mathematics across the practice community.

What issues do those focused on classroom practice identify in the day-to-day teaching and learning of mathematics? What inquiries arise from practice that are common focal points of research (e.g., implementation of curriculum, specific teaching practices, equitable learning opportunities in the mathematics classroom, mathematics teacher education, or professional development), or are new issues yet to be studied? Those designing research inquiries should consider how those inquiries support curriculum, teaching, teachers (mathematics teachers and teacher educators), students, and learning. What positive outcomes will the knowledge generated from research create, and how will that knowledge be used to enhance the teaching and learning of mathematics?

## Declarations

### 1. Mathematics education research must be ethical and comprehensively address

**critical problems.** Research in mathematics education should address critical problems of practice using appropriate and ethical research methods and provide comprehensive syntheses of the state of the field that are usable in practice. An understanding that mathematics education involves multiple constituencies and contexts is foundational for researchers and practitioners to investigate practitioners' most pressing problems of practice (Silver & Lunsford, 2017). Researchers and practitioners should develop, design, and use appropriate research approaches in ethical ways, following ethical principles of professional competence; integrity; professional, scientific, and scholarly responsibility; respect for people's rights, dignity, and diversity; and social responsibility (American Educational Research Association, 2011).

Various approaches can be used to ask and answer critical questions about mathematics teaching and learning at multiple levels from the individual to the classroom to larger populations. A wide range of research methodologies is needed to build a robust and multi-faceted knowledge base. Research inquiries should build on and connect the knowledge base over time, including aggregating results across studies, critically examining prior outcomes, and creating new knowledge in areas not previously studied. Thus, studies of different sizes and forms can contribute to building a common knowledge base (Cai et al., 2018b) that offers insights into effective instructional practices and informs ongoing research in mathematics education. Thus, researchers and practitioners can approach their investigations of problems in different ways to advance mathematics education research and mathematics teaching and learning towards meeting the needs of each and every student (e.g., National Council of Supervisors of Mathematics, 2015).

### 2. Research should identify high-leverage, effective, equitable mathematics practices shared in useful, actionable ways.

Research on mathematics teaching and learning should be used to identify and promote high-quality and equitable mathematics learning experiences for all students and communicated through language and tools that can support implementation and change. Collaboration is required to improve the processes, outcomes, and conditions for mathematics teaching, learning, curriculum, and assessment. Collaborators who examine students' and teachers' experiences in mathematics classrooms, the impact of educational policies on mathematics teaching and learning, or express new commitments to problems of practice should design a program of inquiry using ideas across the research and practice communities.

This work must be conceptually and methodologically sound and open to peer review, and the reports of findings should be accessible to researchers, teachers, school personnel, and policymakers. In doing so, the research and practitioner's literature serves as a resource that these constituencies and others draw on to generate valid and useful knowledge. Classroom implementation can draw from a rich foundation of work that synthesizes the knowledge base in accessible ways, promoting work on:

- students' learning of mathematics (e.g., NCTM's *Putting Essential Understanding into Practice* series, 2019);
- effective teaching practices (e.g., NCTM publications edited by Silver & Kenney, 2015 and Spangler & Wanko, 2017);
- equitable mathematics teaching practices (e.g., Berry et al., 2020; NCTM's *Catalyzing Change* series, 2020);

- developing students' agency and identity in mathematics (e.g., Aguirre et al., 2013);
- mathematics teacher education and professional development (e.g., Elrod et al., 2020; Smith & Heaton, 2013).

The research-practice knowledge base should continually be updated using rigorous quantitative and qualitative research methods. This research should also be influenced by the needs and issues in the classroom and provide results that are readily accessible, including tools to support practitioners and policymakers at all levels. To have the desired impact, results should be reported in ways that can be shared, replicated, and applied or adapted to a variety of instructional settings in pre-K through college mathematics classrooms, mathematics teacher education and professional development programs, and local, state, and national policy and decision-making entities. Research on mathematics teaching and learning should have continuous improvement and systemic change—on the practice of teaching and learning mathematics—as a central goal. Research should be communicated to stakeholders, such as school administration and policy-makers, who can enact change at scale.

**3. All educators build knowledge of mathematics education research and practice.** Connections between research and practice should be bi-directional, with increased collaboration across all those involved in mathematics teaching and learning: PK–12 mathematics classroom teachers, university mathematics educators, professional developers, and administrators. The practice of teaching mathematics informs the research knowledge base, and research outcomes contribute to the practice and professional knowledge base for teaching. Research in mathematics education should reduce the gap between theory and practice and contribute to our professionalization as educators. We propose that research that centers teacher inquiry can both build the research knowledge base and position classroom practice and its context as a critical component in research.

We call for partnerships that connect research and practice contexts that are collaborative, enhance the teaching and learning of mathematics, and are sustainable for teachers. In this partnership, a practitioner can offer knowledge and expertise about the community (classroom, school, district) (Jaworski, 2003), current problems of practice, practical considerations in implementing pedagogical strategies and/or curricular innovations, and larger district/state initiatives. A researcher can offer connections between teachers in the geographical area or with interests in similar problems of practice, knowledge of national/international initiatives, new technologies that draw on professional and social-media networks (Cai et al, 2018a), knowledge of the research literature related to the problem, and knowledge of research methodology about how to collect and analyze data to address the problem.

Furthermore, to support bidirectionality, professionals with primary roles as practitioners should engage in generating research, and these activities should be encouraged and supported within the teaching profession. Increased levels of collaboration—where together researchers and practitioners pose questions, offer theories, engage in research, and form conclusions—can move the field forward. By collaborating to identify practical implications and applications of research and to develop useful tools for practitioners or policymakers, research that foregrounds the problems of practice can help move research into practice.

In summary, strong collaborations and connections between research and practice through high-quality and ethical research are necessary to identify and develop pathways to enhance mathematics teaching and learning for each and every student.

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