JESSUP, NAOMI ALLEN, Ph.D. Understanding Teachers' Noticing of Children's Mathematical Thinking in Written Work from Different Sources. (2018)
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Expertise in teacher noticing of children's thinking is central to a vision of responsive teaching in which teachers regularly elicit and build on children's thinking during instruction (Richards & Robertson, 2016). In mathematics classrooms, this core instructional practice of noticing children's mathematical thinking repeatedly occurs during instruction and involves attending to and making sense of children's mathematical thinking (Sherin, Jacobs, & Philipp, 2011). Teachers daily have opportunities to notice children's mathematical thinking during their conversations with students and in students' written work. However, expertise in noticing children's mathematical thinking does not develop automatically or through years of teaching, and teachers need support developing noticing expertise. To help teachers develop noticing expertise, professional developers often employ artifacts of practice (e.g., video clips and student written work) from teachers' own classrooms as well as strategically selected artifacts from classrooms taught by teachers unfamiliar to the PD participants. This study explored the potential differences in teachers' noticing with written work from these two sources—teachers' own classrooms and classrooms unfamiliar to the teachers. Drawing on the construct of framing (Goffman, 1974), particular attention was paid to the various frames (or lenses) teachers used during noticing.

Using a context of professional development focused on children's mathematical thinking in the domain of fractions, this three-phase study explored teachers' noticing and their use of frames by investigating the relationship between teachers' noticing of

children's mathematical thinking in written work from their own classrooms versus unfamiliar classrooms. In the first phase, this study identified the frames individual teachers used when noticing children’s thinking in written work from their own classrooms. The second phase explored the frames that small groups of teachers used when collectively noticing children’s thinking in written work from unfamiliar classrooms during professional development. The third phase used in-depth interviews to investigate the relationship between the quality of teacher noticing and the use of frames of six teachers who were asked to notice children’s thinking in written work on the same problem from their own classrooms and from unfamiliar classrooms.

Findings identified six frames teachers used while noticing children's mathematical thinking in written work from the two sources, and they fell into three broad categories: (a) noticing focused on the child’s current mathematical performance, (b) noticing focused on the child’s non-mathematical performance, and (c) noticing that compared the child’s performance to the expected performance based on the child’s past performance, the performance of the rest of the class, or curricular or testing guidelines. Confirmation of these frames in three data sets highlighted the variety of ways teachers reason during noticing, suggesting that frames are a useful construct for understanding the complexity of teachers’ noticing because frames capture the multiple and sometimes competing ideas that teachers need to coordinate.

When comparing teachers’ noticing of children’s thinking in written work from their own classrooms versus unfamiliar classrooms, a lack of substantial evidence was found to distinguish the sources in terms of the use of particular frames, the prevalence of particular frames, or the quality of teachers' noticing of children's thinking. Further, there was evidence that teachers "imagined" insider knowledge of children from unfamiliar classrooms to assist with their noticing, which might explain why engaging with written work from either source did not seem to change the quality of teachers' noticing. On the other hand, comparative analyses identified a distinction between teachers' use of frames when they were considering one child's strategy versus several children's strategies regardless of whether the written work came from the teachers' classrooms or unfamiliar classrooms. Specifically, when teachers' noticing focused on more than one child, more frames and a greater variety of frames were invoked. Implications for professional development focus on the need to appreciate and address teachers' coordination of multiple frames and the idea that the use of these frames depends less on the source of the written work and more on the number of children involved in the task.

UNDERSTANDING TEACHERS' NOTICING OF CHILDREN'S

MATHEMATICAL THINKING IN WRITTEN WORK

FROM DIFFERENT SOURCES

by

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Approved by

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Committee Chair

This dissertation is dedicated in loving memory to my mother and to my husband and children who have sacrificed, supported, and encouraged me to pursue my dreams.

APPROVAL PAGE

This dissertation written by NAOMI ALLEN JESSUP has been approved by the following committee of the Faculty of The Graduate School at The University of North Carolina at Greensboro.

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CHAPTER I

INTRODUCTION

There is a current vision of mathematics instruction articulated throughout research and policy documents that calls for teachers to attend to children's thinking in productive ways. The importance of mathematics teaching that foregrounds children's thinking to promote learning for all children derives from a robust research base (Carpenter, Fennema, Peterson, Chiang, & Loef, 1989; Jackson & Cobb, 2010; Jacobs & Empson, 2016; Munter, 2014; NRC, 2001). Similarly, policy documents such as the *Common Core State Standards for Mathematics* (National Governors Association, 2010) and *Principles to Action* (National Council of Teachers of Mathematics, 2014) reiterate the importance of eliciting and building on children's thinking as meaningful practices of mathematics teaching. In short, this vision of mathematics instruction highlights teachers' use of evidence of children's mathematical thinking as a basis for making continual adjustments to instruction that support and extend children's learning.

This dissertation study focused on this vision of instruction, which has been referred to as *responsive teaching* because responding to children's mathematical thinking as an approach to support student learning outcomes is foregrounded (Robertson, Scherr, & Hammer, 2016). In choosing this emphasis, I also acknowledge that there are other ways for teaching to be responsive in the classroom. For example, culturally responsive teaching is another vision of instruction, which foregrounds the importance of eliciting and utilizing children's cultural identities in all aspects of learning (Gay, 2002; Ladson-Billings, 1995). I believe the two types of responsiveness to be mutually reinforcing and my focus on children's thinking is based on the premise that children have a wealth of knowledge and experiences that they bring to the classroom and that are reflected in their mathematical thinking. In turn, it is the teachers' responsibility to facilitate instruction from children's individual knowledge and skills by watching and listening and responding. Thus, in responsive teaching, children are provided opportunities to develop in their thinking, and teachers use their knowledge of how particular children, and children in general, make sense of mathematical ideas to support and extend children's thinking (Jacobs & Ambrose, 2008; Jacobs & Empson, 2016).

Responsive teaching, like all teaching, is complex and composed of a collection of practices to help support student learning (Grossman & McDonald, 2008; Jacobs & Spangler, 2017; Lampert, 2010). Many current efforts focus on identifying and promoting core instructional practices that are research-based, support student and teacher learning, and can be accessed and learned in a variety of settings (Grossman, Hammerness, & McDonald, 2009; Jacobs & Spangler, 2017). While the field has not developed a consensus regarding core practices that are responsive to children's thinking, I join others in arguing that teacher noticing is a core practice of responsive teaching (Jacobs & Spangler, 2017).

Teacher Noticing—Core Practice of Responsive Teaching

Noticing refers to the general everyday process of making observations in which many things are competing for our attention and sense making. Teacher noticing is a more intentional type of noticing (Mason, 2002) in a complex classroom environment, in which so much occurs that it is hard to attend to everything with an equal amount of consideration. Teacher noticing is a construct that has the potential to uncover what teachers find important in a teaching episode, specifically regarding students and learning. In this study, I focus on a specialized type of teacher noticing, *professional noticing of children's mathematical thinking,* that is closely linked to my vision of responsive teaching, which emphasizes building on children's mathematical thinking. Professional noticing of children's mathematical thinking includes the three interrelated skills of attending to children's strategies, interpreting children's mathematical understandings, and deciding how to respond on the basis of children's understandings (Jacobs, Lamb, & Philipp, 2010). Professional noticing expertise is necessary, but not sufficient, for responsive teaching and honing in on children's thinking for use in instructional decision making is an acquired expertise (Jacobs, Lamb, & Philipp, 2010; Louie, 2016; Sherin, Jacobs, & Philipp, 2011).

Expertise in Noticing Children's Mathematical Thinking

Teacher noticing of children's mathematical thinking is challenging. Classrooms are complex environments composed of different interactions that occur throughout the instructional setting. Teachers must determine which aspects of classroom instruction are important while making in-the-moment decisions. Further, there is a range of factors that could shape teachers' noticing, such as teaching environments, preferences, biases, and specialized content knowledge (Sherin et al., 2011). Despite the challenges in developing expertise in teacher noticing, research has shown that it is a learnable practice.

Generally, teachers do not develop noticing expertise automatically, even after years of teaching experience (Jacobs et al., 2010), but there is evidence that with support, noticing expertise can improve for both prospective teachers (Callejo & Zapatera, 2017; Fernández, Llinares, & Valls, 2012; Schack et al., 2013) and practicing teachers (Floro & Bostic, 2017; Jacobs et al., 2010; van Es & Sherin, 2008).

The development of teachers' noticing expertise often occurs in professional development settings in which the practices of teaching are decomposed into manageable parts (Jacobs & Spangler, 2017; Grossman et al., 2009). Teachers then work with these parts through face-to-face interactions with students or engagement with artifacts of practice (e.g., student written work and classroom video). When artifacts of practice are used to promote growth in noticing expertise, these artifacts can come from teachers' own classrooms or can be strategically selected by facilitators from classrooms unfamiliar to the teachers. The inclusion of artifacts from the two sources—teachers' own classrooms and unfamiliar classrooms—has shown promise in supporting the development of teacher noticing expertise during PD, but additional research is needed to understand the potential differences of teacher noticing prompted by each source. Teachers may draw upon the use of insider knowledge of their students when noticing children's mathematical thinking in artifacts from their own classrooms which is not possible in artifacts from unfamiliar classrooms. This insider knowledge potentially influences how closely teachers' noticing is reflective of the mathematical thinking represented in current artifacts.

Study Origins

The idea for this study developed from literature on PD and teacher noticing as well as my observations when working on the *Responsive Teaching in Elementary Mathematics* (RTEM) study. RTEM was a 4-year professional development design study interested in characterizing teachers' development of responsiveness to children's mathematical thinking in the domain of fractions. I observed the same teachers in PD and their classrooms and saw differences in those teachers' noticing of children's mathematical thinking in their own classrooms versus in PD when the written work was mostly strategically selected by the facilitator from unfamiliar classrooms. In the PD, teachers generally seemed to notice children's thinking in written work more effectively than in their own classrooms—they were more likely to attend closely to the details of the students' thinking represented in the strategies, interpret the students' understanding based on evidence found within the strategy, and decide how to respond based on the students' understanding. In contrast, when reflecting on their own lessons, they generally used less specificity when discussing strategy details, and their interpretations of students' understandings and decisions about next instructional steps sometimes used evidence from the strategies in the written work but other times relied more on previous interactions with the students and sometimes were not even mathematically focused. Although prior interactions and non-mathematical foci maybe be useful at times, they often seemed to overwhelm the teachers' noticing in a way that minimized the mathematical work the child had actually done. These types of differences in how teachers noticed children's thinking in the written work in the two settings caused me to wonder about the extent to which teachers foregrounded children's mathematical thinking when noticing children's thinking in written work from their own classrooms versus unfamiliar classrooms, and what implications these differences might have for the use of both types of artifacts in professional development. To better understand the additional, and potentially competing lenses teachers may use when noticing children's thinking in written work from their own classrooms, I drew on the construct of framing.

Teacher Noticing and Framing

The construct of framing is a potential tool to understand the complexity of teachers' noticing of children's mathematical thinking. *Frames* are the lenses used as individuals structure information for the sense-making process of filtering and discarding irrelevant information (Goffman, 1974). Frames provide structures that help people classify, organize, and interpret their experiences, and thus the use of frames refers to the "active sense-making that teachers engage in" (Sherin & Russ, 2014, p. 6). In settings that support the development of expertise in noticing children's mathematical thinking, a children's thinking lens is foregrounded to help teachers attend to and make sense of salient mathematical details within children's strategies. In this study, I chose framing to explore the use of a children's mathematical thinking lens and other lenses that may enhance or impede the use of this lens in teacher noticing. In particular, I am interested in understanding the relationship between teachers' use of frames and their quality of noticing of children's mathematical thinking in written work from their own classrooms and those from unfamiliar classrooms. In this way, I can consider how the context of schooling and experiences with students from the teachers' own classes influence the quality of their noticing expertise. Teaching is not context-free and past and current contextual factors often shape pedagogical decisions, and thus the frames teachers use.

Overview of Dissertation

The purpose of this study was to characterize teacher noticing of children's mathematical thinking to understand differences in noticing expertise and the use of frames employed in noticing as teachers engaged with different sources of student written work. The study involved three phases (See Figure 1.1).

What is the relationship between teachers' noticing of children's mathematical thinking in written work from their own vs. unfamiliar classrooms?		
Phase 1: Post-Observation Interviews	**Phase 2: Small-Group Conversations**	**Phase 3: Noticing Interviews**
Research Question: What frames do teachers use when noticing children's mathematical thinking in written work from their own classrooms?	**Research Question:** What frames do teachers use when noticing children's mathematical thinking in written work from unfamiliar classrooms?	**Research Questions:** 1. What frames do individual teachers use when noticing children's mathematical thinking in written work from their own and unfamiliar classrooms? 2. What is the quality of individual teachers' noticing when noticing children's mathematical thinking in written work from their own and unfamiliar classrooms? 3. What is the relationship between teachers' use of frames and the quality of their noticing?

Figure 1.1. Overview of Dissertation Phases.