Teacher Agency in Using Mathematics Curriculum Materials to Plan Instruction
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Purpose

Since the release of the 1989 *Curriculum and Evaluation Standards* (National Council of Teachers of Mathematics, 1989), an ongoing pursuit in mathematics education has been to support a shift in K-12 mathematics classrooms from teacher-led instruction to student-centered instruction. Such *Standards*-based instruction challenges teachers to provide rich tasks that will elicit students' thinking (Reys, Reys, Lapan, Holliday, & Wasman, 2003) and also to listen to and build on student thinking as they plan and enact instruction. That is, teachers must be responsive to their students (Sherin & Drake, 2009). Teaching responsively requires knowledge of the specific needs of students in a classroom, which is knowledge that only classroom teachers can bring to their teaching. Thus, responsive teaching requires teachers to have some agency over their classroom instruction.

The development and dissemination of mathematics curriculum materials (CMs) has been a popular strategy for providing teachers with rich classroom tasks and supporting them in learning how to implement such tasks (e.g., Ball & Cohen, 1996; Remillard, 2005). However, studies of the ways in which teachers use CMs have revealed that the materials themselves (Stein & Kaufman, 2010), the messaging about the materials given by district leadership (McClain, Zhao, Visnovska, & Bowen, 2009), and external constraints such as heavy focus on standardized assessments (Amador, 2016) can all influence teachers' decisions and restrict their choices related to student responsiveness.

Better understanding when and how teachers perceive themselves to be able, or unable, to respond to students' thinking as they implement instruction from CMs will inform methods for supporting *Standards*-based instruction in mathematics classrooms. In this study, I use the construct of teacher agency to examine teachers' decisions as they plan using CMs and explore the features of CMs and of teachers' professional contexts that support or inhibit responsive teaching.

Theoretical Framework

I define teacher agency as the will and ability of teachers to exert influence over the content and manner of instruction in their classrooms (Rogers & Wetzel, 2013). To exercise agency, teachers must both desire to do something and feel they are capable of doing so. Constraints, such as physical layouts of classrooms or norms for teaching in a particular school, can have diminishing effects on agency (Rivera Maulucci, Brotman, & Fain, 2015). To study the effects of contextual constraints on teacher agency, I adopt an ecological perspective (Biesta & Tedder, 2007), which

suggests agency is not something individuals inherently *have.* Rather, agency is dynamically constructed in response to the constraints of a context.

I take up Konopasky and Sheridan's (2016) conceptualization of agency as made up of two parts: intention, or a speaker's recognition that they were the agent who carried out a particular action, and autonomy, or the extent to which the speaker communicates a sense of control over the decision to carry out that action.

Data Sources

Data was drawn from two sources: in-depth interviews, and recordings of teachers planning a lesson with CMs. The interview participants, Kayla and Ellen (both pseudonyms), were two elementary teachers with ten years of teaching experience. Kayla was teaching first grade and Ellen was teaching fifth grade. The interviews were unstructured conversations focused on all the ways the teachers use mathematics CMs in their classrooms. Kayla was using *Guided Mathematics* (Tunstall, 2015), a teacher-developed set of CMs available on the Teachers Pay Teachers website. Ellen was using *Investigations* (TERC, 2017), a researcher-developed set of CMs published by Pearson.

The recordings of teachers planning from CMs were drawn from an NSF-funded project focused on supporting elementary teachers to integrate computational thinking into their mathematics and science instruction. During an accompanying professional development program, participants spent an afternoon examining a lesson from their CMs with attention to opportunities to engage students in computational thinking. They then planned how they would implement the lesson. Alice and Cindy (both pseudonyms) both used *Math Expressions* (Fuson, 2012), a researcher-developed curriculum published by Houghton Mifflin Harcourt. Alice was teaching fourth grade and Cindy was teaching fifth grade.

Methods

I used a qualitative methodology to pursue better understanding of how teachers coordinate multiple goals and constraints as they use mathematics CMs to plan lessons. Qualitative research is appropriate due to its focus on description, meaning-making, and understanding of processes (Bogdan & Bilken, 2007). Teachers' decisions as they plan lessons reflect their processes of meaning-making from the resources and constraints within which they work.

I coded the data in three steps. First, I conducted a thematic analysis (Braun & Clarke, 2006) to identify six themes in the data, summarized in Table 1. Second, to explore how the six themes related to teachers' planning decisions, I identified all of the statements of actions teachers said they took or planned to take in order to prepare for or teach lessons. Further, I identified all the sentences providing justification for each action. Table 2 shows an example of an action from each teacher, along with its justification and the themes present in the justification.

Table 1: Themes at the Semantic Level of the Data

Theme	Description	Example
Curriculum materials (CMs)	Reference to some aspect of the CMs the teacher uses, including the content, sequence, features, general approaches, and identity of the developers.	*Ellen:* And so the way this curriculum is written is, these are the suggested things like you're supposed to say [referring to bold blue text on page].
Students	Reference to the students in the teacher's classroom, including activities they do, strategies they use, differences among them, and their understanding or affect.	*Alice:* So if the student would have done that and went to 50, but then when they rounded it to 50 and then they got their, they're looking at their actual answer, as long as they know that if it was originally 56 they need to add in, as opposed to subtract 4.
Context	Reference to some aspect of the teacher's broader working context, such as class size, amount of class time, report card or specials schedule, or standards and assessments.	*Cindy:* And as a teacher, you want to dig deep, but like, I know it was the end of the year, and we're rushing 'cause we have MSTEP in and amongst this, and I'm trying to cram stuff in days before MSTEP to try to give them as much exposure as I can.
Teacher	Reference to the teacher's own knowledge and beliefs about teaching, students, mathematics, or curriculum, past teaching experiences, and common practices.	*Ellen:* So, I have a minor in math. I'm pretty comfortable with it. I know my standards.
Mathematics	Reference to mathematics, including the focus of a lesson or grade level, the overall nature or difficulty of a mathematics topic, or its real-world applicability.	*Cindy:* I feel like fractions in and of themselves in math is just abstraction that goes on and on and on.
Other resources	Reference to an instructional resource other than the teacher's core CMs, including its content, format, purpose, or source.	*Kayla:* ABCYah, I don't know if… (interviewer shakes head) Um, it's a, it's a website. It's a really fun for the younger…. So they just have different games they can do.

Table 2: Example Actions, Justifications, and Themes

Case	Action	Justification	Themes in Justification
Kayla	I don't really look at this [the unit overview] any more. I did the first year. And then when we did the, um, report card this year...	… we looked at it just to make sure we were hitting the standards that we needed to hit. And that was when we really pulled out … like, alright, we're going to do lessons one through four, 'cause that really hits NBT 1 and 2.	Context - Standards Curriculum materials - Lesson content
Ellen	Um, so I will probably spend more on measurement conversions than they [other fifth grade teachers at her school] will.	So, I'm a little bit different than the rest of my grade level in that I've had my kids for two years. And my kids are better. But, so, my kids finished their decimal unit before break and the other three are finishing up decimals when we come back from break.	Context - Having same students twice Students - Student understanding Teacher - Knowledge of students
Alice	So I need to go back to my very first lesson on this. I'm gonna make this my very first lesson, estimation, and focus on that.	Um, they've already had all of their instruction on rounding. Now I'm worried, because all of the rest, all of their practice on rounding is always looking at those two numbers and saying is it closer to? You know what I'm saying? And it's not necessarily… so they're automatically gonna default to that rounding.	Curriculum materials - Lesson sequence Students - Student strategies
Cindy	I've done pattern blocks. Yup, I've had them do that before as well.	So the visualizing it. You see the extra. … If they're trying to draw it, they don't have to worry about drawing rectangles that are the same size, or "how do I cut this into fifths?" And "it's not working!", 'cause get really frustrated with that.	Students - Strategies, affect

Finally, I used Konopasky and Sheridan's (2016) nine linguistic cues for agency to code each statement of action according to what extent a teacher felt agency over the decision that led to the action. Table 3 shows the nine cues with illustrative examples.

Table 3: Linguistic Cues for Agency (Konopasky & Sheridan, 2016)

Component of Agency	Linguistic Cue	Connection to Agency	Example
Intention	Self as subject	Placing oneself as the subject of a sentence establishes intention.	*Kayla:* **I** jumped to here because I knew I needed to get that done.
	Presence of a verb object	Including a verb object heightens intention.	*Alice:* So I need to go back **to my very first lesson** on this.
	Animation of object	Acting on an animated or living object signifies stronger intention than an inanimate object.	*Ellen:* I might have to teach **some of my lower students** converting within the same system.
Autonomy	Placing self as member of generalized group	Framing the action as one of a group rather than as one's individual action lessens autonomy.	*Kayla:* Besides the math recovery. That is all… **everybody's** doing that.
	Indication of obligation or necessity	Using a verb such as *have to* or *need* lessens personal control and thus autonomy.	*Alice:* I **have to** hold them back into strategy groups and talk about why.
	Mitigating a verb with *just*	Adding a mitigator before a verb lessens the sense of one's control and thus autonomy.	*Cindy:* I think **just leave** some blank ones at the end.
	Connection to an external cause, usually with *so*	Attributing the action to an external cause lessens autonomy.	*Ellen:* Like, you can't just .. one or two lessons and expect kids to have mastery of things. **So,** we supplement.
	Active vs. passive or relational verb	Active verbs (e.g., *run*) indicate greater autonomy than passive (e.g., *drift*) or relational (e.g., *were*) verbs.	*Cindy:* Because my math talks, sometimes they would take off, and it was just so good that it was like, just **go with it.**
	Removing self from sentence	Removing oneself in favor of using a generic statement (e.g., *There are*) lessens autonomy.	*Kayla:* So… yeah, and **the math stations are** about, depending on how they're doing, about 15 minutes.

For each action, I looked across the three codes for intention to determine whether the linguistic structure suggested the teacher saw herself as the agent of action. Then I looked across the six cues for autonomy to decide whether the linguistic structure suggested full autonomy (only positive cues for autonomy), mitigated autonomy (a mix of positive and negative cues), or no autonomy (only negative cues). Based on this analysis, I coded each action with one of the agency codes shown (with examples) in Table 4.

Table 4: Example Actions with Each Level of Agency

Agency Code	Example	Explanation
Intention and autonomy	*Cindy:* When I did this, **I** would never put the fraction next to it. **I** would **push** them to get there.	Cindy uses *I* to place herself as the subject, establishing intention. She uses the active verb *push,* and does state an external cause or obligation, suggesting autonomy.
Intention with mitigated autonomy	*Kayla:* That first year I was **just kind of dabbling** in it. **Picking and choosing** because we got this like mid-year that first year.	Kayla uses *I* to place herself as the subject, establishing intention. She uses active verbs *dabble, pick,* and *choose,* suggesting some autonomy, but also uses the verb mitigator *just* and identifies an external cause with *because we...*
Intention but no autonomy	*Alice:* I guess that's the best one. So **I'm just going to go** with that one.	Alice uses *I* to place herself as the subject, establishing intention, but she uses the verb mitigator *just* and the passive verb construction *going to go with*, suggesting low or no autonomy.
No intention or autonomy	*Ellen:* My first year that I was there, **they** were going through the process of getting this. Um, and then, my second year **we got** this curriculum.	Ellen uses *they* as the subject of the first sentence, suggesting an actor other than herself, and says *we got* in the second sentence, placing herself as a passive recipient. This establishes a lack of intention and a lack of autonomy.

After coding, I developed a narrative for each of the four cases describing patterns among levels of agency, the type of decision that led to the action (e.g., decisions about what content to cover or how to present that content), and the themes that appeared in the justifications. I focused on how the CMs and context features enabled or constrained teachers in making decisions

responsive to student needs. Lastly, I looked across the four cases to identify cross-case themes. I focus on two of these themes in the results section below.

Results

Cross-case themes included: (1) teacher agency is lowest over the choice *of* CMs as compared to choices about *how to use* CMs, and (2) increasing knowledge of CMs supported agency related to student responsiveness.

First, three of the four teachers expressed one action with the lowest level of agency—that is, with no intention and no autonomy—and in all three cases, the action related to using a particular set of CMs. Kayla and Ellen each said their use of *Guided Mathematics* and *Investigations* was a result of action taken by someone else—district leadership in Ellen's case (see the last row of Table 4), and the other first-grade teachers in Kayla's case. While neither Cindy nor Alice directly mentioned how they came to be using *Math Expressions,* Cindy said the following about fractions content: "it's at the beginning of the year now, and they have… I mean it is in the first unit of our text, but the way our curriculum was last year, this was in like March." The context surrounding this comment makes it clear there is a prescribed set of CMs in Cindy's district and a prescribed order in which teachers are expected to use them. Cindy's use of *they* and *it* as the subjects of her sentences about when to teach fractions suggests she felt no intention over those decisions. Amy does not express an action related to choice of CMs, but does note that *Math Expressions* is "not [her] favorite program," suggesting that if she were in control of the choice of materials, she would select something else. In short, while the rest of teachers' actions reflected some level of agency—at least intention, with varying levels of autonomy—teachers felt no intention or autonomy over choice of materials.

Second, for three of the teachers, knowledge about the particular CMs they were using seemed to play a role in how they exercised agency (or not) over decisions about how to use them. In each case, increases in knowledge about the CMs corresponded to increases in agency with respect to the materials—which in turn seemed to support responsiveness to students. For example, Kayla described different ways of using her materials in her first versus her second year of implementation. During her first year, she "just ran it straight through," but during her second year, she and her co-teachers were "jumping around more and making it a bit more user friendly." Both the nature of the use patterns and the linguistic cues suggest greater agency in the second year; in the first year Kayla follows the materials as written but in the second year she does not, and in her expression of the first pattern she uses the mitigator *just* but in her expression of the second pattern she does not. Later in the interview, Kayla attributes her first-year pattern of use to her lack of knowledge of the first-grade standards and of the CMs. Thus her lack of curriculum knowledge seemed to have a limiting effect on her agency.

By contrast, when Kayla describes more specifically the changes she made to the order of the materials in her second year, many of the changes are expressed with high agency and justified with reference to responding to student needs. For example, when describing her decision to move time to the hour to earlier in the year, Kayla said, "[I]t's just a very simple concept. Most of them already know it. So to put it early on and help them feel successful was a big piece of that." Thus, once she had gained knowledge of the CMs during her first year of use, Kayla's agency over the materials seemed to increase and allow her to be more responsive to student needs.

Alice and Cindy each have similar patterns in their data. Because their planning discussions focused on single lessons, the knowledge they gain about their CMs is about single lessons, rather than the CMs overall. In each case, their careful examination of the lessons led to new insight about the intent of the curriculum designers, and these insights led to agentic decisions that were responsive to anticipated student needs. For example, Alice realized her lesson asked students to do more mental math than she had previously assumed, and so she chose to incorporate more mental math activities leading up to her lesson to better prepare her students.

Scholarly Significance

These findings add additional perspective to existing research about how mathematics CMs can support or inhibit teaching that is responsive to students. Drake and Sherin (2009) illustrated how teachers developed curriculum vision and trust over multiple years of using a set of CMs, and argued that teacher knowledge *about* curriculum was important to develop. Choppin (2011) demonstrated that teachers can and do make adaptations to CMs in response to student thinking, and argued that these adaptations required both knowledge of the materials designers' intent and knowledge of how the curriculum played out in practice. The second cross-case theme discussed above supports and enriches these conclusions, suggesting that knowledge of CMs also relates to teachers' feelings of agency over decisions to adapt the materials to be responsive to students.

Relatedly, lack of knowledge about the curriculum may inhibit teacher agency in making such decisions. This point is especially important when interpreted in the context of the first cross-case theme. Teachers feel little or no agency over the choice of which CMs to use. When making decisions about changing the CMs teachers are expected to use, the agents in such decisions—often, school or district leadership—should consider the implications related to teacher knowledge of the curriculum. Changing materials can support changes in practice, but may also inhibit responsiveness to students as teachers learn about the new materials.

References

Amador, J. M. (2016). Teachers ' considerations of students' thinking during mathematics lesson design. *School Science and Mathematics*, *116*(5), 239–252.

Ball, D. L., & Cohen, D. K. (1996). Reform by the book: What is -- or might be -- the role of curriculum materials in teacher learning and instructional reform? *Educational Researcher*, *25*(9), 6–8, 14. Retrieved from http://www.jstor.org/stable/1177151

Biesta, G., & Tedder, M. (2007). Agency and learning in the lifecourse: Towards an ecological perspective perspective. *Studies in the Education of Adults*, *39*(2), 132–149.

Bogdan, R. C., & Biklen, S. K. (2007). *Qualitative Research for Education: An Introduction to Theories and Methods.* Boston: Pearson.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*, 77–101.

Drake, C., & Sherin, M. G. (2009). Developing curriculum vision and trust: Changes in teachers' curriculum strategies. In J. T. Remillard, B. A. Herbel-Eisenmann, & G. M. Lloyd (Eds.), *Mathematics Teachers at Work: Connecting Curriculum Materials and Classroom Instruction* (pp. 322–337). New York: Routledge.

Choppin, J. (2011). Learned adaptations: Teachers' understanding and use of curriculum resources. *Journal of Mathematics Teacher Education*, *14*(5), 331–353.

Fuson, K. (2012). *Math Expressions.* Boston: Houghton-Mifflin Harcourt.

Konopasky, A. W., & Sheridan, K. M. (2016). Towards a diagnostic toolkit for the language of agency. *Mind, Culture, and Activity*, *23*(2), 108–123.

McClain, K., Zhao, Q., Visnovska, J., & Bowen, E. (2009). Understanding the role of the institutional context in the relationship between teachers and text. In J. T. Remillard, B. A. Herbel-Eisenmann, & G. M. Lloyd (Eds.), *Mathematics Teachers at Work: Connecting Curriculum Materials and Classroom Instruction* (pp. 56–69). New York: Routledge.

National Council of Teachers of Mathematics (NCTM). (1989). *Curriculum and Evaluation Standards.* Retrieved from https://www.nctm.org/Standards-and-Positions/More-NCTM-Standards/Curriculum-and-Evaluation-Standards-(1989)/

Remillard, J. T. (2005). Examining key concepts in research on teachers' use of mathematics curricula. *Review of Educational Research*, *75*(2), 211–246.

Reys, R., Reys, B., Lapan, R., Holliday, G., & Wasman, D. (2003). Assessing the impact of standards-based middle grades mathematics curriculum materials on student achievement. *Journal for Research in Mathematics Education*, *34*(1), 74–95.

Rogers, R., & Wetzel, M. M. (2013). Studying agency in literacy teacher education: A layered approach to positive discourse analysis. *Critical Inquiry in Language Studies*, *10*(1), 62–92.

Sherin, M. G., & Drake, C. (2009). Curriculum strategy framework: Investigating patterns in teachers' use of a reform-based elementary mathematics curriculum. *Journal of Curriculum Studies*, *41*(4), 467–500.

Stein, M. K., & Kaufman, J. H. (2010). Selecting and supporting the use of mathematics curricula at scale. *American Educational Research Journal*, *47*(3), 663–693.

TERC. (2017). *Investigations 3*. Glenview, IL: Pearson.

Tunstall, R. (2015). *First Grade Guided Math*. ETA hand2mind. Available at https://www.teacherspayteachers.com/Product/First-Grade-Guided-Math-1940110