

# Chapter 9

## Using Designed Instructional Activities to Enable Novices to Manage Ambitious Mathematics Teaching

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It has become commonplace among educational reformers to assert that all students should learn and that learning should involve complex ideas and performances. In mathematics, the universal goal of education has been characterized as “mathematical proficiency” in which conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and productive disposition are intertwined in mathematical practice and learning at every grade level for every student (Kilpatrick, Swafford, & Findell, 2001; Rand Mathematics Study Panel, 2003; US Department of Education, 2008). This intellectually and socially ambitious goal leads to new definitions of teachers’ work. We define this kind of work – aimed at ambitious learning goals – to be “ambitious teaching.” Our vision of ambitious mathematics teaching is informed by a growing body of research built over the last three decades to understand what teachers need to do to accomplish ambitious mathematical goals (Franke, Kazemi, & Battey, 2007). Our concern is with making this kind of teaching more common and, in particular, with designing a specific form of what Leinhardt (2001) refers to as “instructional explanation” and teaching it to novices using what we call Pedagogies of Practice.

### Challenges of Ambitious Teaching

Developing students “strategic competency” means the teacher needs to get them to be willing to reason and make decisions about what procedures to use while solving problems, and this requires a kind of social management that is not necessary when students are simply expected to follow directions (Chapin, O’Connor & Anderson, 2003; O’Connor & Michaels, 1993; Forman, Larreamendy-Joerns, Stein, & Brown, 1998; Cobb & McClain, 2002). “Intertwining procedures with concepts” means not teaching lessons on small discrete topics, but working from different angles on big ideas like place value and ratio and expecting students to explain why procedures make sense (Henningsen & Stein, 1997; Hiebert et al., 1997). Because students need

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to interact to refine their understanding, teachers need to structure those interactions to focus on mathematical goals while managing different levels of competence and interest, while also attending to all students maintaining a productive disposition toward the subject (Ball & Wilson, 1996; Lampert & Cobb, 2003; Greeno, 2007).

As students perform authentic problem-solving tasks, teachers need to observe and listen and adjust both content and methods to what they observe in those performances to enable diverse learners to succeed in doing high-quality academic work (Smith, Lee, & Newmann, 2001; Wood, Scott Nelson, & Warfield, 2001; Ball, Hill, & Bass, 2005; Hill et al., 2008). Stein, Engle, Smith, and Hughes (2008) review several studies of expert mathematics teachers who “make rapid online diagnoses of students’ understandings, compare them with disciplinary understandings, and then fashion a response” (p. 302). They highlight the challenges of this kind of teaching and question whether it is reasonable to expect novices to do such sophisticated improvisation. But other mathematics education research has established that teachers who can adjust both content and methods to what they observe in student performance are more likely to enable all kinds of learners to succeed at high-quality academic work (Fennema, Franke, Carpenter, & Carey, 1993; Hill, Rowan, & Ball, 2005; Smith, Lee, & Newmann, 2001; Knapp, Shields & Turnbull, 1992). Such deliberately responsive and discipline-connected instruction greatly complicates the intellectual and social load of the interactions in which teachers need to engage, making ambitious teaching particularly challenging – but fundamentally important – for novices to learn.

## **Routines as a Tool for Managing These Challenges**

In 1986, Gaea Leinhardt was going against the grain when she asserted, on the one hand, that teaching should be characterized as a “complex cognitive skill” requiring the making of rapid online decisions and, on the other hand, that skilled teachers have a large repertoire of activities they perform fluently, which she referred to as “routines”. Leinhardt and Greeno (1986) observed that “routines play an important role in skilled performances because they allow relatively low-level activities to be carried out efficiently without diverting significant mental resources from the more general and substantive activities and goals of teaching” (p. 76). Over more than a decade, Leinhardt conducted several studies of elementary mathematics teachers, explicating the nature of teaching routines in elementary mathematics, refining our understanding of and ability to articulate the work of teaching, and enabling us to identify what to teach novices.

Research in other fields suggests that all kinds of professionals working in complex relational domains rely on routines to manage complexity of key elements of this kind of practice (e.g., Axelrod & Cohen, 1999). These routines are not “standard operating procedures” that provide mechanical solutions to the problems of practice (Feldman & Pentland, 2003). Rather they are well-designed procedures that have been proven in practice, that take account of the complexity of the goals that need to be accomplished, and that allow the practitioner temporarily to hold some things constant while working on others. The use of such routine procedures involves not

only acquiring the capacity to do the steps in the routine in an actual working environment but also the learning professional norms or “principles” that would enable the practitioner to make appropriate judgments about when and where it is appropriate to use the routines (Weick & McDaniel, 1989). Feldman and Pentland (2003) term these judgments the “performative” aspects of using routines. The performative aspects of ambitious teaching routines would occur as teachers use them in response to elicitation and interpretations of student skill and understanding.

## A Focus on Instructional Dialogue

A relatively recent focus of Leinhardt’s work on teaching routines has been how they are used in “instructional dialogue” (Leinhardt & Steele, 2005), a practice we would consider to be the centerpiece of ambitious mathematics teaching. In this kind of teaching, an explanation is co-constructed by the teacher and students in the class during an instructional conversation. Maintaining a coherent mathematical learning agenda while encouraging student talk about mathematics is perhaps the most challenging aspect of ambitious teaching. In their study of teaching through instructional dialogues, Leinhardt and Steele (2005) demonstrated the use of eight kinds of “exchange” routines in this kind of teaching to accomplish explanatory work, including maintaining mathematical clarity in the face of student inarticulateness, fixing the agenda of the class on a single student’s idea, making it safe for students to revise incorrect contributions, and honing students’ contributions toward mathematical accuracy and precision. The exchange routines that Leinhardt and Steele (pp. 143–144) identified include the following:

- The *call-on* routine, which is initiated by a rather open invitation to discussion and has two separate components: the initial identification of a problem and the speaker who responds, followed by a second part in which the class is prompted to analyze, justify, or critique the statement given by the first speaker or another speaker in the discussion.
- The related *revise* routine in which students were asked to rethink their assertions and publicly explain a new way of thinking about their solutions.
- The *clarification* routine “which was invoked when a confusion arose regarding an idea or conjecture volunteered into the public space, which in turn involved understanding the source of confusion.”

In the back-and-forth dialogue among students and teacher that occurs in these routine kinds of interaction, the work of the teacher is to deliberately maintain focus and coherence as key mathematical concepts get “explained” in a way that is co-constructed rather than produced by the teacher alone.

In exchange routines, the seeming contradiction between responsive complexity and interactive routines is at the heart of the work. Leinhardt and Steele (2005) directly state that this interactive work requires the teacher to invent the dialog in response to student contributions: “The orchestration and creation of an instructional dialogue that serves to provide a mathematical explanation is not routine. It

is a unique pattern of actions and responses that serve overarching sets of valued goals” (p. 142). But they go on to note that the instructional dialogues they analyzed fundamentally “rest on some shared routinized behavior.” Constructing an instructional dialogue is an intellectual and social challenge that needs to be met in the immediacy of the moment, in response to particular students and particular mathematics. Leinhardt and Steele (2005) see the identification of routines as a step in the direction of making this kind of work teachable to novices: “By untangling some of these complex elements, perhaps we can begin to free new teachers from the linear, often overly procedural presentation that textbooks afford. By making aspects of explanations explicit, we may provide tools for teachers’ self-analysis of lessons. By understanding the routines that facilitate different types of teaching, we may also clarify some of the complexities of the tasks” (p. 142).

It is here that our work and Leinhardt’s converge. It is not insignificant that the teaching in which Leinhardt and Steele identified and examined the use of exchange routines was done by Lampert. Over the course of more than 20 years, Lampert (e.g., 2001, 1992a, 1992b, 1989, 1986), Franke (e.g., Franke & Kazemi, 2001; Carpenter, Fennema, Franke, Levi, & Empson, 1999; Fennema et al., 1993), and Kazemi (e.g., Kazemi & Stipek, 2001; Kazemi, 1998) and several others<sup>1</sup> have investigated what ambitious and authentic learning goals imply for the work of teaching in classrooms. Leinhardt’s work on routines has contributed substantially to enabling us to take the next step, which is to teach this kind of teaching to novices.

## **Instructional Activities Using Routines as Tools for Teacher Education**

If teacher education is to prepare novices to engage successfully in the complex work of ambitious instruction, it must somehow prepare them to teach within the continuity of the challenging moment-by-moment interactions with students and content over time. With Leinhardt, we would argue that teaching novices to do routines that structure teacher–student–content relationships over time in order to accomplish ambitious goals could both maintain and reduce the complexity of what they need to learn to do in order to carry out this work successfully. These routines would embody the regular “participation structures” that specify what teachers and students do with one another and with the mathematical content (Ghousseini, 2008; Stein et al., 2008; Erickson & Schultz, 1981). But teaching routines are not practiced by ambitious teachers in a vacuum and they cannot be learned by novices in a vacuum. In Lampert’s classroom, the use of exchange routines occurred inside of *instructional activities* with particular mathematical learning goals like successive approximation of the quotient in a long division problem (Lampert, 1992b),

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<sup>1</sup>See for example, Chazan (2000), Herbst (2003), Cobb & McClain (2002), Ball (1993), Heaton (2000), and Schoenfeld (2008).

charting and graphing functions (Lampert, 1992a), and drawing arrays to represent multi-digit multiplications (Lampert, 1989).

## How Instructional Activities Using Routines Might Work in Teacher Education

To imagine how instructional activities using exchange routines could be designed as tools for mathematics teacher education, we have drawn on two models from outside of mathematics education. One is a teacher education program for language teachers in Rome and the other is a program that prepares elementary school teachers at the University of Chicago. Both programs use instructional activities built around routines as the focus of a practice-oriented approach to teacher preparation. They both teach content and methods to novices through the use of these activities in a cycle of demonstration, planning, rehearsal with feedback, teaching actual lessons, and debriefing those lessons using video records and other evidence of student learning. In the past, teacher educators sought to prepare beginning teachers to use instructional routines and specified skills (Kennedy, 1987). However, these efforts typically neglected considerations of how to prepare beginners to make judgments about when to use and how to adapt routines, or the role of subject matter knowledge in making these judgments effectively (Grossman & McDonald, 2008).

Lampert, together with her Italian colleague, Filippo Graziani, studied the structure of a program in Rome (called “Dilit”),<sup>2</sup> which prepares novices to teach Italian using the “communicative method,” an approach to language teaching that presents many of the same challenges as ambitious mathematics teaching. (See Lampert & Graziani, 2009 for a complete description of this program.) We were attracted to study this program because we found that it was able to successfully prepare teachers from a wide range of backgrounds to teach the Italian language to foreigners in ambitious ways (Lampert, Boerst, & Graziani, in press). In this program, we saw teacher educators structuring their work around a small, carefully chosen set of “instructional activities” that novices were taught to use. The routine components of these activities served as a stable and rehearsable backdrop for the dynamic work of responding to student thinking. In terms of social dynamics, they enabled both new teachers and their students to take the kinds of risks associated with working on authentic problems of communication (reading, writing, speaking, listening) because they carefully specified the kinds of student performances that students would be expected to produce. They also helped to manage the intellectual dynamics as they constrained the range of content that would need to be engaged to extend student performance toward ambitious learning goals. Novice teachers could thus get started with doing and learning from ambitious teaching on somewhat safer and more manageable ground.

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<sup>2</sup>Dilit is an acronym for *Divulgazione Lingua Italiana*, which translates as “making the Italian language accessible.”

We simultaneously found an example of the use of ambitious instructional activities in the Urban Teacher Education Program (UTEP) at the University of Chicago. Teacher educators in this program specify early literacy activities like Guided Reading (Fountas & Pinnell, 2006) in terms of action protocols that can be taught to novices. Guided reading is a series of structured interactive routines for tapping students' prior knowledge about the subject of a text, introducing the book to be read, having students "whisper-read" the book independently, and so on. In doing Guided Reading, the same protocol for relating teacher, students, and content can be used no matter what the book or reading level of the students. The routine parts of a Guided Reading Lesson can be practiced and mastered; they do not require tailoring to be enacted responsibly (Bryk et al., under review).

Like the activities taught to novices in the Dilit program in Rome, the routine parts of Guided Reading and other "balanced literacy" activities are an important backdrop for the part of the activity that, in contrast, requires a great deal of teacher observation and judgment: namely, choosing a "teaching point" and giving a mini-lesson on this point to the group of students who needs it (Glazer, 2005). The guidelines for the activity as it is used in the UTEP program direct novice teachers *to decide* what to teach: "If you notice a new reading behavior or a pattern of difficulty experienced by the group, teach a strategy lesson on that topic. For example, some children may remark that the words *cat*, *sat*, and *mat* rhyme. This provides an opportunity to focus on word families" (Urban Teacher Education Program, 2004, p. 1). By holding some aspects of teacher–student–content interaction constant, while leaving others to the teachers' professional judgment, instructional activities like Guided Reading give novices some control over practice while at the same time enabling them to learn to use their knowledge to make well-informed, responsible, on-the-fly judgments about what students need to learn. The guided rehearsal and debriefing of instructional activities like Guided Reading can scaffold the novice's entry into complex interactions with students, giving them particular instances of teaching to practice, enact, and analyze with input from a teacher educator (Scott, 2008).

In talk about teaching, using the term "instructional activities" as we use it here – to encompass routine structures that are regular features of social and intellectual interaction and materials use – is a bit unusual. Pointing out the difference between how we use the term and how it is commonly used will further help to explain why we argue that instructional activities can play a central role in knowledge building for teacher education. Ordinarily, the term "instructional activities" would be used to refer to a collection of different things that teachers and students can do together to get at some content. Typing "instructional activities" into a search engine together with a topic like "Shakespeare" or "electricity" or "fractions" generates long lists of different materials, different things to do, and instructions for how to do them. Although such lists of miscellaneous activities may have a use, collections of idiosyncratically configured ways of relating teacher, students, and content do not serve very well for either teacher learning or teacher educator learning because each has a unique participation structure and each requires a unique set of material and intellectual resources. The kinds of activities we are interested in,

by comparison, have a regular structure for interaction among teacher, students, and materials.

Regularizing a spare set of interactive structures reduces the cognitive and social load of ambitious instruction on teachers and students since the kinds of social and intellectual skills that are required to carry them out are repeated, and therefore practiced. As they make ambitious teaching more doable by novices, they also make it more teachable by teacher educators (Lampert & Graziani, 2009). Deliberate practicing builds skills and knowledge about how to teach as the same interactive structure would be used over and over again in different circumstances (Ericsson, Krampe, & Tesch-Romer, 1993; Ericsson, 2002). Learning common activity structures in teacher education settings means that all of the novices in a class can produce lessons with similar characteristics when they try out what they are learning in classrooms, generating similar problems of practice to work on with teacher educators (Kazemi, Lampert & Ghouseini, 2007; Franke & Chan, 2008). Similar to what occurs in medical “rounds” and other kinds of professional work on problems of practice, novices can acquire professional judgment by being guided by more knowledgeable others in the collaborative evaluation and revision of the forms of their interactions with students (Patel, Kaufman, & Magder, 1996; Weick & McDaniel, 1989).

This conception of instructional activities suggests that preparing novices for ambitious mathematics teaching would mean finding structured ways to enable them to get deep enough into authentic interactions with specific learners to practice inventing educative responses while not being overwhelmed with the unpredictability and complexity of creating improvised interaction (Ball & Cohen, 1999; Grossman & Mc Donald, 2008; Ghouseini, 2008). It would mean establishing the groundwork for maintaining the mathematical complexity of activities like discussing multiple solutions to a problem by structuring the components of interaction between teachers and students around content in ways that are regular over time (Silver, Ghouseini, Gosen, Charalambous, & Strawhun, 2005).

## **Moving to the Preparation of Ambitious Mathematics Teachers**

### ***A Work in Progress***

In teaching novices at the University of Michigan, the University of Washington, and UCLA, we are currently employing several key instructional tools and methods intended to reduce some of the inherent risk and complexity of ambitious mathematics teaching. First, we are developing a set of key instructional activities that collectively embody the core practices and professional principles that we believe are central to the work of teaching. Individually, these instructional activities are “chunks” of teaching that maintain the complexities of practice while simultaneously providing manageable, structured routines that constrain instructional choice. They are intended to maintain complexity in that their structure encompasses an

instructional sequence that enables a teacher to address a particular instructional purpose (albeit at a range of different levels) in principled, ambitious ways. The predetermined, stable structures of the instructional activities we are using constrain the set of decisions a beginning teacher (or experienced teacher, for that matter) must make during their enactment.

Drawing on recent research that relates computational fluency with conceptual understanding, we have identified four instructional activities to teach to novices. They all target teaching and learning in the domain of number and operations at the heart of elementary mathematics and can be used to accomplish multiple learning goals in lessons across the elementary spectrum. Our hypothesis is that this set of activities will serve as a productive starting place for novice teachers, enabling them to develop broadly applicable skills and knowledge. We plan to adapt these and add others through a design research process. If this work proves to be successful, we expect the field to take on other activities and other domains as we work toward building a theoretically and empirically grounded instructional system for elementary mathematics (Cohen, Raudenbush, & Ball, 2003; Raudenbush, 2008). The four activities we will begin with are described below:

- *Choral counting*: The teacher leads the class in a count, teaching different concepts and skills by deciding what number to start with, what to count by (e.g., by 10s, by 19s, by  $\frac{3}{4}$ s), whether to count forward or backward, and when to stop. The teacher publicly records the count on the board, stopping to elicit children's ideas for figuring out the next number, and to co-construct an explanation of the mathematics that arises in patterns.
- *Strategy sharing*: The teacher poses a computational problem and elicits multiple ways of solving the problem. Careful use of representations and targeted questioning of students are designed to help the class learn the general logic underlying the strategies, identify mathematical connections, and evaluate strategies in terms of efficiency and generalizability.
- *Strings*: The teacher poses several related computational problems, one at a time, in order to scaffold students' ability to make connections across problems and use what they know to solve a more difficult computational problem. This activity is used to target a particular strategy (as compared to eliciting a range of strategies). For example, posing  $4 \times 4$ , then  $4 \times 40$ , and then  $4 \times 39$  is designed to help students consider how to use  $4 \times 40$  to solve  $4 \times 39$ , developing their knowledge of compensating strategies in multiplication (Fosnot & Dolk, 2001).
- *Solving word problems*: The teacher first launches a word problem to support students in making sense of the problem situation, then monitors while students are working to determine how students are solving the problem, gauges which student strategies are best suited for meeting the instructional goal of an upcoming mathematical discussion, and makes judgments about how to orchestrate the discussion to meet those goals.

The fourth activity, solving word problems, is ubiquitous in elementary mathematics curricula and rarely done in ways that teach important mathematics (Hiebert,



Stigler, Jacobs, Givvin, & Garnier, 2005; Kilpatrick, Swafford, & Findell, 2001). The first three activities can be used as warm-ups in the classroom and appear as such in many existing curricula. Typically, however, these activities are not instructionally specified in teachers' guides to the extent that we envision being necessary for novices. By choosing warm-ups that can be routinely used, we have also built in the opportunity for novices to use them more than once, supporting a cycle of preparation, enactment, analysis, and reenactment.

We hypothesize that the instructional activities we are using with novices can provide a mental schema for an instructional "chunk" that can routinely be utilized by adapting it across content and grade levels to achieve instructional objectives (Leinhardt & Greeno, 1986). It is this adaptability, in part, that we contend makes work on instructional activities generative of novices learning both practical skills and professional judgment. In order to support ambitious mathematics teaching, instructional activities need to be structured to generate the variety of skills and knowledge that display to teachers what students can do and what they still need to learn. They also need to leave room for teachers to create teaching in response to what is displayed. At the same time, they structure what teachers and students do with the content to bring about an intended learning goal. They organize teacher and student interactions with the material resources of instruction, including texts, representations, and furniture. They are sequences of coordinated operations that can be mastered by teachers and students and repeated with different materials so that students can learn different aspects of the content at different levels of proficiency. They are grounded in experience, continually evolving in their design as they are used by ambitious practitioners.

While specifying instructional activities that we believe are generative of novices' learning, we are simultaneously developing "Pedagogies of Practice"<sup>3</sup> for teacher educators to use in preparing novices to engage in the activities with elementary-level students. These pedagogies are enacted in recurrent cycles during which teacher educators support novice teachers to analyze and observe, to plan and rehearse, and to experiment with the instructional activities, cycling between a phase in which the activities are taught and studied in a university classroom setting and a phase where beginners use them in interaction with children in actual classroom contexts. We believe that creating a pedagogical structure for novice teacher education in elementary mathematics that links coursework tightly with fieldwork and instructional investigation with enactment will be a substantial contribution of our work (Grossman & McDonald, 2008). The tightly integrated cycle of "Pedagogies of Practice" is designed to counter common problems of inert knowledge, mechanical skill implementation, and principles that are espoused but not enacted (e.g., Borko et al., 1992; Eisenhart et al., 1993; Ensor, 2001).

The Pedagogies of Practice we are developing for working with instructional activities built of what Leinhardt and Steele (2005) call "exchange routines" will

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<sup>3</sup>We see Pedagogies of Practice as a cyclic integration of what Grossman et al. (2009) have identified as Pedagogies of Investigation and Pedagogies of Enactment.

guide novice teachers' planning and enactment, helping them learn how to introduce an activity, manage materials and student participation, manage discussion toward an instructional goal, work with mathematical representations, and respond to student error. We are specifying particular routines and having novices rehearse them in ways that are integrated with developing their judgment about responding to students' learning. We are reviewing their use of the routines in classrooms and attending to what students are learning from engaging in them, and we are adjusting the activities based on what we learn from their enactment. In all of this work, we are indebted to Gaea Leinhardt for paving the way.

## References

- Axelrod, R., & Cohen, M.D. (1999). *Harnessing complexity: Implications of a scientific frontier*. NY: The Free Press.
- Ball, D. L. (1993). With an eye on the mathematical horizon: Dilemmas of teaching elementary school mathematics. *Elementary School Journal*, 93(4), 373–397.
- Ball, D. L., & Cohen, D. K. (1999). Developing practice, developing practitioners: Toward a practice-based theory of professional education. In L. Darling-Hammond & G. Sykes (Eds.), *Teaching as the learning profession* (pp. 3–31). San Francisco: Jossey-Bass.
- Ball, D. L., Hill, H. C., & Bass, H. (2005). Knowing mathematics for teaching: Who knows mathematics well enough to teach third grade, and how can we decide? *American Educator*, 29(3), 14–22, 43–46.
- Ball, D. L., & Wilson, S. M. (1996). Integrity in teaching: Recognizing the fusion of the moral and intellectual. *American Educational Research Journal*, 33(1), 155–192.
- Borko, H., Eisenhart, M., Brown, C. A., Underhill, R. G., Jones, D., & Agard, P.C. (1992). Learning to teach hard mathematics: Do novice teachers and their instructors give up too easily? *Journal for Research in Mathematics Education*, 23, 194–222.
- Bryk, T., Kerbow, D., Pinnell, G. S., Rodgers, E., Hung, C., Scharer, P.L., et al. (under review). Measuring change in the instructional practices of literacy teachers.
- Carpenter, T., Fennema, E., Franke, M. L., Levi, L., & Empson, S. B. (1999). *Children's mathematics: Cognitively guided instruction*. Portsmouth, NH: Heinemann.
- Chapin, S. H., O'Connor, C., & Anderson, N. (2003). *Classroom discussions: Using math talk to help students learn (Grades 1–6)*. Sausalito, CA: Math Solutions Publications.
- Chazan, D. (2000). *Beyond formulas in mathematics and teaching: Dynamics of the high school algebra classroom*. New York: Teachers College Press
- Cobb, P., & McClain, K. (2002). Supporting students' learning of significant mathematical ideas. In G. Wells & G. Claxton (Eds.), *Learning for life in the 21st century* (pp.154–166). Oxford, England: Blackwell.
- Cohen, D., Raudenbush, S., & Ball, D. (2003). Resources, instruction, and research. *Educational Evaluation and Policy Analysis*, 25(2), 1–24.
- Eisenhart, M., Borko, H., Underhill, R., Brown, C., Jones, D., & Agard, P. (1993). Conceptual knowledge falls through the cracks: Complexities of learning to teach mathematics with understanding. *Journal for Research in Mathematics Education*, 24, 8–40.
- Ensor, P. (2001). From preservice mathematics teacher education to beginning teaching: A study in recontextualizing. *Journal for Research in Mathematics Education*, 32(3), 296–320.
- Erickson, F., & Schultz, J. (1981). When is a context? Some issues and methods in the analysis of social competence. In J. L. Green & C. Wallat (Eds.), *Ethnography and language* (pp. 147–160). Norwood, NJ: Ablex.
- Ericsson, K.A. (2002). Attaining excellence through deliberate practice: Insights from the study of expert performance. In M. Ferrari (Ed.), *The Pursuit of excellence in education* (pp. 21–55). Hillsdale, NJ: Erlbaum.

- Ericsson, K.A., Krampe, R.T., & Tesch-Romer, C. (1993). The role of deliberate practice in the acquisition of expert performance. *Psychological Review*, *100*, 363–406.
- Feldman, M.S., & Pentland, B.T. (2003). Reconceptualizing organizational routines as a source of flexibility and change. *Administrative Science Quarterly*, *48*, 94–118.
- Fennema, E., Franke, M. L., Carpenter, T. P., & Carey, D. A. (1993). Using children's mathematical knowledge in instruction. *American Educational Research Journal*, *30*, 555–583.
- Forman, E. A., Larreamendy-Joerns, J., Stein, M. K., & Brown, C. A. (1998). "You're going to want to find out which and prove it": Collective argumentation in a mathematics classroom. *Learning and Instruction*, *8*(6), 527–548.
- Fosnot, C. T. & Dolk, M. (2001). *Young mathematicians at work: Constructing Number Sense, Addition, and Substractions*. Westport, CT: Heinemann.
- Fountas, I. C., & Pinnell, G. S. (2006). *Teaching for comprehension and fluency: Thinking, talking, and writing, K-8*. Portsmouth, NH: Heinemann.
- Franke, M. L., & Chan, A. (2008). *Learning about and from focusing on routines of practice*. Paper presented at the annual meeting of the American Educational Research Association, New York.
- Franke, M. L., & Kazemi, E. (2001). Learning to teach mathematics: Developing a focus on students' mathematical thinking. *Theory Into Practice*, *40*, 102–109.
- Franke, M. L., Kazemi, E., & Battey, D. (2007). Understanding teaching and classroom practice in mathematics. In F. K. Lester (Ed.), *Second handbook of research on mathematics teaching and learning* (pp. 225–256). Greenwich, CT: Information Age Publishers.
- Ghousseini, H. (2008). *Learning with routines: Preservice teachers learning to lead classroom mathematics discussions*. Unpublished doctoral dissertation, University of Michigan, Ann Arbor. Retrieved December 1, 2008 from Dissertations and Theses database.
- Glazer, J. L. (2005) *Educational professionalism: The development of a practice-centered frame and its application to the America's Choice school design*. Unpublished doctoral dissertation, University of Michigan, Ann Arbor. Retrieved September 15, 2008 from Dissertations and Theses database.
- Greeno, J. G. (2007). Toward the development of intellectual character. In E. W. Gordon & B. L. Bridglall (Eds.), *Affirmative development: Cultivating academic ability* (pp. 17–47). Lanham, MD: Roman & Littlefield.)
- Grossman, P., & McDonald M. (2008). Back to the future: Directions for research in teaching and teacher education. *American Educational Research Journal*, *45*, 184–205.
- Grossman, P., Compton, C., Igra, D., Ronfeldt, M., Shahan, E., & Williamson, P. (2009). Teaching practice: A cross-professional perspective. *Teachers College Record*, *111*(9) retrieved on February 20, 2009 from <http://www.tcrecord.org/content.asp?contentid=15018>.
- Heaton, R. (2000). *Teaching math to the new standards: Relearning the dance*. New York: Teachers College Press.
- Henningsen, M., & Stein, M. K. (1997). Mathematical tasks and student cognition: Classroom-based factors that support and inhibit high-level mathematical thinking and reasoning. *Journal for Research in Mathematics Education*, *5*, 524–549.
- Herbst, P. (2003). Using novel tasks to teach mathematics: Three tensions affecting the work of the teacher. *American Educational Research Journal*, *40*, 197–238.
- Hiebert, J., Carpenter, T. P., Fennema, E., Fuson, K.C., Wearne, D., & Murray, H., (1997). *Making sense: Teaching and learning mathematics with understanding*. Portsmouth, NH: Heinemann.
- Hiebert, J., Stigler, J. W., Jacobs, J. K., Givvin, K. B., & Garnier, H. (2005). Mathematics teaching in the United States today (and tomorrow): Results from the TIMSS 1999 video study. *Educational Evaluation and Policy Analysis*, *27*, 111–132.
- Hill, H. C., Blunk, M., Charalambous, C., Lewis, J., Phelps, G., Sleep, L., et al. (2008). Mathematical knowledge for teaching and the mathematical quality of instruction: An exploratory study. *Cognition and Instruction*, *26*(4), 430–511.
- Hill, H. C., Rowan, B., & Ball, D. L. (2005). Effects of teachers' mathematical knowledge for teaching on student achievement. *American Educational Research Journal*, *42*(2), 371–406.

- Kazemi, E., Lampert, M., & Ghouseini, H. (2007) *Conceptualizing and using routines of practice in mathematics teaching to advance professional education*. Report to the Spencer Foundation, Chicago
- Kazemi, E., & Stipek, D. (2001). Promoting conceptual thinking in four upper-elementary mathematics classrooms. *Elementary School Journal*, 102, 59–80.
- Kazemi, E. (1998). Discourse that promotes conceptual understanding. *Teaching Children Mathematics*, 4, 410–414.
- Kennedy, M. (1987). Inexact sciences: Professional education and the development of expertise. *Review of Research in Education*, 14, 133–167.
- Kilpatrick, J., Swafford, J., & Findell, B. (Eds.) (2001). *Adding it up: Helping children learn mathematics*. Washington, DC: National Academy Press.
- Knapp, M. S., Shields, B. J., & Turnbull, B. (1992). *Study of academic instruction for disadvantaged students: Academic challenge for the children of poverty Summary Report* (SRI International No. LC88054001). Washington DC: U.S. Department of Education, Office of Policy and Planning (45).
- Lampert, M., Boerst, T., & Graziani, F. (in press). Using organizational assets in the service of ambitious teaching practice. *Teachers College Record*.
- Lampert, M., & Graziani, F. (2009). Instructional activities as a tool for teachers' and teacher educators' learning in and for practice. *Elementary School Journal* 109(5), 491–509.
- Lampert, M. (1986). Knowing, doing, and teaching multiplication. *Cognition and Instruction*, 3, 305–342.
- Lampert, M. (1989). Choosing and using mathematical tools in classroom discourse. In J. Brophy, (Ed.), *Advances in research on teaching* (Vol. 1, pp. 223–264). Greenwich, CT: JAI Press.
- Lampert, M. (1992a). Practices and problems in teaching authentic mathematics in school. In F. Oser, A. Dick, & J.-L. Patry (Eds.), *Effective and responsible teaching: The new synthesis* (pp. 295–314). New York: Jossey-Bass.
- Lampert, M. (1992b). Teaching and learning long division for understanding in school. In Leinhardt, G., Putnam, R., & Hattrup, R. (Eds.), *Disseminating new knowledge about mathematics instruction*. Hillsdale, NJ: Erlbaum.
- Lampert, M. (2001). *Teaching problems and the problems of teaching*. New Haven & London: Yale University Press
- Lampert, M., & Cobb, P. (2003) Communication and learning in the mathematics classroom. In J. Kilpatrick & D. Shifter (Eds.), *Research companion to the NCTM standards* (pp. 237–249). Reston, VA: National Council of Teachers of Mathematics.
- Leinhardt, G. (2001). Instructional explanations: A commonplace for teaching and locating contrast. In V. Richardson (Ed.), *Handbook of research on teaching* (4th ed., pp. 333–337). Washington, DC: American Educational Research Association.
- Leinhardt, G., & Greeno, J. (1986). The cognitive skill of teaching. *Journal of Educational Psychology*, 78(2), 75–95.
- Leinhardt, G., & Steele, M. D. (2005). Seeing the complexity of standing to the side: Instructional dialogues. *Cognition and Instruction*, 23(1), 87–163.
- O'Connor, M. C., & Michaels, S. (1993) Aligning academic task and participation status through revoicing: Analysis of a classroom discourse strategy *Anthropology and Education Quarterly*, 24(4), 318–335
- Patel, V. L., Kaufman, D. R., & Magder, S. A. (1996). The acquisition of medical expertise in complex dynamic environments. In K. A. Ericsson (Ed.), *The road to excellence: The acquisition of expert performance in the arts, sciences, sports, and games* (pp. 127–166). Hillsdale, NJ: Lawrence Erlbaum.
- Rand Mathematics Study Panel. (2003). *Mathematical proficiency for all students: Toward a strategic research and development program in mathematics education*. Santa Monica, CA: Rand.
- Raudenbush, S. (2008). Advancing educational policy by advancing research on instruction. *American Educational Research Journal*, 45(1), 206–230.

- Schoenfeld, A. H. (Ed.) (2008). A study of teaching: Multiple lenses, multiple views. *Journal for research in Mathematics Education* (monograph series). Reston, VA: National Council of Teachers of Mathematics.
- Scott, S. E. (2008). *Rehearsing for ambitious instruction in the university classroom. A case study of a literacy methods course*. Paper presented at the annual meeting of the American Education Research Association, New York.
- Silver, E. A., Ghouseini, H., Gosen, D., Charalambous, C., & Strawhun, B. T. F. (2005). Moving from rhetoric to praxis: Issues faced by teachers in having students consider multiple solutions for problems in the mathematics classroom. *Journal of Mathematical Behavior*, 24, 287–301.
- Smith, J., Lee V., & Newmann, F. (2001). *Instruction and achievement in Chicago elementary schools*. Chicago, IL: Consortium on Chicago Schools Research.
- Stein, M. K., Engle, R. A., Smith, M. S., & Hughes, E. K. (2008). Orchestrating productive mathematical discussions: Helping teachers learn to better incorporate student thinking. *Mathematical Thinking and Learning*, 10(4), 313–340.
- Urban Teacher Education Program, (2004). *Guided reading sample lesson plan: STEP 2, text level B*. Unpublished document.
- US Department of Education (2008), *Foundations for success: The final report of the National Mathematics Advisory Panel*. Washington, DC: US Department of Education.
- Weick, K., & McDaniel, R. (1989). How professional organizations work: Implications for school organization and management. In T. J. Sergiovanni & J. H. Moore (Eds.), *Schooling for tomorrow: Directing reforms to issues that count*(pp. 330–355). Boston: Allyn & Bacon.
- Wood, T., Scott Nelson, B., & Warfield, J. Eds. (2001) *Beyond classical pedagogy: Teaching elementary school mathematics*. Hillsdale, NJ: Lawrence Erlbaum.