

An Examination of Prospective Secondary Mathematics Teachers'

Curricular Noticing when Planning

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While curriculum use is at the center of practice, research indicates that teacher education programs do not prepare teachers to learn to use curriculum materials in adaptive and flexible ways (Drake, Land, & Tyminski, 2014). Since 80% of practicing teachers use some form of curriculum materials in their instruction (Banilower, et al., 2013), teacher educators need to support prospective teachers (PSTs) in learning to use materials. However, we know little about how PSTs learn to use curriculum, and further how varying designs (i.e., approach, format) influence use. This paper focuses on how PSTs interact with curriculum materials by examining their curricular noticing or what they attend to and how this interacts with how they interpret and respond to materials while planning.

Theoretical Perspectives on Curriculum Materials Use

Over the last few decades, efforts have been made to develop research-based descriptions or models for how teachers use curriculum materials (Lloyd, Cai, & Tarr, 2017). Although researchers around the world have come to describe this use in different ways (e.g., Brown & Edelson, 2003; Brown, 2009; Choppin, 2009; Gueudet & Trouche, 2009; Lloyd, 2008a, 2008b; Pepin, Gueudet, & Trouche, 2013; Remillard & Bryans, 2004; Sherin & Drake, 2009), what these descriptions have in common is the premise that curriculum use involves some kind of interaction between teachers and the materials. For example, Remillard (2005) describes this interaction as a participatory one where the influence is bi-directional, meaning that the teacher influences the materials and the materials influence the teacher. This participatory relationship is further emphasized by Gueudet and Trouche (2009) who suggest that teachers engage with materials in what they call a documentational genesis. This documentational genesis involves

two processes: instrumentation, a process by which the curriculum materials influence what and how teachers use resources in the design and enactment of instruction and instrumentalization, a process by which the curriculum materials are influenced by the teacher.

Exploring Curriculum Use through Curricular Noticing

We draw on the theory that teachers' interactions with curriculum materials are participatory (Remillard, 2005) and use the Curricular Noticing Framework (Dietiker, Males, Amador, & Earnest, 2018) to describe this interaction. We argue as Jacobs, Lamb, and Philipp (2010) did about teachers interacting with student thinking - that teachers' interactions with curriculum materials require a special type of noticing. We call this noticing curricular noticing (Dietiker, Males, Amador, & Earnest, 2018). Drawing on the work in professional noticing of children's mathematical thinking, we describe curricular noticing as the set of skills that constitute the curricular work of mathematics teaching, namely: curricular attending, curricular interpreting, and curricular responding. Curricular attending involves "viewing information within curriculum materials to inform the teaching and learning of mathematics" (Dietiker, Males, Amador, & Earnest, 2018, p. 525), curricular interpreting involves making sense of that to which is attended, and curricular responding involves making curricular decisions based on the interpretation of curriculum materials. Figure 1 depicts the Curricular Noticing Framework.

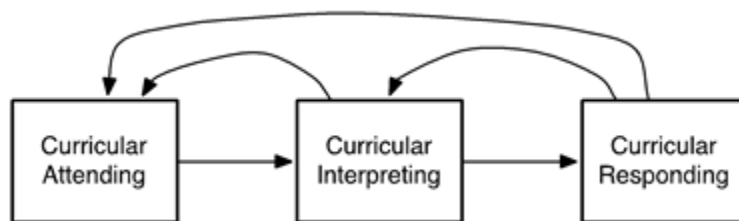


Figure 1. The Curricular Noticing Framework (Dietiker, Males, Amador, & Earnest, 2018).

Although these definitions seem to presuppose a sequence, we argue that the process may not unfold in a strictly linear fashion. For example, while a response is dependent on a curricular

interpretation of that to which a teacher attended, an interpretation may trigger a teachers' attention, or a decision to respond in a particular way may result in the teacher attending to something new.

Purpose and Research Questions

The purpose of this paper is to describe PSTs' attention and how their interpretations and responses interact with their attention. Specifically, we address the following questions:

When planning lessons using given curriculum materials with different designs

1. To what extent do PSTs' curricular interpretations and curricular responses interact with their attention to the curriculum materials?
2. To what extent do *curriculum elements and format* of each set of curriculum materials influence PSTs' attention?

Methods

Participants and Data Collection

We engaged four secondary mathematics PSTs who had not yet taken any mathematics teaching methods courses in two semi-structured think-aloud Staged Planning Interviews, one in which they were asked to plan a hypothetical lesson using College Preparatory Mathematics (CPM) Algebra Core Connections (Dietiker, et al., 2014) as a resource and one in which they used Pearson Education, Inc (PEI) Algebra I Common Core (Charles, et al., 2015). In addition to being asked to verbalize their thoughts as they planned, each PST wore Tobii Pro 2 Glasses in order to track their eye movements.

Data Analysis

Documents and videos were uploaded to a shared drive. The glasses recording and images of each of the curriculum pages were imported into Tobii Pro Labs (Tobii Technology,

Inc., n.d.). Finally, the glasses recording and transcripts were imported into NVivo11 Plus, a qualitative analysis software program. To address attention, we used Tobii Pro Labs to map the gaze data recorded by the glasses to each of the curriculum pages. We used this data to generate timelines that illustrate when PSTs were attending to student and teacher materials (i.e., looking anywhere on the student or teacher pages) and when they were not attending to the curriculum materials (i.e., looking at their written lesson plan, at the interviewer, or at other places in the room).

To address interpretations and responses and how these interacted with attention we coded the PSTs' transcripts. We assigned an Interpret code when a PST made sense of the curriculum materials. We assigned a Respond code when teachers made a curricular decision related to what to include (or not to include) in their plans. We then examined their thought processes via idea units. Each time a PST focused on one big idea, we defined this as an idea unit. Within these idea units we identified idea sequences by recording the sequence of attention, interpretations, and responses. For example, when Fay discusses her thoughts around the problems following the introductory problem in the PEI lesson we generated the idea sequence in Figure 2.



Figure 2. Example of Idea Sequence

Results & Discussion

Figure 3 illustrates each PST's attention to the curriculum materials for CPM and PEI across the planning sessions. The black portions indicate times when the PST was not attending to the curriculum materials (e.g., looking at their lesson plan or other things in the room) whereas blue and yellow indicate attention to the student and teacher materials, respectively.

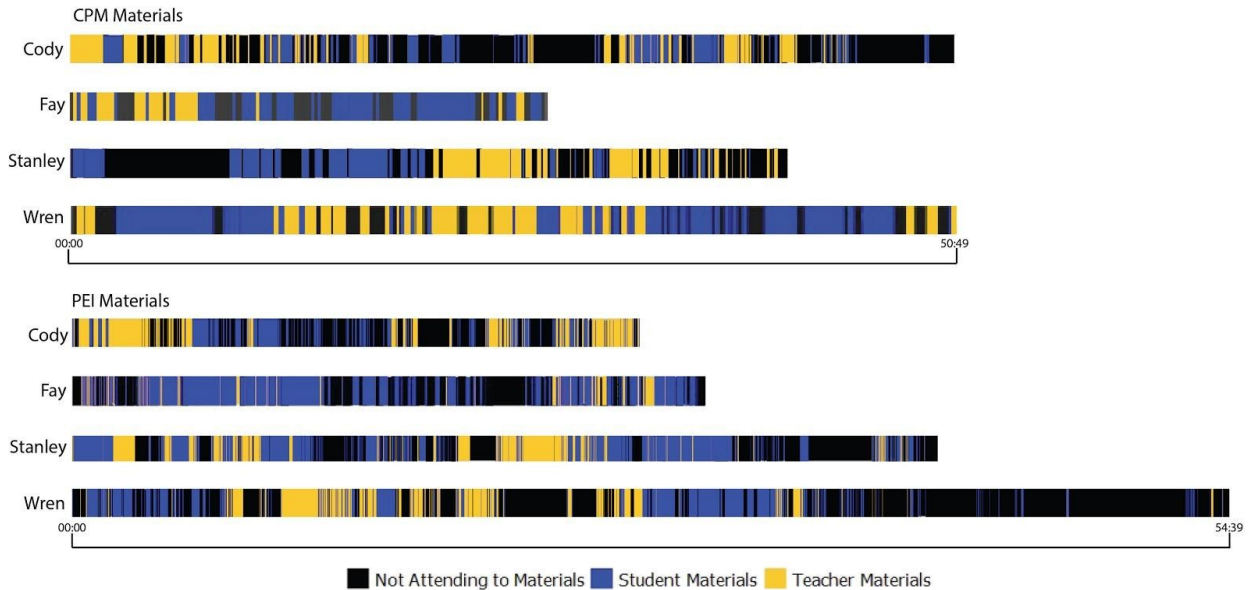


Figure 3. Attention across the Planning Session by Curriculum and PST

The timelines show that PSTs were shifting frequently between attending to student and teacher materials, with 40-85% of their attention time for both sets of materials devoted to student materials. When planning with both sets of materials, all PSTs, except for Cody, spent more time attending to student rather than teacher materials. Cody was the opposite, spending more time attending to the teacher materials in both planning sessions. Looking across the curriculum materials, the timelines illustrate that PSTs shifted between teacher and student more frequently for PEI and that they attended for shorter amounts of time before switching compared to CPM.

While attending (blue and yellow in the figure), PSTs were simultaneously interpreting and responding to the curriculum materials. For instance, for three of the four PSTs, we see heavy concentrations of attention in the beginning of the CPM planning periods. Our idea sequences indicate PSTs were attempting to make sense of the unfamiliar format and content of the materials, often looking back at preceding portions of the text and spending considerable amounts of time interpreting. For example, during this time, PSTs were interpreting the reason

for what seems to be provided answers in the student portion of the materials, such as Grant who states “I’m assuming that this...they ask me to write an equation at the top that represents the table below. But then they give me the equation?” Over the course of two and a half minutes, he comes to the realization that the bolded answers are not included in the materials given to the student. The unfamiliar content also seemed to require more attention and interpretation. For example, Cody, who spent 22 more minutes planning his CPM lesson than his PEI lesson, struggled to make sense of the lesson, specifically what was meant by a tile pattern. At the beginning of his planning sessions, he spent more time searching for information from the teacher materials (yellow in his timeline) and working out his ideas on his scratch paper (black in his timeline) as seen in Figure 4.

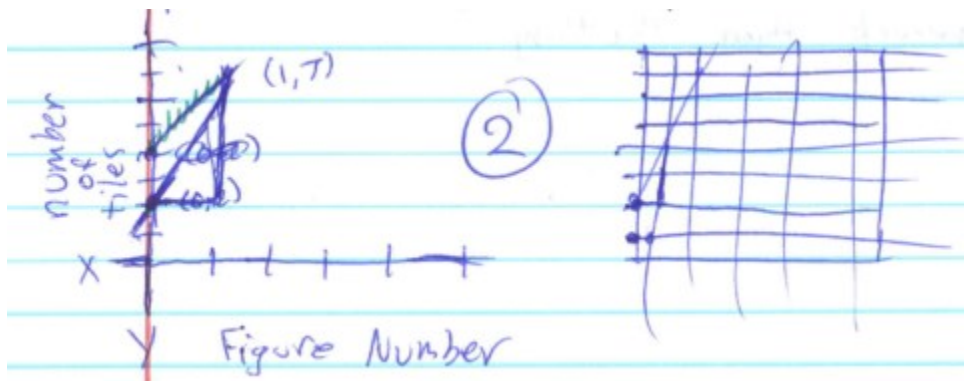


Figure 4. An excerpt from Cody's scratch paper

Cody first thought that tiles meant a grid of some sort. Then he drew what appears to the left in the figure followed by what appears to the right as he said “So they want to look at tiles... something like that...I see they’re trying to bring in some physical type of thing... but to me a normal grid just kind of makes more sense so I’d probably just keep going with the x y axis.”

Towards the end of the CPM planning periods, PSTs went back to portions they had initially attended to, attending again and then interpreting the intended trajectory or concept

before deciding to respond based on the alignment of the perceived structure with their own beliefs on how a lesson on slope should carry out.

In contrast, during PEI planning, we see heavy concentrations of attention throughout the entire planning period for each PST. Examining the idea sequences, we see that many more responses are made, along with interpretations, in the beginning half of these periods as compared to PSTs planning with CPM where responses were made towards the end of the planning periods. The most common interpretations involved PSTs making sense of the introductory slope problem and deciding quickly to adapt or supplement this because it was not “real-world” enough or approached in the way they would like, such as Stanley who says “...But that's not how I would actually solve that problem in the real world. Because really you just want to take 1 over 0.25, equals 4. 4 over 1 equals 4. 7 over 1.75 equals 4. Use those comparisons. I know these are mathematically equivalent, but this is just a little more roundabout and confusing.”

Our idea sequences indicated that PSTs began to work with new ideas by attending, meaning each of our idea sequences began with an Attend code. We also saw that, particularly for CPM that attending to one curriculum element often led to attention (or repeated attention) to other elements. For example, after reading briefly through the CPM teacher materials around problems 2-12, when attending to the student materials, Cody interprets problem 2-12 saying it “seems kind of obvious.” He then initially responds by deciding not to use the problem in his plan. However, he goes back to the teacher materials and attends to the suggestions for problem 2-13 and he notices that the problems are linked and 2-12 provides valuable experience, so he decides to use both problems.

Our analysis indicated that idea sequences were different across materials. The average duration of the sequences were longer when PSTs were planning with CPM. In addition, when planning with CPM, in the first half of their planning period, PSTs had many more idea sequences that only involved Attend and Interpret codes (21 out of 53 idea sequences across all PSTs), while with PEI there were many more Respond codes in the beginning of the planning periods (32 out of 49 idea sequences across all PSTs). This means that PSTs made planning decisions more quickly in their planning period for PEI than they did for CPM.

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