

## Engaging in Research: Why? How? Now!

**W**hy should teachers engage in research studies? As a community, teachers and researchers are concerned with addressing critical issues in math education. NCTM's web resources and conferences, as well as the pages of this journal, give evidence of a growing community and an expanding body of work supporting NCTM's (2012) position of linking research and practice—a “border crossing” between the world of research and the world of teaching (Silver 2003). Despite these initiatives, an emerging issue remains: How do we work together to cultivate a two-way exchange of professional knowledge (Heid et al. 2006)?

Based on our experiences as math educators, we address the following questions:

- Why should teachers engage in research?
- What might teachers' roles be in a research project?
- How do teachers get involved?

From a perspective of community building toward a shared goal and our experiences in collaborating with sec-

ondary math teachers, we showcase some of the diversity of teachers' roles in research. Reflecting on lessons learned, we share potential challenges, benefits, and practical suggestions for teachers who wish to engage in research and professional inquiry.

### WHY SHOULD TEACHERS ENGAGE IN RESEARCH?

The goal of providing all students access to quality math education requires that teachers and researchers collaborate and engage together as a community. Researchers working alone lack the information needed to effectively address problems of practice that matter most—problems that are highly contextual and based on teachers' day-to-day experience. For example, Ms. B wondered, “How can I strengthen my students' understanding of ratios and proportions?” Ms. L wondered, “How can I better support students' learning with multiple representations using technology?” Mr. D wondered, “What curriculum might I draw on to enhance my instruction? I want students to engage in inquiry-oriented practices.” Such questions, grounded in teachers' experiences, may be best addressed through collaborative efforts of teachers, researchers, and other stakeholders committed to improving math teaching and learning.

### WHAT MIGHT TEACHERS' ROLES BE IN A RESEARCH STUDY?

A teacher may choose to *participate* in a study because it piques her interest or because her voice, context, and experience would make an important contribution. Or she might actively *collaborate*

with a researcher on addressing a shared problem of practice. Or a teacher might *research* his own problem of practice to address an important goal. Across these roles teachers influence the findings of research, co-shape the direction of research, or determine the very question to be studied. To illustrate the diversity of teachers' roles in research, we offer three vignettes of teachers engaged in research.

#### *Teacher as Participant and Collaborator*

Ms. B, an eighth-grade math teacher, was part of a cohort of middle school math teachers taking courses at a local university through a district partnership. She was invited to participate in a research project aimed at teacher-led implementation of an instructional unit designed by researchers to support students' algebraic reasoning through quantitatively rich situations. The goal of the unit was to understand that a relationship is linear if the rate of change of one quantity compared to another is constant. To this end, a set of tasks was developed using gears as a context; a sample gears task is shown in **figure 1**.

Before implementing the instructional unit that focused on linear relationships grounded in gear ratios, Ms. B met with the research team (including authors Reiten and Ozgur) to discuss the goals of the unit and supports for implementing lessons in her classroom (e.g., how to use physical gears as manipulatives). Throughout the unit, Ms. B modified the lessons based on her students' needs (e.g., adding additional directions) and found that the lessons extended

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#### Department editor

**Dana Cox**, [dana.cox@miamioh.edu](mailto:dana.cox@miamioh.edu), Miami University, Oxford, Ohio

her students' thinking. Reflecting on the unit, she said it gave students an opportunity to think deeply about linear relationships in terms of proportional thinking before going to the book, which "just jumps in and goes and doesn't dig that deep."

After about two weeks of teaching the unit, she increasingly felt that her students were not ready for the tasks, and she ended her participation in the research project. When asked about her participation, Ms. B remarked that she was glad she had done the unit and that there was value in the unit. After seeing how much her current on-grade-level students' understanding of proportions and linear relationships had improved compared to students in years past, she decided to implement the unit with her algebra students later in the year.

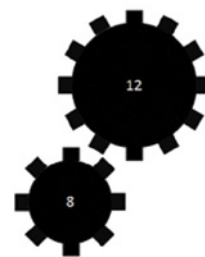
### **Teacher as Collaborator**

Some teachers may choose to collaborate with researchers. Such was the partnership between author Fonger, a math education researcher, and Ms. L, a ninth-grade teacher. Motivated by NCTM's linking research and practice initiative (Arbaugh et al. 2010), Fonger searched for a collaborating teacher who expressed interest in a problem of practice: What are productive supports for algebra students' representational fluency in solving problems involving linear equations with computer algebra systems (CAS) and with paper and pencil?

Initially, Ms. L and Fonger met to develop learning goals for three mathematical ideas: equivalence of expressions, understanding one-variable equations as relations between equivalent or nonequivalent expressions, and solving equations. They also planned a potential instructional path for addressing these goals through the use of CAS and paper-and-pencil graphs, tables, symbols, and words. They worked to find a balance between the district-adopted curriculum and alternative research-informed approaches.

During the study, Ms. L and Fonger collaborated on designing lessons: Ms. L taught all lessons, and Fonger supported instruction by identifying

Say you had two gears that had 5 teeth and 7 teeth, instead of the 8 teeth and 12 teeth like we have been working with. What would be the relationship between the number of turns the small gear makes and the number of turns the big gear makes in this situation?



**Fig. 1** A sample gears task (from <http://tinyurl.com/hy6drdm>) highlights a gear ratio of 7/5.

students' work to discuss and facilitating technology use. Ms. L and Fonger debriefed after each lesson to discuss what went well, what they could build on for the next lesson, and how they were meeting their goals. Ms. L's use of "warm-ups" and "exit tickets" was useful for reflecting on students' emerging understandings.

Fonger shared results of her analysis with Ms. L during and after the study. They learned about the power of encouraging students to "predict, act, reflect, and reconcile" their activity with CAS and with paper and pencil (Fonger 2014), an activity structure that informed Ms. L's teaching after the research project.

Ms. L openly shared her professional knowledge to support the collaboration. Beyond this study, Ms. L used prediction questions and reflection questions to probe student thinking. Fonger also gained practical knowledge of supporting secondary school students' learning with CAS, which has informed her work with preservice teachers and her presentation of this research.

### **Teacher as Collaborator and Researcher**

Mr. D, an eighth-grade science and math teacher, assumed a researcher role in a study conducted in partnership with the same research team as Ms. B's. Like Ms. B, Mr. D had support to implement the gears unit both before and during instruction.

Intrigued by the premise of supporting students' algebraic reasoning through quantitatively rich situations, Mr. D expressed interest in being part of the study because he wanted to "inform his own understanding" of an inquiry

approach to teaching mathematics. He wanted to investigate how he could use a research-based unit in a response to intervention (RtI) class while also working toward an advanced degree.

Mr. D was motivated to explore on his own whether this research-based unit could better support students' learning and wondered whether a more "constructivist approach to mathematics and mathematical reasoning [may] be a better fit for the RtI [class]" rather than what he described as currently occurring in RtI classrooms (i.e., "we're just going to kill them with worksheets").

Mr. D took on an independent role as a practitioner-researcher. While implementing the unit, Mr. D analyzed his students' reasoning and reflected on his instructional support. This investigation informed his implementation of subsequent iterations of the unit with a different group of students. Mr. D pursued questions that interested him, enabling him to take ownership as a researcher.

### **LESSONS LEARNED**

These stories tell of how experiences and professional knowledge shape and are shaped through engagement in research. Across all forms of engaging in research, teachers play important and central roles and navigate a complex web of potential benefits and concerns.

Even teachers who know the benefits of engaging in research may be hesitant to add more to already high demands on their time. We suggest that teachers advocate for their needs and discuss potential direct and indirect benefits for their local and broader context. Across the vignettes we see examples of how teachers managed their roles in research and addressed issues that interested

**Table 1 Guidance for Addressing Issues in Linking Research and Practice**

Issue	Guiding Question	Role of Teacher(s)
Relevance to practice	Is the research helping teachers better understand and/or address an important problem of practice related to curriculum, instruction, assessment, or student learning?	Help uncover a problem of practice that is shared among stakeholders.
Level of participation	How are stakeholders involved in the design and implementation of the research?	Participate in and negotiate your role and level of participation.
Time commitment	Is the research something that is already a part of teachers' practice or an add-on that requires additional time?	Help decide the level of commitment based on the context and needs of the district, school, and classroom.
Contribution to research	What is the role of existing research in shaping the study? How might this work contribute to math education?	Discuss how research might inform practice, and potential short-term and long-term benefits for both research and practice.

them. For example, Ms. B decided to shorten her participation to better meet the needs of her class, Ms. L worked with Fonger to shape the direction and duration of the study, and Mr. D took ownership of the research to address his professional goals.

Another concern that teachers and other school stakeholders may have is that research is a one-way street that helps researchers only. However, we argue that both teachers and researchers (and the wider math education community) may benefit from teachers' engagement in research. As the vignettes demonstrated, taking part in research gave the teachers access to supports and provided researchers with an opportunity to test and refine ideas. Research can serve as a professional learning opportunity for both teachers and researchers. For example, both Ms. L and Fonger benefited from daily reflection in which they learned from each other's varied expertise. This professional learning continued beyond the research study. Although some benefits to teachers may be indirect or take time

to occur, we encourage all teachers to be open and explore where their participation in research might lead them.

A final approach to bolstering benefits for teachers as well as researchers is to frame and design research studies that address shared problems of practice (Arbaugh et al. 2010), a foundational motivation for the collaboration between Fonger and Ms. L. Finding common interest among stakeholders is important so that the goals of research and the goals of teachers' practice are well aligned, as in the case of Mr. D's collaborative and researcher roles.

### HOW CAN TEACHERS GET INVOLVED? A CALL TO ACTION

Teachers' engagement in research aligns with NCTM's (2012) position linking research and practice, in which the importance of community and collaboration is a priority. This position requires that teachers and researchers work together to figure out how best to meet the needs of all stakeholders, including teachers, students, administrators, and parents. In this article we have tried

to show why teachers might engage in research and what their engagement might look like in practice.

We offer some possible next steps for how to get involved in linking research and practice:

- **Reflect**—Take an inquiry-oriented and reflective stance toward teaching and learning (e.g., What stands out to me as a problem of practice?).
- **Be open**—Keep in mind that research opportunities take on a variety of forms, styles, time scales, and levels of commitment both within and across schools and institutions (e.g., How might new ideas impact my practice?). Also see <http://www.researchandpractice.org>.
- **Start local**—Share your desire to engage in research with colleagues, school and district leaders, and math education professors and researchers.
- **Share goals**—Advocate for issues that matter to you, your students, and your local context.
- **Network**—Attend conferences, contact journal authors, or capitalize on social media for support and inquiry into issues (e.g., the Facebook® group “Mathematics Education Researcher” or MT’s Twitter chats on the fourth Wednesday of each month).

Ultimately, linking research and practice involves collaboration among teachers, researchers, and other stakeholders in ways that are mutually beneficial. There is also great value in teachers doing independent research. We encourage you to consider the factors listed in **table 1** and ask yourself what your role might be in the growing community of teachers engaged in research.

### REFERENCES

- Arbaugh, Fran, Beth Herbel-Eisenmann, Nora Ramirez, Eric Knuth, Henry Kranendonk, and Judith Reed Quander. 2010. *Linking Research and Practice: The NCTM Research Agenda Conference Report*. Reston, VA: National Council of Teachers of Mathematics. [https://www.nctm.org/uploadedFiles/Research\\_and\\_Advocacy/Linking\\_Research\\_and\\_Practice/Linking\\_Research\\_20100511.pdf](https://www.nctm.org/uploadedFiles/Research_and_Advocacy/Linking_Research_and_Practice/Linking_Research_20100511.pdf)

Fonger, Nicole. 2014. "Equivalent Expressions Using CAS and Paper-and-Pencil Techniques." *Mathematics Teacher* 107 (9): 688–93.

Heid, M. Kathleen, Matthew Larson, James T. Fey, Marilyn E. Strutchens, James A. Middleton, Eric Gutstein, Karen King, and Harry Tunis. 2006. "The Challenge of Linking Research and Practice." *Journal for Research in Mathematics Education* 37 (March): 76–86.

National Council of Teachers of Mathematics. 2012. "Linking Mathematics Education Research and Practice." <http://www.nctm.org/Standards-and-Positions/Position-Statements/Linking-Mathematics-Education-Research-and-Practice/>

Silver, Edward A. 2003. "Border Crossing: Relating Research and Practice in Mathematics Education." *Journal for*

*Research in Mathematics Education* 34 (3): 182–84.



**NICOLE L. FONGER**, [nfonger@wisc.edu](mailto:nfonger@wisc.edu), is a post-doctoral fellow of Mathematical Thinking, Learning, and Instruction at the Wisconsin Center for Education Research at the University of Wisconsin-Madison. She researches students' learning of algebra and the nature of curricular and instructional supports for learning. Fonger aims to cultivate links between research and practice in her work as an educator.



**LINDSAY REITEN**, [reiten@wisc.edu](mailto:reiten@wisc.edu), is a doctoral candidate at the University of Wisconsin-Madison. A

former middle and high school mathematics teacher and university lecturer, she is interested in teacher education and supporting teachers' modification and integration of technology activities. **SUSANNE STRACHOTA**, [ssrachota@wisc.edu](mailto:ssrachota@wisc.edu), is a doctoral candidate in Curriculum and Instruction with a focus on mathematics at the University of Wisconsin-Madison. Before graduate school, she taught high school math in Boston. She researches algebraic reasoning, specifically how students generalize functional relationships and justify those generalizations. **ZEKIYE OZGUR**, [zozgur@wisc.edu](mailto:zozgur@wisc.edu), is a doctoral candidate at the University of Wisconsin-Madison. She is interested in student cognition and the ways in which teachers support students' learning, particularly in the area of algebraic reasoning and proof.



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