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Curricular Noticing: A Framework to Describe  
Teachers' Interactions with Curriculum Materials

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### Abstract

Building on the work of Professional Noticing of Children's Mathematical Thinking, we introduce the Curricular Noticing Framework to describe how teachers recognize opportunities within curriculum materials, understand their affordances and limitations, and use strategies to act on them. This framework builds on Remillard's (2005) notion of *participation with* curriculum materials, connects with and broadens existing research on the relationship between teachers and written curriculum, and highlights new areas for research. We argue that once mathematics educators better understand the strategic curricular practices that support ambitious teaching, which we refer to as *professional curricular noticing*, then this knowledge can lead to recommendations for how to support the curricular work of teachers, particularly novice teachers.

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“The math lessons, they’re so short, it says like objective – ‘to get the kids to know about representing length’ – Okay, what’s that supposed to mean? And it says, ‘you’ll need these materials’ – Okay, I’ve got the materials, now what am I supposed to do with them? ... You know, it doesn’t hardly tell you anything ... I am not sure what they mean by all this stuff?” – Linda, a pre-service teacher (Ball & Feiman-Nemser, 1988, p. 416)

During the past 25 years, educational researchers have aimed to develop evidence-based models for how teachers interact with curriculum materials (as described in Lloyd, Cai, & Tarr, 2017; Taylor 2016). Such efforts reflect the central role curriculum plays in classroom instruction, including its influence on what mathematics teachers plan for and enact in their classrooms (Tarr, Chávez, Reys, & Reys, 2006), as well as its influence on student learning (Matsumura et al., 2006; Stein, Remillard, & Smith, 2007). As evidenced in the teacher’s quote above, teaching with curriculum materials is not simply a matter of opening a textbook and teaching (Lloyd & Behm, 2005). Rather, teaching with curriculum materials is a complex and dynamic process that is mediated by a teacher’s knowledge, beliefs, experiences, and dispositions (e.g., Remillard, 2005). This complexity of planning with materials necessitates that teachers develop *curricular reasoning*, which Breyfogle, Roth McDuffie, and Wohlhuter (2010) define as the “thinking processes that teachers engage in as they work with curriculum materials

to plan, implement, and reflect on instruction” (p. 308). In order to take advantage of the mathematical and pedagogical opportunities offered in curriculum materials, teachers like Linda need to be able to see these opportunities, recognize their affordances and limitations, and have strategies to act on them.

In this paper, we present a theoretical framework to describe these interactions between mathematics teachers and curriculum materials. We use the phrase *curriculum materials* to refer to written and digital textbooks that contain mathematical content designed for pedagogical purposes. We build on Remillard’s (2005) theory that teachers both draw from and shape the curriculum materials with which they work. In other words, teachers *participate with* curriculum materials. This conceptualization shifts the role of curriculum from being a fixed object to a dialogic partner in a curricular process. This framing also re-positions teachers as actors who influence and manipulate the curricular materials “for [their] specific purpose and context” (Remillard, 2013, p. 925).

Remillard’s (2005) framing raises questions regarding the nature of this participation. What are the different dimensions of this interaction? Are there interactions between teachers and curricula that are more strategic than others? The interactions between teachers and curriculum materials have been described by researchers in various ways (e.g., Brown & Edelson, 2003; Brown, 2009; Choppin, 2009; Gueudet & Trouche, 2009; Lloyd, 2008; Pepin, Gueudet, & Trouche, 2013; Remillard & Bryans, 2004; Sherin & Drake, 2009). For example, some researchers have focused on recurring *patterns* of participation with materials, such as explaining that teachers read, adapt, and evaluate materials (Sherin & Drake, 2009). Others have focused on *characterizing* the manner in which the curriculum materials are manifested in

enactment, such as recognizing that teachers may offload, adapt, or improvise with curriculum materials (e.g., Brown, 2009). Yet little is understood so far about how these different descriptions of interactions collectively reveal a broader curricular process of participation with curriculum materials.

This paper adds to this theoretical body of work by proposing a framework for describing a process for how teachers can effectively draw from the affordances and complexities of their curriculum materials to make informed decisions with these materials. We argue that this framework enables researchers to describe a process in which a teacher, like Linda, may engage to take advantage of curricular opportunities beyond what a textbook “tells you” to do (or not). We take a sociocultural perspective to consider that, like Goodwin’s (1994) archaeologists whose professional practices involve highlighting minute variations in the color and texture of dirt, teachers may develop their own professional vision for recognizing important features of curriculum materials. With this perspective, we interpret curriculum materials as a tool that may be employed in various ways to contribute to instruction in a classroom. Specifically, we propose that *noticing*, which has proven to be a useful theoretical construct for examining and improving the work of teaching (e.g., Sherin, Jacobs, & Philipp, 2011), can connect and broaden existing frameworks that describe mathematics teachers’ interactions with curriculum materials.

### **Mathematics Teacher Noticing**

There is growing agreement that what mathematics teachers notice (or do not notice) impacts their decisions in the classroom (van Es, 2011). Teachers, like other professionals, have profession-specific ways of “seeing and understanding events,” (Goodwin, 1994, p. 606) which connect knowledge of content and students in ways that supports their decision-making (Jacobs,

Lamb, & Philipp, 2010; van Es & Sherin, 2008). Such seeing and understanding is further informed by the cultural, historical, and economic contexts that comprise their varied experiences (Darling-Hammond, 2002). Specifically, mathematics teachers need to recognize and understand the complexity of students' mathematical thinking in order to use this information to inform their teaching practice in the classroom or when preparing subsequent lessons (Jacobs et al., 2010). This includes both the interpretation of how students are thinking and the recognition of unique or different ways students think mathematically as described in Sherin and Star (2011). This deliberate sensitizing of oneself to notice opportunities to act and being able to recognize possible actions one might take has been framed as *noticing* (Mason, 2002). The framing of teacher noticing has fueled a rapidly-growing line of research to examine how teachers elicit and draw upon student thinking in mathematically and pedagogically productive ways and to enable the creation of educational opportunities that seek to enhance how teachers can recognize and draw from student thinking as they teach (e.g., Sherin et al., 2011; van Es & Sherin, 2008). Specifically, this framing of the work of teachers has led to the development of interventions that provide evidence that both novice and experienced teachers can improve their noticing practices with support (e.g., Amador & Weiland, 2016; Star & Strickland, 2008; van Es, 2011; van Es & Sherin, 2008).

Building on Mason (2002) and the idea that professionals have particular ways of attending (Goodwin, 1994), Jacobs et al. (2010) developed the Professional Noticing of Children's Mathematical Thinking framework to describe how teachers attend to, interpret, and decide how to respond to student thinking. This framework highlights the need for teachers to learn to listen and interpret student actions (i.e., talk, gestures, and writing) and to leverage

students' mathematical thinking in their decision making, both before and during enactment. We propose that the Jacobs et al. (2010) noticing framework describes a process of interaction (in this case, with student mathematical thinking) that can similarly describe teachers' work with curriculum materials both in planning before the lesson and in the classroom.

### **The Curricular Noticing Framework**

In order to take advantage of opportunities in curricula in mathematically and pedagogically productive ways for students, teachers need to recognize and make sense of such opportunities--or lack thereof--in curricula. Thus, drawing from Jacobs and colleagues (2010), we refer to the set of skills that constitute the curricular work of mathematics teaching as *curricular noticing*. These skills, such as interpreting a lesson objective or deciding how to use recommended manipulatives, can be grouped into three phases of interactions between teachers and curriculum materials, namely *curricular attending*, *curricular interpreting*, and *curricular responding*. Although the term "skill" can sometimes connote a simple or mindless performance developed through rote practice, we instead frame *skills* in terms of strategic and purposeful professional practices that must be intentionally learned and developed (Ball & Forzani, 2009). We argue that these skills comprise a set of curricular practices that enable teachers to recognize, make sense of, and strategically employ opportunities available within their curriculum materials. Although the term "noticing" in the name of the framework is sometimes used as a synonym of "attending," we, like Jacobs et al. (2010), instead use "attending" as the first of three phases that together constitute the practices of curricular noticing. *Curricular noticing*, therefore, is a process of interaction between the teacher and the curriculum materials that is initiated by

attending and is extended to include interpreting and responding, which are each dependent on the preceding phases.

We propose that the Curricular Noticing Framework constitutes the entire participatory relationship between teachers and curriculum materials (Remillard, 2005). As we represent in Figure 1 with the bidirectional arrow from Remillard's (2005) diagram, the Curricular Noticing Framework organizes the dimensions of this interaction within broad phases of use. We contend that the patterns that have been identified in research, such as Sherin and Drake's (2009) notions of reading, evaluating, and adapting curriculum, are types of attending, interpreting, and responding, but not the only ones. For example, we argue that curricular interpreting also includes skills such as sense-making and connecting with curricular expectations, such as the CCSS-M's Standards of Mathematical Practice (National Governors Association [NGA] Center for Best Practices, & Council of Chief State School Officers [CCSSO], 2010).

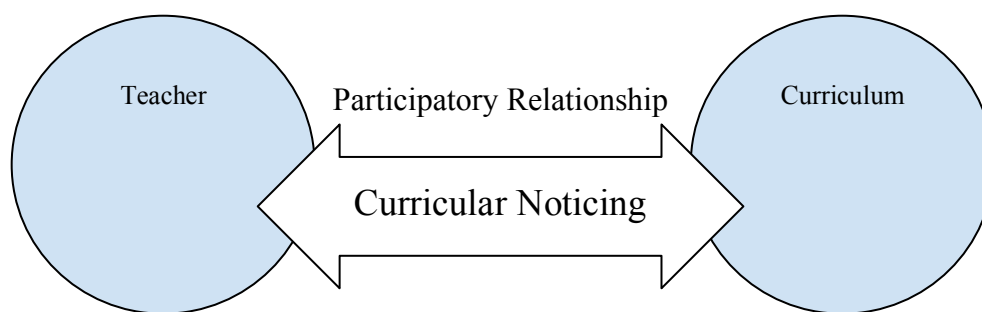


Figure 1. The process of teachers' participation with curriculum materials.

Note that the Curricular Noticing Framework does not exclude or ignore the role of students in the curricular work of teachers. Rather, we recognize that a teachers' knowledge of students (including students' dispositions and prior experiences) and beliefs about mathematics teaching and learning inform and guide how the teacher interacts with their curriculum materials.

Just as the Professional Noticing of Children’s Mathematical Thinking Framework foregrounds the teacher-student dimension (as represented in Ball and Cohen’s (1996) instructional triangle) as teachers and students work on a curricular task, the Curricular Noticing Framework foregrounds the teacher-curriculum dimension with the consideration of the goals, experiences, and dispositions of students.

The remainder of this section defines in more detail each of these phases—attending, interpreting, and responding—and discusses their interrelationships. Each phase is linked to existing research on teachers’ use of mathematics curriculum materials.

### **Curricular Attending**

*Curricular attending* describes the skills involved in viewing information within curriculum materials to inform the teaching and learning of mathematics. Thus, curricular attending includes the skills involved in searching, looking, locating, surveying and other ways of visually taking in materials prior to their interpretation. Curricular attending is not limited to the recognition of noteworthy or unique aspects of curricular materials. Rather, it includes all aspects of curriculum materials, construed here broadly as it comes in many forms, including mathematical activities (e.g., tasks, games, exercises), mathematical content (e.g., a definition or theorem), and strategic teaching advice (e.g., recommendations for pacing or for how to group students).

Although there are many aspects of curriculum materials to which one can attend, we do not suggest that it is practical (or possible) that teachers notice all components all of the time. In fact, with limited time, teachers need to be selective in how they attend to their curriculum materials. What a teacher sees in a set of materials can be haphazard or indiscriminate and

possibly restricted only by graphical design and layout, such as a textbox that catches the eye or portions of text that are outside the main viewing area (what Guedet & Trouche (2009) refer to as *instrumentation*). Yet what a teacher looks at can also be influenced by the educational goals and purposes of the interaction (what Guedet & Trouche (2009) refer to as *instrumentalization*). For example, Linda from the opening quote focused attention on the objective statement and suggested materials in order to understand what to do. Choppin (2011) provides evidence that some teachers read curriculum materials for specific ideas about how to structure a student activity, questions to ask during the activity and summary parts of the lesson, and any reference to potential student strategies. In addition, a teacher's *curriculum vision* (that is, the knowledge of the design, content, and philosophy of a curriculum) establishes particular expectations regarding what they will find, thereby influencing that to which they attend (Drake & Sherin, 2009). In fact, curriculum vision may lead to strongly-held curricular attending habits which might aid a teacher's recognition of opportunities embedded in curriculum materials, yet also may potentially make them unaware of slight deviations in design.

### **Curricular Interpreting**

*Curricular interpreting* refers to the skills used by teachers to make sense of that to which they attended. This framing includes connecting the ideas found in the curriculum materials with the teachers' mathematical knowledge for teaching (Ball, Thames, & Phelps, 2008), such as subject matter knowledge and pedagogical content knowledge (including knowledge of students, teaching, and curriculum). Interpreting a portion of curriculum materials (e.g., a lesson or a unit) also includes making sense of the portion in relation to what has come before and what will be taught in the future.

A teacher's interpretation of curriculum materials is dependent on their prior experiences, goals, and background knowledge (Rosenblatt, 1988). For example, Lloyd (1999) demonstrates that teachers, when interpreting mathematical tasks, employ a conception of curriculum that accounts for how one teacher can view one task as open-ended while another interprets the same task as overly-scaffolded. Drake and Sherin (2009) explain that curriculum vision includes professional understandings of curricular tools that shape a teacher's interpretation of curriculum materials. Choppin (2011) also provides evidence that beyond a teacher's prior experience with the curriculum materials, understanding the design rationale of curriculum materials is a factor in a teacher's interpretation of curriculum materials.

### **Curricular Responding**

*Curricular responding* describes the skills involved in making curricular decisions based on the interpretation of curricular materials. Note that Jacobs et al. (2010) described their third skill as "deciding how to respond." However, in contrast to Jacobs et al. (2010), we frame "responding" to include both decisions of how to respond along with how these responses are enacted in the classroom. We do this to reflect the increasing recognition that the curricular experiences of students (i.e., the enacted curriculum) are ultimately what restricts or enables students to learn and thus is of paramount importance. We use the term "responding" to describe both of these aspects for ease of reading.

In this phase of interaction, teachers decide what they want to do and how they want to do it, taking into account their interpretation of what the curriculum has to offer and how this aligns (or not) with the experiences in which they want to engage their students. The key activities in this phase are making curricular decisions, such as choosing a task, and acting on

those decisions, such as posing the task to students in class. Curricular responding is likely to occur in particular patterns based on teachers' identities as learners and teachers of mathematics (Drake & Sherin, 2009) and is likely to change as teachers learn through enactment in what Choppin (2011) refers to as "learned adaptations." Teachers also use their interpretations to make decisions about what curriculum materials to use and how to use these materials as they both plan and enact instruction. Brown's (2009) framework enables the characterization of these decisions. For example, teachers may decide to adapt curriculum resources (e.g., reword a task or change the order of content) both before a lesson and in the moment. Teachers may also decide to use curriculum materials as designed or may instead decide to replace the curriculum materials for something self-created.

### **Curricular Noticing as a Process of Participation with Curriculum**

The potential influential relationships of the phases of curricular noticing are represented with arrows in Figure 2. With this framing, we suggest that teachers can only interpret that to which they attend, and to the extent that teachers' curricular decisions are informed by curriculum materials, these decisions rely on the interpretations of that to which teachers attended. In the figure, each rectangle encompasses a phase of curricular noticing which includes a variety of skills. While this framing presupposes the interactions unfolding in a linear fashion, Figure 2 illustrates that as teachers engage in the phases of interpreting and responding that these phases may spur engagement in other phases. For example, just as what is attended to in curriculum materials becomes the material for interpretation, what is interpreted may raise a question for the teacher that directs their attention to another part of the materials. Also, as a teacher decides how to respond (e.g., planning to use a particular problem), they may also make

further interpretations (e.g., due to changes in curricular goals) or attend anew to the curriculum materials (e.g., searching for a needed resource).

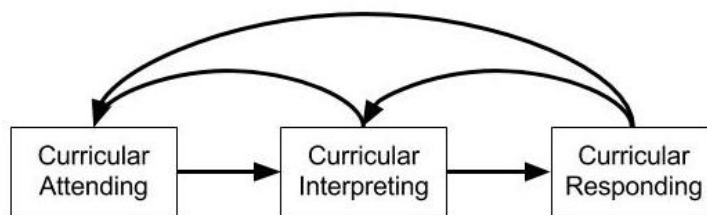


Figure 2. The Curricular Noticing Framework

We acknowledge that at times, teachers may employ curriculum materials in ways that do not involve attending and interpreting such as assigning the odd numbered exercises in a homework set without ever looking at them. We do not include these interactions as “curricular responding.” Instead, we restrict curricular responding to those decisions for how to act and actions with curriculum materials that are based on what is attended to and interpreted by teachers in the curriculum materials. Thus, one way to influence teachers’ enacted curriculum (i.e., how they respond with curriculum materials) is to influence how teachers attend to and interpret curriculum materials. We suggest that the more curricular opportunities that are attended to and interpreted by teachers in their curriculum materials (e.g., noting how a written task could spur a mathematical debate among students or recognizing mathematical connections between different procedures or tasks), the more likely teachers will design and enact lessons that involve these types of mathematical activities for their students.

We also recognize that there is a range of ways teachers notice curriculum. We predict that teachers may notice different aspects of curriculum materials due to their experiences (e.g., more experiences with students and the content, intentional examination and use of curriculum materials in teacher education courses). For example, we expect that some teachers learn to

recognize the limitations of their curricular materials and improve them accordingly. Thus, in line with other forms of professional vision (Goodwin, 1994), we suspect that a teacher's curricular noticing practices shift over time as the teacher interacts with curriculum materials and engages in the practices of teaching. These shifts can result from a variety of professional changes for a teacher, such as an increase in their mathematical content knowledge, the development of their curricular reasoning, or a change in the cultural biases the teacher holds about their students and community (such as assumptions regarding the abilities of students or the potential for change within the school setting).

### **Professional Curricular Noticing and Future Directions**

We advocate for research and practice that moves towards empowering teachers to make strategic and informed decisions in which curriculum materials are one of many tools to support student learning. In particular, we propose that there are “professional” ways of noticing curriculum materials and that the shifting of one's curricular noticing is a fundamental aspect of becoming professional members of the teaching community. Specifically, if mathematics educators better understood the strategic curricular practices that support ambitious teaching (what we refer to as *professional curricular noticing*), then this knowledge could lead to recommendations for how to support teachers such as Linda.

In this paper, we have laid out the first step toward this vision. That is, we propose that the Curriculum Noticing Framework articulates *how* teachers participate with curriculum materials by characterizing broad phases of interaction. This framework highlights the connections between existing descriptions of use (e.g., teachers adapting curriculum materials) and exposes aspects of curriculum work that are overlooked (e.g., what teachers attend to in

curriculum materials). Our hope is that this framework supports future research that will identify and describe a set of skills within each phase (attending, interpreting, and responding) that together constitute professional curricular noticing.

Some of this work has already begun. Although it is in its early stages, preliminary studies with prospective and practicing teachers have begun to identify what teachers notice and how this noticing influences their use of curriculum materials (e.g., Amador, Males, Earnest, & Dietiker, 2017; Males, Earnest, Dietiker, & Amador, 2015). For example, some studies have concentrated specifically on attending to describe what teachers look at while planning with curriculum materials (e.g., Males, Flores, Ivins, Smith, Lai, & Swidler, 2016). Other studies have concentrated on how the conceptual framing of curriculum may enable teachers to interpret the mathematical content of their curriculum resources (e.g., Miller, Dietiker, Ryan, Brakoniecki, & Richman, 2016) or how the sense-making frames of novice and expert readers influence readers to develop interpretations of the mathematics in textbooks (e.g., Weinberg, Wiesner, & Barr, 2016). In addition, studies have described what curricular responses prospective teachers make when planning for and envisioning how the enacted curriculum might unfold (e.g., Amador & Earnest, 2016; Earnest & Amador, 2017, 2018, in press). Finally, this framework has been taken up and extended by other researchers to describe how prospective teachers learn to use other tools, such as technology (e.g., Smith, Shin, & Kim, 2016).

However, all of this empirical work just scratches the surface. Future research is needed to address questions such as, *What are the skills associated with each of the phases of curricular noticing? How might these skills interact with each other and influence practice? How are these phases manifested in different aspects of the curricular transformation from policy documents*

*through what is planned and then enacted in the classroom? How might teacher educators support curricular noticing in order to shift curricular practices that support ambitious teaching?* Addressing these questions could support the curricular noticing of teachers by revealing the ways in which teachers--from novice to experienced to expert--notice in the context of curricular materials and how such noticing may relate to the philosophy, design, and medium of a particular set of curriculum materials.

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