

PLANNING WITH CURRICULUM MATERIALS: AN ANALYSIS OF TEACHERS' ATTENDING, INTERPRETING, AND RESPONDING

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Curriculum materials are integral to the teaching and learning of mathematics and have been described as having the most influence on what teachers actually plan for and enact in their classrooms. In this paper we describe how two teachers with varying years of experience, but similar experiences with curriculum materials, use curriculum materials in planning. Through a semi-structured think aloud interview, we describe what teachers attended to, how they interpreted what they attended to, and how they decided to respond to the curriculum materials when planning a hypothetical lesson on slope.

Keywords: Instructional Activities and Practices, Curriculum, Teacher Knowledge

Curriculum materials are integral to mathematics instruction. In fact, more than 80% of K-12 teachers use a textbook or curricular program for mathematics instruction (Banilower et al. 2013). Furthermore, curriculum materials have the most direct influence on what teachers actually plan for and enact in their classrooms (Brown & Edelson, 2003) and, although research does describe what teachers do with materials, we do not necessarily know the process by which teachers make decisions about what to do and how to do it (Stein, Remillard, & Smith, 2007).

In this paper, we consider how we might gain insight into the process by which teachers make decisions about the use of curriculum materials while planning. We draw on a framework called Curricular Noticing (Males, Earnest, Amador, & Dietiker, 2015) to describe what teachers attend to, their interpretations of what they attend to, and how they respond to (or make decisions) about how to use curriculum materials to plan lessons.

Background and Theoretical Framing

Phases of Curriculum Use: From Written to Intended

The influence of written curriculum on student learning is not straightforward. Figure 1 illustrates that before a written curriculum is experienced by students, it goes through a series of transformations; the first occurs when the teacher interacts with the written curriculum to produce the intended curriculum, or the teacher's plan. These phases are mediated by a variety of factors, such as teachers' knowledge and beliefs, orientation toward curriculum, classroom structures and norms, and organizational and policy contexts. Therefore, while the written curriculum materials themselves have an influence on student learning, this influence is not direct because the written curriculum is transformed by teachers before students access it. Although the enacted curriculum is the phase that researchers indicate most directly influences students' mathematical experience and ultimately what they learn (Remillard & Heck, 2014), it is within the enacted curriculum or the "design-in-use" (Pepin, Gueudet, & Trouche, 2013) phase that teachers draw on the plan that they developed when interacting with the written curriculum.

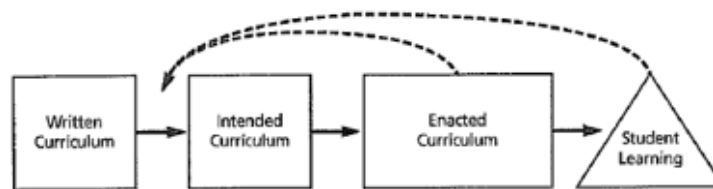


Figure 1: Temporal Phases of Curriculum Use.
(Adapted from Stein, Remillard, & Smith, 2007, p. 322)

In this paper, we focus on planning, specifically the transformation from written to intended curriculum, because this is one of the most critical activities in improving teaching (Morris, Hiebert, & Spitzer, 2009). Furthermore, understanding how teachers use curriculum in planning is imperative in understanding how curriculum influences student learning because it is within this transformation that important variations in written curriculum get introduced. These variations shape the opportunities and experiences students have and therefore, ultimately shape what students learn.

Teachers' Use of Curriculum Materials

Research on teachers' uses of curriculum materials has presented us with a foundation for describing what teachers do with materials. In the midst of planning and enacting instruction, teachers engage in a variety of activities with curriculum. Remillard (2005) describes the teacher-curriculum relationship as a dynamic transaction in which teachers participate with the materials. The socio-cultural conception of this relationship emphasizes the fact that both the teacher and the curriculum influence what and how curriculum materials are used. Using this conception, researchers have outlined ways in which teachers participate with curriculum, including the activities teachers engage in such as reading, evaluating, and adapting (Drake & Sherin, 2009) and what Brown (2009) describes as offloading, adapting, and improvising. When considering the transition between the written and intended curriculum, the role of the teacher is that of a designer (Brown, 2009). In the pursuit of instructional goals, teachers must perceive and interpret existing resources, evaluate the classroom environment, balance tradeoffs, and devise strategies. Thus, there is an integral relationship between agents (teachers) and tools (e.g., curriculum materials); curriculum materials play a role in affording and constraining teachers' actions. It is this design activity that is the focus of this paper.

Curricular Noticing

Curricular noticing is the process through which teachers make sense of the complexity of content and pedagogical opportunities in written or digital curricular materials (Males et al., 2015) and involves sets of skills that unfold in the following three phases: *Curricular Attending*, *Curricular Interpreting*, and *Curricular Responding*. See Figure 2.

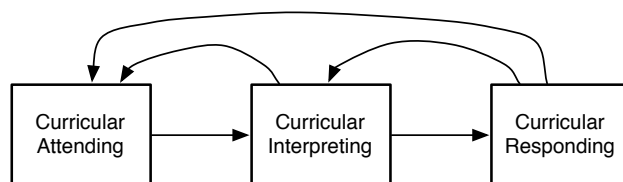


Figure 2: The Curricular Noticing Framework.

First, teachers attend to or perceive and recognize information on the page. Second, they interpret, or make sense of, what they attended to. Finally, teachers decide to respond in a particular way based on their interpretations of what they attended to. It is reasonable to assume that the more curricular opportunities noted by teachers in their curriculum materials, the more supported the

teachers are to design and enact lessons that involve the types of mathematical experiences they want for their students. Although we describe a process that seems linear, we hypothesize that the process does not always occur in this linear fashion. For example, as a teacher interprets a portion of their textbook, this may trigger her desire to find an additional resource and therefore, she may attend anew before further interpretations or responses are made.

Research Focus and Questions

The focus of this study was to describe how two mathematics teachers with varying years of experience, but similar experiences with curriculum, use curriculum materials in planning. Specifically, we address the following research question: When planning a lesson with curriculum materials, what do two teachers with varying number of years of experience attend to, how do they interpret what they attend to, and what responses do they make (i.e., what do they decide to do and how do they decide to do it)?

Methods

Participants and Context

Participants. This paper focuses on two teachers, Aaron and Evan, teaching in two different high-needs urban high schools in the same district in a mid-western city. Both teachers were part of a cohort of Noyce Fellows. The Robert Noyce Teacher Scholarship Program, funded by the National Science Foundation (NSF), targets the needs of creating and retaining high-quality teachers by funding fellowships for qualified individuals to become or remain mathematics (and science) teachers and commit to teaching in high-need schools. NSF [DUE-1439867] funded 30 Master Teaching Fellows and 13 Teaching Fellows (preservice teachers) who participated in a 14-month Masters + Certification program. Aaron is one of seven Noyce Master Teaching Fellows who participated in this study. At the time of the study, Aaron, a National Professional Board Certified Teacher, had just completed 13 years of teaching. Evan was one of two Noyce Teaching Fellows who participated in this study. At the time of this study, Evan had completed two years of teaching.

These two teachers were purposefully chosen to examine the potential influence of experience on the ways in which curriculum materials are used during planning by keeping other characteristics similar. Although their number of years of teaching experienced differed significantly between the two teachers, both teachers have taught a variety of content at the high school level, ranging from classes for students who struggle to advanced/honors classes. Both had experience teaching slope, the focus of the lesson we gave them to use in planning. In addition, in the last two years, both teachers participated in a course focused on curricular issues, with a specific focus on learning opportunities in written curriculum materials, taught by the first author of this paper. Both teachers had never used the curriculum materials utilized in the staged planning as their primary course materials, but both had heard of the materials. Evan mentioned in the pre-lesson planning portion of the interview that he had seen them in a class taught by the first author, “but I haven’t really studied them too much.” Aaron had analyzed a portion of the materials (different from what we provided in this study) with a partner for a curriculum analysis assignment and has used activities similar to the activities in these materials in his classroom.

Context. The urban district serves approximately 40,000 students in a Midwestern city. There are six high schools and one alternative community school. The demographics for Aaron’s and Evan’s schools can be seen in Table 1.

Table 1: High School Demographics

School	Enrollment	% White	Free/Red Lunch	Special Needs	ELL students	Gifted
Aaron's School	1,750	46%	59%	17%	12%	17%
Evan's School	1,978	62%	53%	15%	6%	14%

Curricular Context. At the high school level, the textbook series in use by the district include those published by Pearson, Holt McDougal, McGraw Hill, and Wiley. Teachers teaching the same course throughout the district use the same book and are expected to follow generally the same progression of topics as guided by a list of course objectives written by district math curriculum specialists. Students are assessed using district common assessments written by curriculum specialists and district-selected teams of teachers. These assessments are written to align with the course objectives. In addition, during the semester in which this study took place, the state had recently adopted newly revised state college and career-ready standards for mathematics. Unlike previous versions of the standards, this new revision includes both a set of content standards, but also a set of processes.

Data Collection & Analysis

Data Collection Procedures. Three researchers (one mathematics teacher educator researcher, one mathematics education graduate student, and one undergraduate mathematics education preservice teacher) conducted semi-structured staged planning interviews with nine Noyce Fellows. Recently, staged planning interviews have been used by researchers (Mcduffie, 2015; Reinke & Hoe, 2011) to gain insight into teachers' use of curriculum materials. In a staged planning interview teachers are asked to produce a hypothetical lesson plan, meaning that the plan produced by teachers is not necessarily something that they plan to enact. The advantage to this is that teachers do not have to be tied to district policies and can feel free to use the curriculum materials as they wish. For the staged planning interview, we used a semi-structured think aloud interview protocol that included teachers planning a hypothetical lesson using as a resource Dietiker, Kysh, Sallee, and Hoey's (2013) *Algebra Core Connections* Lesson 2.1.2 How can I measure steepness? These interviews lasted approximately 50 to 120 minutes.

After explaining the procedures to teachers, including telling them what lesson they would be using from the materials, we gave them five minutes to familiarize themselves with the curriculum materials. We then provided teachers with a single-sided copy of both the teacher and student materials for Lesson 2.1.2. We asked teachers to imagine that these were newly adopted materials in the district and that they were planning a lesson that they would enact the next day. We asked them to develop a written plan even if they do not normally write out a plan. In addition, we asked teachers to indicate aspects of the materials that they were reading (highlight in yellow), planning to use as is (bracket in red), and adapt (bracket in green), and to continuously talk out loud as they did this. Once teachers completed the plan we asked follow-up questions, such as how they anticipated students would work through the lesson, what aspects of the materials helped them make decisions about how to plan the lesson, what, if any, portions of the materials did they skim or skip, what portions of the materials did they find most helpful, and how similar or different was what we did today from their typical planning process. During both the pre-lesson planning portion and the lesson planning portion, the researchers remained silent. All interviews were recorded using two video cameras, one focused on the teacher and one focused on the materials. All written materials, including the written or typed plan, any additional written work, and the student and teacher curriculum materials were collected.

Data Analysis. Written materials were electronically scanned in color and video was uploaded to a network server. Video and written materials were imported into MAXQDA12, a qualitative data analysis program. The first three authors independently coded each of the teachers' interviews in MAXQDA by selecting portions of the video in which teachers attended, interpreted, and responded. Attending codes were assigned when there was explicit evidence that the teacher saw something on the page as evidenced by reading aloud and/or highlighting the text. Interpreting codes were assigned when a teacher visibly or audibly attempted to comprehend or made sense of the content. Finally, responding was assigned when the teacher made a decision to do something, such as indicating an aspect of the lesson materials they would choose to use. During the analysis, an additional code was created to capture instances when the teacher described what they were doing.

To facilitate coding, each sentence of the teacher and student lesson materials was given a unique identifier made up of a number identifying the paragraph and a letter identifying the sentence within that paragraph (e.g., 01-A, 01-B, 02-C). These unique identifiers enabled the researchers to assign codes for teachers' attention to, interpretations of, and responses with respect to particular portions of both the teacher and student materials. After independently coding each of the interviews, coders met to discuss and come to consensus on the coding.

Results & Discussion

We first describe the process that each teacher followed to plan their lesson. The process by which the teachers engaged in the planning activity was not only visible, but both teachers verbally expressed how they planned to use the materials while planning the lesson. We follow this by describing how teachers responded to the materials by describing their plans. We then follow this with a description of what each teacher attended to and how they interpreted what they attended and, when possible, how this attention and interpretation connected to their responses.

Teachers Planning Processes

Although we did not explicitly ask teachers to describe the process that they planned to use to plan their lessons each teacher explicitly commented on how they were going to plan the lesson either from the start or within the first few minutes of beginning the planning portion interview.

Aaron. Aaron began by laying out the teacher and student materials side-by-side and stated "So I'm gonna start by just kind of reading through the teacher materials and possibly flipping through the student stuff as I read the teacher materials." Aaron did this until about 22 minutes into the interview at which point he decided to turn his attention solely to the teacher materials as he found it "a little confusing to translate from this [the teacher materials] to this [student materials] ... So I'm thinking I'm gonna take the relevant information from here [teacher materials], thinking about it in terms of students."

Evan. Unlike Aaron, Evan did not at first place the student and teacher materials side-by-side. He placed the teacher materials in a pile in front of him with the student materials off to the side not in view of the camera. He then began to read through the teacher materials. Once Evan remembered he was supposed to be talking out loud as he planned, he provided insight into his process by stating

I'm just reading what the lesson is all about and how the curriculum creators made this lesson. So, I'm just getting a sense of how I'm gonna start the lesson or how they're going to have me start the lesson and then just going from there. So, I'm just reading the information not making any decisions right now.

The notion of not making decisions early in the planning was true for both Aaron and Evan. Although both teachers made some decisions as they worked their way through the text about which problem they would use as is and which they might adapt, neither teacher began to write their plan

until approximately 40 minutes into the interview. As both teachers wrote the plan, they attended again to the text in the teacher and student material at a quicker pace.

Responses to the Curriculum Materials: The Lesson Plan

These lesson plans produced by each teacher can be seen in Figure 3.

Aaron's Lesson Plan	Evan's Lesson Plan
<ul style="list-style-type: none"> • Objective: Understand slope • Intro: Students read questions • Do 2-11, 2-12, 2-13 • Discuss 2-13 (maybe) – Float: Struggling with 2-11, 2-12, 2-13 – Focus on graph • Do 2-14 as a team • Do 2-15 • Discuss 2-15 • Do 2-16 • Discuss 2-16 • What else could happen? • Check for Understanding 2-19 or 2-10 (similar to 2-14, 2-15) • Homework: Assign 2-21, 2-22, 2-24 	<ul style="list-style-type: none"> • Objective: Introduction to slope • Materials: Student • Handout/Resource (Modified) • Students will be groups in teams of 3-4 at tables • Students read focus questions • Teams working on questions • Think, write, team share on 2-11 (3 min) • Think, write, team share on 2-12 (1-2 min) • Intro 2-13 as class, team work time - Monitor and push teams to read graph and not rely on table • Students work on modified 2-14 as team to think about growth/slope triangle for figure numbers Draw connection on part c compared with part a • Begin discussion of steepness and how line is steeper or less steep using arms • Do 2-15 as whole group. Emphasize vocab • Let teams work together on 2-16 focusing on steepness again using their vocab • Students work on 2-17 and discuss $A_y = 0$ & $A_x = 0$ • Discuss 2-18 with teams as error analysis to extension to idea of negative slope • Assign 2-19, 2-20 a & c, 2-21, 2-22, 2-23, 2-24, a teacher-created problem addressing negative slope

Figure 3: Final Lesson Plans

First, when looking at the lesson plans we see that Evan's has more detail than Aaron's. Although analyzing the level of detail is not a specific focus of this study it provides us with interesting methodological considerations as it makes it somewhat hard to analyze how Aaron interpreted some of the suggestions in the teacher's materials from reading his plan, particularly with respect to participation structures (i.e., teams, whole-class). That said, even Evan's more detailed plans leaves some of these questions unanswerable as he does not always include what groupings students will be working within, nor did he always verbalize this.

Second, we see a number of similarities in the plans. Both teachers decided to have students read the focus questions, do problems 2-11, 2-12, 2-13 as is (with no modification), discuss problem 2-15, and do problem 2-16, assign three of the same homework problems 2-21, 2-22, and 2-24, and focus students on reading graphs. One important point to make, however, is that although these decisions to have students engage with this content is the same it is unclear that the teachers expect the students to engage in the same way. For example, both teachers will use problem 2-15 and we know that Evan decided to complete this via a whole-group discussion, but it is not clear how Aaron will engage his students with this same problem.

Finally, we see some differences, beginning with the objectives. The objective as written in the teacher materials states

Students will gain an abstract understanding of slope as they discover that slope is the change in y (referred to as Δy) divided by the change in x (referred to as Δx) between any two points on a line.

They will continue to connect growth and starting value to multiple representations of a linear function.

Both Aaron's and Evan's objectives are simplified with Evan opting to use the word "introduction" rather than "understand." In addition, Aaron does not have students share or discuss problems 2-11, 2-12, and is undecided about 2-13. He also chooses to have students do problem 2-14, but Evan decides to have his students do a modified version of the problem. We discuss this modification in the next section. Evan also decides to have his students complete problems 2-17 and 2-18, which Aaron does not, and give students additional homework problems including a teacher-generated problem that address the concept of negative slope. Although Aaron does not assign all of the additional homework problems Evan does, he does decide he will use one of these, either 2-19 or 2-20 as a check for understanding at the end of class because these problem are similar to two problems students had done in class.

Attention and Interpretation

Capturing teachers' attention proved to be somewhat difficult, particularly when teachers were not talking out loud and/or highlighting as they read. That said, we coded a teachers' attention whenever they highlighted a portion of the text or read the text out loud, meaning that it is possible that we missed aspects of the text to which a teacher attended. We coded teachers' interpretations whenever the teacher was attempting to make sense of the content. This included working out the mathematics in written form or discussing the mathematics or pedagogical structure or suggestions in the text.

Both Aaron and Evan attended to all text in the teacher edition, with the exception of the portion that outlined the mathematical practices, length of activity, core problems, and materials. Evan did not seem to attend to this. Interpretations made of the text in the teacher's guide were most often related to pedagogical suggestions and whether they were good or not. Both teachers also attended to all of the student text and although they did not seem to work through each problem, they tended to solve or work through the same problems. One such example was problem 2-14 in the student materials that asked students to examine a graph that depicts a line for a tile pattern and describe how the line was growing. As both teachers attended to this problem they worked out the slope and found that it was $27/3$ or $9/1$ and interpreted this problem to be a useful problem in helping student make connections to previous or future content such as the notion of a unit growth rate. This problem was an example of a problem in which both teachers took a few minutes to make sense of what the graph was representing. Although both teachers interpreted the graph in the problem to be a representation of some kind of tile pattern, Evan initially interpreted this to be connected to the earlier tile pattern in problem 2-11 creating a disconnect for him as the number of tiles did not seem to match. When Evan first attended to this problem he stated, "I'm getting stumped. Maybe I won't have my students do that or maybe I will if I can figure it out." After returning to the problem before writing his final plan he decides to add points onto the line because it is "tough" and mentions that he "doesn't think there is a connection [to problem 2-11]... maybe someone can tell me" His difficulty in interpreting this problem may have influenced his addition of the points, but it is not clear how this modification allowed him to see the connection he was looking for nor provided him with a reason to include the problem in his lesson plan.

Conclusion

This preliminary work has enabled us to gain insight into how teachers with different years of experience plan using the same curriculum materials. Not only could we identify similarities and difference in their plans, but we were able to capture what these teachers attended to, how they interpreted what they attended to, and begin to explore how these interpretations influenced the intended curriculum, or their plan. We hope that future research can enhance the methods used in this

study to capture and report more details about the interactions between the three curricular noticing phases and expand this research determine how curricular noticing influences the enacted curriculum and eventually students' opportunities to learn.

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