# TRACING BEGINNING TEACHERS' MATHEMATICS CURRICULUM USE IN THEIR FIRST THREE YEARS OF TEACHING

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*This study explores how five beginning elementary teachers used their mathematics curriculum materials in their first three years of teaching. Prior research suggests that teachers' curriculum material use in their earlier careers may not change significantly from year to year (e.g., Valencia, Place, Martin, & Grossman, 2006). Our investigation builds on this prior research with a focus on elementary mathematics curriculum use. We analyzed interview transcripts from five teachers' first three years drawing on a framework developed by Forbes and Davis (2010). Our analysis indicates that these five teachers used their mathematics curriculum in different ways from Year1 through Year 3. They followed their mathematics curriculum with few adaptations in their first year, and then began to modify their curriculum more extensively in their second and third years.*

Keywords: Curriculum, Elementary School Education

## Purpose

The purpose of this paper is to explore how novice elementary teachers use mathematics curriculum materials in their first three years of teaching. Understanding novice teachers' use of mathematics curriculum materials across the first three years contributes to a body of research related to teacher-curriculum interactions (e.g., Remillard, 2005). Prior research on teacher-curriculum interactions has tended to explore teachers' curriculum use in the short term (e.g., Pak & Drake, 2021; Brown, 2009; Forbes & Davis, 2010; Remillard, 2005). One exception is Valencia, Place, Martin, and Grossman (2006). They investigated beginning teachers' curriculum use related to reading in the first three years because "early teaching experiences lay the foundation for future success in the classroom" (Valencia et al., 2006, p. 99). Building particularly on Forbes and Davis (2010) and Valencia et al. (2006), we focus in this paper on how beginning elementary teachers "mobilize and adapt" (Forbes & Davis, 2010, p. 821) mathematics curriculum materials in the first three years of teaching. In doing so, we aim to contribute to the field's understanding of the beginning teachers' mathematics curriculum use in the early years of teaching. Increasing our understanding of novice teachers' curriculum use, particularly in the current quickly changing and unpredictable curriculum landscape, is important not only in theory, but also in practice as teacher educators and school and district leaders seek new approaches to supporting teachers' curriculum use.

## Perspectives

We draw on the two perspectives in this paper, which are related to curriculum use in the contexts of reading and science. In relation to the first perspective, we drew on a finding by a group of researchers who have explored how beginning teachers use curriculum materials in their early careers, including during teacher preparation programs. In a longitudinal study, Valencia and colleagues (2006) conceptualized teaching practices as being shaped by interactions among the curriculum materials, teachers' knowledge, and the contexts. They

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followed three beginning elementary teachers from a teacher preparation program to their third years of teaching to understand how they used curriculum materials for teaching reading. They found that "over the first three years of full-time teaching, there was relatively little change" concerning "how they used them" (Valencia et al., 2006, p. 111). For example, Dorothy, a beginning teacher in the study, tended to closely follow a reading curriculum in her first three years of teaching reading. Since this study involves novice teachers' reading curriculum use, this specific finding raises a question as to whether or not beginning elementary teachers closely follow mathematics curriculum in their early years. Further, because the curriculum landscape has changed significantly in recent years, including the availability of a much wider range of resources than in previous years (Aguirre et al., 2019), we were interested in novice teachers' curriculum use in this new context.

We began to answer this question in another paper (Pak & Drake, 2020) in which we analyzed one beginning teacher's mathematics curriculum use. Our finding was different from the finding of Valencia and colleagues (2006). In our paper, we found that the beginning teacher followed the mathematics curriculum closely in her first year and began to modify the curriculum in her second and third year of teaching. The finding provided us with a start to understand the patterns of the trajectory related to beginning teachers' mathematical curriculum use. As such, we investigate in this current paper how five beginning teachers used their mathematics curriculum materials in their first three years of mathematics instruction.

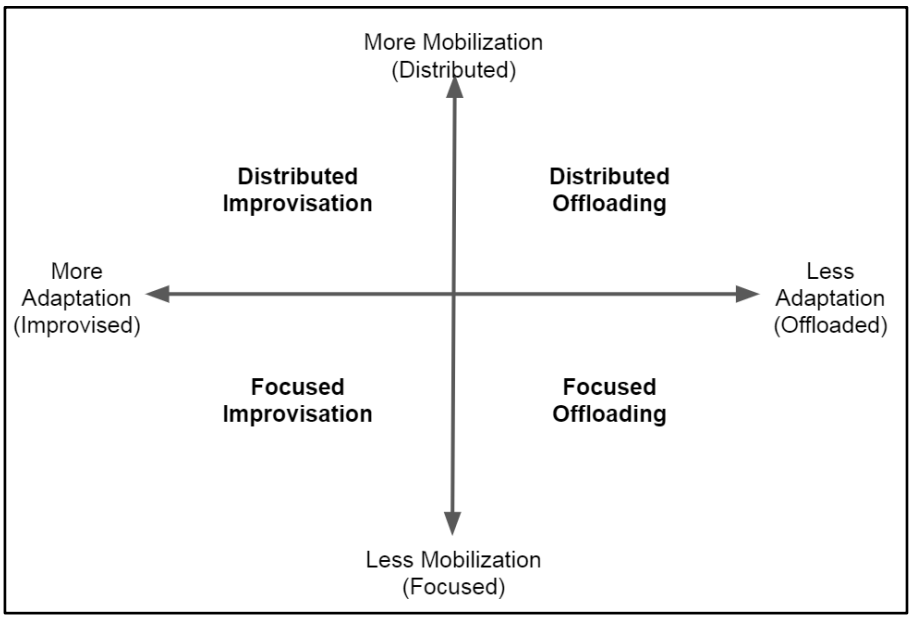


**Figure 1. Framework for teacher-curriculum interactions (adapted from Forbes and Davis, 2010, p. 823)**

The second perspective is related to a framework from Forbes and Davis (2010). Particularly, our analysis for this current paper draws on the framework and also utilized in our prior work analyzing the curriculum use patterns of beginning teachers in their first year (Pak & Drake, 2021). As we noted in the prior work, the framework is built on the work of Brown (2009) and Remillard (2005) in relation to teacher-curriculum interactions. The framework conceptualizes how prospective teachers mobilized and adapted existing curriculum materials (e.g., lesson plans



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and students' worksheets) for their science instruction by creating a two-dimensional space (Figure 1). Forbes and Davis (2010) also included a third dimension focused on the "inquiry orientation" of the lesson, but, here, we are focusing only on the dimensions of mobilization and adaptation. According to Forbes and Davis (2010), mobilization refers to the number of different curriculum materials used and adaptation means the degree to which teachers modified curriculum materials.

Building on Forbes and Davis's framework, Figure 1 shows how teachers' use of curriculum materials is conceptualized in this paper. In Quadrant 1, teachers adapt multiple curriculum materials (DI: distributed improvisation). In Quadrant 2, teachers offload teaching responsibility (i.e., make few adaptations) using multiple curriculum materials (DO: distributed offloading). In Quadrant 3, teachers offload teaching responsibility using a single curriculum material (FO: focused offloading). In Quadrant 4, teachers adapt a single curriculum material (FI: focused improvisation). It is important to note that this framework categorizes curriculum use in terms of the quadrants defined by the axes and not in terms of the endpoints of those axes. In other words, we recognize, and also found empirically, that these quadrants represent continua along the dimensions of mobilization and adaptation and that most teachers' curriculum use is not found in the extreme corners of the framework.

We use this framework as our second perspective in this current paper because it guides us to make sense of how beginning teachers mobilized and adapted mathematics curriculum materials in their first three years of teaching. In this paper, we are building on the analysis we did of beginning teachers' curriculum use in their early years (Pak & Drake, 2020) by following five beginning teachers in depth over three years to understand teachers' mathematics curriculum use.

## Methods

This study was part of a four-year longitudinal large-scale research project, Developing Ambitious Instruction. The purpose of the larger project was to explore the relationships between teacher preparation and ambitious instruction in elementary mathematics and English Language Arts (ELA). This study recruited 175 participants from five teacher preparation programs in three states. There were two cohorts of participants who completed pre-service teacher preparation in 2016-2017 and 2017-2018, respectively. The project team collected data including online surveys, observations, and interviews. For this paper, we focused on analyzing the interview data from the first cohort (N=69). The project team conducted three, two, and two interviews with each of the teachers in their first, second, and third years if they taught both subjects (ELA and mathematics). Interview questions included questions related to classroom/school/local community contexts, as well as lesson planning and enactment, which led the novices in some cases to talk about ways they used curriculum materials in ELA and mathematics.

## Data Sources and Analysis

For this particular study, first, we analyzed interview excerpts from 27 beginning teachers who talked explicitly about how they mobilized and adapted mathematics curriculum materials in their first year of teaching. We identified 84 excerpts from these 27 beginning teachers. The second step was individual coding of each excerpt. In coding, we used codes (DI, DO, FI, and FO) based on the framework (Forbes & Davis, 2010). After individual coding, both authors compared codings to find and resolve disagreement. Building on these codes and excerpts, we then selected five teachers to explore mathematics curriculum use in the first three years of teaching. We chose these five teachers because they demonstrated a clear curriculum use pattern

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in Year 1 through Year 3, which means we had the full three years of their interview transcripts. We identified 15, 22, and 21 excerpts from these teachers' interview transcripts in the first, second, and third year, respectively.

The last step was looking for common patterns across the three years of all five teachers. The patterns we identified in this step included transitions the teachers made from Year 1, to Year 2, and to Year 3. To visualize the patterns, we created a line chart that showed the numbers of the four codes (FO, DO, FI, and DI) by year (Figure 2). To understand the patterns on the part of individual teachers, we also visualized a coordinate graph for each teacher as described below (Figure 3).

To obtain the final coordinate of each teacher by year, we counted the numbers of I (Improvised), O (Offloaded), D (Distributed), and F (Focused), and found the final coordinate by cancelling different codes on the same axis (Improvised-Offloaded on X axis and Distributed-Focused on Y axis ). For example, we coded four excerpts in Year 1 of one beginning teacher as two FOs, one DO, and one FI, respectively. We separated these codes into one I, two Os, two Fs, and one D. By cancelling one I and two Os on X axis, and one D and two Fs on Y axis, we got a coordinate at (1, -1) as the final coordinate.

As shown in Figure 3, some teachers have the same final coordinates, either a given year or in a different year. For example, the final coordinate of three teachers (310.050, 310.115, and 310.076) in Year 1 are placed together at (2, -2), and the final coordinate of one teacher (210.055) in Year 1 and another teacher (310.050) in Year 2 are placed together at (-1, 1). Distance from the origin at the coordinate graph suggests a magnitude of codes of each teacher. If a teacher has similar codes, then the teacher's final coordinate is distant from the origin. For example, since a teacher (310.076) has many similar codes (FI) in Year 3 (Figure 3), the final coordinate (-5, -7) is relatively distant from the origin. By creating this coordinate graph, we attempted to present a way to detail the general patterns (Figure 2) on the part of these individual teachers.

## Results

Although the specifics differed for each teacher, we were able to identify some general patterns in relation to how the five beginning teachers used their mathematics curriculum in their first three years (Figure 2).

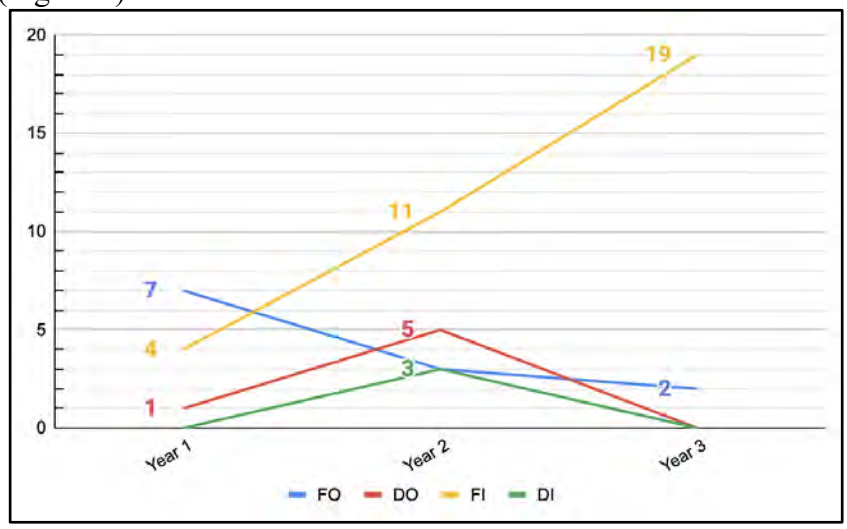


**Figure 2. Pattern related to beginning teachers' mathematics curriculum use by year**



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Year 1 shows more FOs than FIs or DIs, suggesting that these five beginning teachers typically followed their mathematics curriculum materials closely, with few adaptations of the curriculum to meet their students' needs. Year 2 shows a change in mathematics curriculum use on the part of these five teachers. Unlike Year 1, there are higher numbers of FIs in Year 2, indicating that these beginning teachers began to modify their mathematics curriculum in different ways. Year 3 illustrates predominantly FIs, which suggests that these beginning teachers made more consistent adaptations of their mathematics curriculum materials.
To illustrate these patterns, we present an excerpt from Year 3 interview with one beginning teacher who reflected on how she used her mathematics curriculum in her first three years of her teaching. This excerpt describes many of the patterns shown in Figure 2.

> Yes. So my very first year it was, "You're doing this program with fidelity. You are not doing anything else but this program." And so even something as little as like fact fluency, it was like, "No. You are doing this program." Now no one was knocking on our door asking us like, "What do you do for Math?" Or watching our math instruction. But, it was like required for us to do it... Like we have a pacing guide that our instructional coaches came up with, and we were to follow, "OK, this lesson's one day. This lesson's two days. This lesson's one day." You know? And pace it out through there and where we should be by the end of the year and in November and everything. My second year, I moved grade levels, and everything was new to me. So I was taking recommendations from my teammates and how long to spend on certain lessons or like how to do reteaching. But still it was like... People, I think, started to supplement a little more. I know like, for example, I still did the pacing guide with fidelity last year, but I would supplement with like different hands-on games and not use all the materials from *Envision*. Instead I would find different ways to like hit the same standard, but to practice in a different way. And then this year (her third year), it has been kind of like loosey-goosey, like it's like they redid the (inaudible) binder this summer.

As described in the excerpt, this teacher followed her mathematics curriculum material "with fidelity" (FO) in Year One. The fidelity was required and expected by the school and school district through a pacing guide reinforced by her instructional coaches. In another part of the same interview, she mentioned "And supplementing isn't like... I wasn't told not to do it, but it's not like told to do it. Like, really we should be sticking to this curriculum." In Year 2, moving grade levels, she began to modify her curriculum (FI) even though she used the pacing guide with fidelity. Taking advice from her grade teammates, she supplemented *Envision* curriculum materials with "different hands-on games" and she did "not use all the materials from *Envision*." In Year 3, she began to modify Envision (FI) in a "loosey-goosey" way. Another excerpt in the same interview suggests why she became more comfortable at modifying the mathematics curriculum material. She said, "A lot of the reason I'm trying new things this year (third year) is that I'm comfortable at this grade level."

In Figure 3 (below), we present the differences among individual teachers in terms of how they used their mathematics curriculum materials in their first three years. These differences indicate that there are different trajectories among these teachers, each taking their own paths within the general pattern seen in Figure 2. For example, in her first year of teaching, one beginning teacher (210.055) began by using and adapting multiple mathematics curriculum materials using a DI (Distributed Improvisation) approach. In her second year, the teacher tended to follow the multiple curriculum materials more closely. More details about the similarities and differences across the five trajectories will be shared during our presentation.



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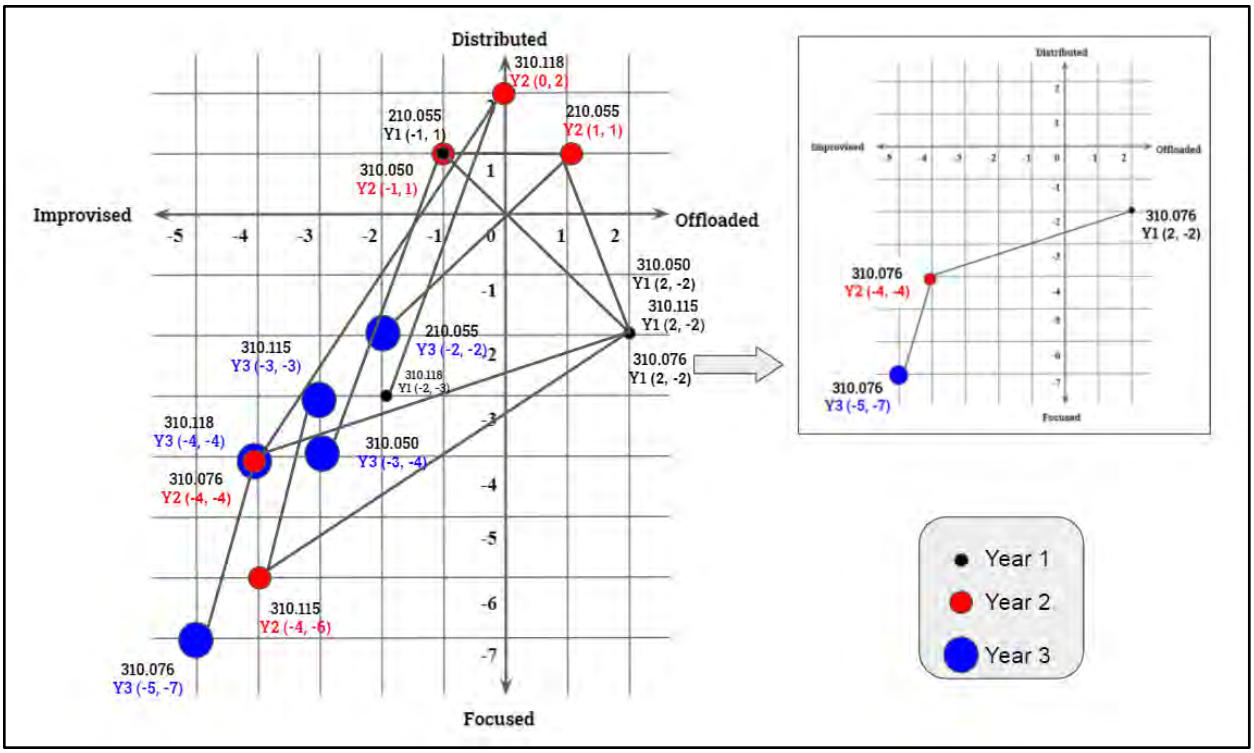


**Figure 3. Yearly trajectories of five individual beginning teachers' mathematics curriculum use (each teacher is represented by code number, such as 310.076)**

We found that each of the teacher's patterns of curriculum use involved interactions among the teachers' own beliefs, knowledge, and orientations toward mathematics curriculum and the school contexts in which they worked, including school and district policies related to curriculum use and the curriculum use patterns of their colleagues. Nonetheless, as depicted in Figure 3, all five of the teachers' curriculum trajectories arrived by Year 3 in the Focused Improvisation quadrant. Each third-year teacher could provide a clear rationale for their FI approach to curriculum use at that point. For example, one teacher (210.055) said, "And if it's not enduring curriculum, we have the freedom to not spend as much time on it. So that's been good." In other words, in this teacher's case, they were in a school context that required the use of a core curriculum to address the big mathematical ideas of the grade level, but also allowed them the agency to drop or modify less essential curricular components. A different third-year teacher, also in the FI quadrant, described how, through experience at the grade level, she was learning to use and adapt (improvise) her core curriculum materials in a way that was more responsive to her students versus strictly following the curriculum, as she had in her first year (when she was in the FO quadrant):

> So, the benefit of teaching the same grade two years in a row is that I... Like last year I would say I was more like, "OK, what does the book tell me to do?" Where this year, I'm more like, "OK, what do the kids need?" And that has helped a lot to not sound robotic, I guess. And make sure that what the kids are saying are actually what they're saying instead of like, "Oh, the book says that they have to say this, and I think I heard that." Or rephrasing it into like what the book wants them to say. And so the structure of the lesson was very similar to what



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> the series structure is, where they start with a collaborative solve and share and then move into some independent practice.

In this excerpt, the teacher describes the elements of the curriculum series she still follows closely (e.g., the lesson structure), but also identifies ways in which both her planning and her classroom interactions are now focused on listening and responding to her students instead of doing what the curriculum "tells" her to do and expecting her students to always say what the book indicates they will say.

## Significance

We found that these five beginning teachers changed how they used mathematics curriculum materials over the first three years of teaching. These teachers tended to make a transition from FO (Focused Offloading) or DI (Distributed Improvisation) to FI (Focused Improvisation) in the second and third years. These findings can contribute to the research on teachers' mathematics curriculum use in several ways.

First, this paper offers the field ways to integrate perspectives from research conducted in the context of English Language Arts (Valencia et al., 2006) and science education (Forbes & Davis, 2010) to understand beginning teachers' mathematics curriculum use in their first three years. As mentioned in the introduction section, the literature on teacher-curriculum interactions has explored (novice) teachers' curriculum use in the short term. This current paper allowed us to understand teacher-curriculum interactions in mathematics curriculum in the longer term (their first three years). Our findings differed from those of Valencia and colleagues (2006), which found little change in their first three years. Besides the different nature of mathematics and English Language Arts, one reason for this difference might be that since Valencia and colleagues' study (2006), mathematics teacher educators have been improving ways to help beginning teachers modify and adapt their mathematics curriculum materials, for example, by supporting prospective teachers in using educative curriculum materials in mathematics (e.g., Drake, Land, & Tyminski, 2014). In addition, as mentioned above, the curriculum landscape has changed substantially in the past 15 years. Building on this finding, further research can use the perspectives to understand m in mathematics curriculum use of larger numbers of beginning teachers in their early years.

Second, this paper contributes to the field's conceptual understanding of what a yearly trajectory of individual beginning teachers can look like in their early years. In another paper (Pak & Drake, 2020), we investigated a case of this trajectory with one beginning teacher in her first three years. In this current paper, we extended the number of beginning teachers to five teachers and analyzed excerpts we obtained from these beginning teachers in Year 1 through Year 3. The finding related to the general patterns (Figure 2) provides the field with an initial understanding of beginning teachers' mathematics curriculum use in their first three years. Our finding related to individual teachers' yearly trajectories (Figure 3) also suggests that, within the general patterns, each teacher illustrated a unique story from Year 1 through Year 3. Nonetheless, all five teachers modified and adapted their mathematics curriculum in their third years, suggesting a potential area for the future research in relation to a deeper understanding of individual teachers' mathematics curriculum use.

Lastly, this paper also contributes to developing how to analyze ways beginning teachers use their mathematical curriculum in their first three years. As an analytic tool, we drew on the framework Forbes and Davis (2010). In particular, we analyzed the teachers' movement along



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the quadrants in the framework (Figure 1). In our prior work (Pak & Drake, 2020; 2021), this framework illustrated well how beginning teachers used their mathematics curriculum. In this current paper, we conceptualized the yearly trajectory in terms of a coordinate graph where we could see each beginning teacher's movement from one quadrant to another (e.g., FO → DI → FO). We think that analyzing and visualizing data in this way shows a way to understand how beginning teachers use curriculum materials in relation to mathematics as well as other content areas (e.g., science and ELA), which would be a contribution to teacher education in general.

In addition to theoretical, conceptual, and methodological implications above, this paper contributes to mathematics teacher education. By providing a detailed understanding of the range of ways in which beginning teachers use curriculum materials in their early years, this paper can support mathematics teacher educators to better prepare prospective teachers to mobilize and adapt their mathematics curriculum. On the whole, we hope that this study can contribute to a deeper understanding of how teachers, including novice teachers, interact with curriculum materials in mathematics (e.g., Remillard, 2005) in their early years of teaching.

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