

**A Search for Support:
Beginning Elementary Teachers' Use of
Mathematics Curriculum Materials**

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ABSTRACT

This paper analyzes data from case studies of the use of mathematics curriculum materials by four second-year, elementary school teachers, two using a traditional math textbook and two using a reform math textbook. Three research questions are addressed: 1) How do beginning elementary school teachers who work in the context of standards-based reform and high-stakes accountability describe their use of mathematics curriculum materials? 2) To what extent do they feel supported by those materials, if at all? 3) What factors appear to influence beginning teachers' use of curriculum materials and their feelings of being supported? Overall, I found that mathematics curriculum materials, particularly textbooks and teacher's guides, are central to the work of these four beginning teachers. The teachers all look to their curriculum materials for support in planning and delivering instruction, but they vary widely in their approaches to using the materials and the extent to which they feel supported by the materials. Three themes of support emerge from these teachers' experiences: 1) efficacy, or their perceptions of the instructional effectiveness of the materials; 2) ease of use, meaning the extent to which the materials alleviate or exacerbate the demands of planning and teaching mathematics; and 3) agency, the extent to which the teacher feels that she is choosing what to teach and how to teach it. Individual factors, including new teachers' beliefs about teaching mathematics, influence how beginning teachers use and experience their curriculum materials. In addition, and perhaps more important for policy considerations, those responsible for curriculum at the district and school level play a major role in creating an environment that permits or does not permit the beginning teachers to benefit from the potential support of curriculum materials.

INTRODUCTION

American public schools will hire over 2.2 million new teachers in the next decade (Gerald & Hussar, 1998). The expectations and experiences of these new teachers may differ from those of the retiring cohort due to a changed career context (Peske, Liu, Johnson, Kauffman, & Kardos, 2001) and the prevalence of standards-based reform and high-stakes accountability (Jerald, 2000). Policies to attract, retain, and support new teachers should be informed by a better understanding of the experiences of new teachers beginning their careers in this changed context.

The literature on the first year of teaching describes a time of extreme challenge and rapid learning (e.g., Lortie, 1975; McDonald & Elias, 1983; Ryan, 1970; Wideen, Mayer-Smith, & Moon, 1998). First-year experiences may influence whether people stay in teaching and, if so, the types of teachers they become (Gold, 1996; McDonald & Elias, 1983). Curriculum decisions are among the many challenges new teachers face (Grossman, Thompson, & Valencia, 2001; Kent, 2000; Veenman, 1984); they must determine what to teach and how to teach, often by themselves through trial and error (Feiman-Nemser, 1983; Kauffman, Johnson, Kardos, Liu, & Peske, 2002; Lortie, 1975). Making these decisions in mathematics may be especially challenging for elementary school teachers, who are typically generalists teaching several subjects. They often lack high levels of confidence and strong knowledge regarding mathematical content and pedagogy (Ball, 1997; Ma, 1999). New state standards and commercial curriculum materials, modeled largely after standards promoted by the National Council of Teachers of Mathematics (1989), reflect new conceptions of, and approaches to, mathematics education. Therefore, teachers may well be expected to teach mathematics that they never learned and in ways they themselves never experienced (Ball, 1997; Kilpatrick, Swafford, & Findell, 2001).

Given the challenges new teachers face in their work, curriculum materials, defined here as the textbooks, teachers' guides, and other printed materials that describe the curriculum and how to communicate it to students, have the potential to support new teachers for several reasons. First, curriculum materials are present in most classrooms and address the central activities of students and teachers, making them a "concrete and daily" part of the classroom with a "uniquely intimate connection to teaching" (Ball & Cohen, 1996, p. 6).

Second, research has consistently shown that many teachers rely heavily on commercially published curriculum materials to plan and deliver instruction (e.g., Brophy, 1982; Goodlad, 1984; Woodward & Elliott, 1990). In a longitudinal study of six prospective teachers, Ball and Feiman-Nemser (1988) found that even novices who began student teaching with negative opinions about textbooks and teachers' guides turned to such materials in the absence of other support. Furthermore, in a recent exploratory study in Massachusetts, many first- and second-year teachers reported that they wanted greater specification of what to teach and how to teach it; several expressed a desire for prepared lessons (Kauffman et al., 2002). Apple & Junck (1990) describe how teachers in one school, including a new teacher, perceive prepared curriculum materials "as a practical and sensible solution" to the problem of scarce time, resources, and skills (p. 248).

Third, some curriculum materials may hold the potential for deliberately educating new teachers about content, pedagogy, and student learning. Whereas curriculum designers have traditionally treated curriculum materials simply as "representation of the content for instruction" (Ball & Cohen, 1996, p. 7), a growing body of theory and empirical research views them as potentially educative for teachers as well (e.g., Ball & Cohen, 1996; Collopy, 2000; Remillard, 2000; Russell, 1997), particularly if they provide detailed information that supports teachers in

making decisions, rather than simply prescribing regimented teacher activity (Cohen & Ball, 1999; Kilpatrick et al., 2001).

Prior research on the use of curriculum materials strongly indicates that teachers do not “teach strictly by the book” (e.g., Stodolsky, 1989, p. 180). Instead, teachers enjoy considerable discretion, even when policy dictates the use of certain materials (Schwille et al., 1983). Existing research has identified many influences over what teachers actually teach, including several factors pertaining to the individual teachers and other factors pertaining to the school or district context in which they work. Individual-level influences include teachers’ skills and knowledge (Ball & Feiman-Nemser, 1988; Brophy, 1982; Cohen, 1990), beliefs and preferences (Barr, 1988; Schmidt, Porter, Floden, Freeman, & Schwille, 1987; Stodolsky, 1989), and attitudes toward textbooks (Ball & Feiman-Nemser, 1988; Freeman & Porter, 1989). It is likely that phases of adult cognitive development would also have an effect (Kegan, 1994). Contextual influences include the subject matter being taught (Barr, 1988; Sosniak & Stodolsky, 1993; Stodolsky, 1989), the nature of the curriculum materials (Stodolsky, 1989), the particular students in the class (Freeman & Porter, 1989; Schmidt et al., 1987; Stodolsky, 1989), the school context (Stodolsky, 1989), and district curriculum objectives (Freeman & Porter, 1989; Schmidt et al., 1987).

Standards-based reform and high-stakes assessments, which have been implemented in nearly every state in the past decade (Jerald, 2000), create additional pressures that might influence new teachers’ use of curriculum materials. A primary goal of standards and assessments is to influence what teachers teach (Porter, 1989; Porter & Smithson, 2000; Smith & O’Day, 1991). Available curriculum materials may not align clearly with standards and assessments, however. Fewer than half of the teachers in a recent national survey “said they have ‘plenty’ of access to curriculum guides or textbooks and other materials that match state standards” (Hoff, 2001). Furthermore, interviews with fifty first- and second-year teachers in Massachusetts reveal that many new teachers feel pressure from the high-stakes student tests, but think they themselves lack the requisite experience and support, including standards-based curriculum materials, to teach the standards well (Kauffman et al., 2002).

The literature on teachers’ use of curriculum materials predates the current policy and career context, largely ignores *new* teachers, and typically treats curriculum materials as potential determinants of teaching content and practice without also considering them as potential sources of support for teachers. The study described in this paper addresses the following questions through case studies of four second-year elementary teachers: 1) How do beginning elementary school teachers who work in the context of standards-based reform and high-stakes accountability describe their use of mathematics curriculum materials? 2) To what extent do they feel supported by those materials, if at all? 3) What factors appear to influence beginning teachers’ use of curriculum materials and their feelings of being supported?

METHODS

Using interviews, observations, questionnaires, and document reviews, I conducted a multiple-case study of four second-year, elementary school teachers’ use of mathematics curriculum materials. I chose case study methods in order to explore the complexity and interrelatedness of the various factors that may affect how teachers use and experience their curriculum materials (see Yin, 1994).

Teachers and their schools

The study includes four second-year elementary teachers in the intermediate grades, each in a different district. I selected second-year teachers because they have some experience with their curriculum materials, but are still relatively new in the profession and are able to reflect back on their first year. I chose elementary school teachers because they are normally generalists and are expected to teach all subjects, thus allowing the case study protocol to include some comparison of math to other subjects. By selecting an intermediate grade, in which the mathematics content is a higher level than in the primary grades, I hoped to increase the likelihood that some of the respondents would lack comfort and/or understanding in mathematics, which might influence their use of the curriculum materials.

To include some variation in the nature of the available curriculum materials, I selected two teachers from districts that use TERC's *Investigations in Number, Data, and Space* (1998) and two from districts that use Houghton Mifflin's *Math Central* (1998). Of the two, *Investigations* contains more resources deliberately designed to promote teacher learning about math content and how students learn it (see Houghton Mifflin, 1997; Russell, Tierney, Mokros, Goodrow, & Murray, 1997). Also, *Investigations* uses an inquiry-based approach, which expects teachers to use a more inductive teaching style, to exhibit greater tolerance for uncertainty, and to pay greater attention to how individual students understand or misunderstand concepts (see Askey, 2001 for a discussion of the cognitive demands of reform mathematics materials). In contrast, *Math Central* provides lessons that explicitly introduce concepts and techniques, followed by numerous practice problems (see Van de Walle, 1994, for a description of traditional mathematics materials). Furthermore, *Investigations* generally provides a single, detailed plan for each lesson, whereas *Math Central* offers numerous alternative teaching ideas and a variety of optional resources for each lesson (See Appendix A for further description of the curriculum materials.)

I identified second-year teachers by directly contacting schools in districts in eastern Massachusetts that use the targeted curriculum materials. Criteria for teacher selection were limited to teaching third, fourth, or fifth grade, having the targeted math curriculum materials available for use, and being in the second-year of teaching. I contacted the identified teachers via post, e-mail, or fax, sometimes through their principals, to explain the nature of the study and to invite them to participate. Of the 22 eligible teachers I contacted, 13 never replied, four replied but declined to participate, and five agreed to participate. One of these five was excluded because the four participants had already been chosen. I also gathered data from a second-year, sixth-grade teacher because she offered an interesting perspective on four different sets of math curriculum materials. Because she taught a middle school grade, her case is not presented here, but it did inform the analysis of the other teachers. Participating teachers each received a \$15 gift certificate for an Internet bookstore as a token of appreciation.

Table 1 summarizes background information about the four participants. Karen and Melissa teach fifth grade, Lindsey teaches fourth, and Teri teaches third.¹ They all teach the same grade during their second year as they did during their first. They all attended traditional teacher certification programs, but have undergraduate majors in fields other than education. Teri and Karen earned master's degrees in education prior to the first year of teaching, while Lindsey and Melissa were still enrolled in master's programs during data collection. Karen and Melissa are in their mid-20s, with teaching as a first career. Lindsey is roughly 30 years old, having worked in

¹ All teachers' names in this paper are pseudonyms.

another occupation before deciding to teach. Teri, who is in her early 40s, was a full-time mother and homemaker before deciding to teach. All four are white women.

Table 1: Background Information about Study Participants

Pseudonym	Textbook	Grade	Age	Education degrees	Prior career
Karen	<i>Investigations</i>	5 th	20s	Ed.M.	None
Teri	<i>Math Central</i>	3 rd	40s	Ed.M.	Homemaker
Lindsey	<i>Investigations</i>	4 th	30s	Enrolled in Ed.M. program	Counselor
Melissa	<i>Math Central</i>	5 th	20s	Enrolled in Ed.M. program	None

The four describe similar histories in mathematics. None excelled in the subject or loved it as a student. Only Teri reports having had consistently negative experiences in math, while the other three say that there were times they did well and times they did poorly. Each reports being comfortable with most of the math content she is now expected to teach.

They teach in relatively small schools, with enrollments ranging from 300 to 400 students, in suburban districts that are demographically similar. The percentage of students in their schools who are white or Asian-American range from 90 percent to 99 percent. The percentage of students described as limited-English-proficient ranges from zero percent to approximately 10 percent. The percentage of students who qualify for free or reduced-price lunch ranges from four percent to 10 percent.

In the spring of 2001, during these teachers' first year, student achievement on the MCAS, the state's criterion-referenced, standardized test, was high relative to other schools in the state in each of the four schools. All four were in the top 20% of schools in the state in both math and English language arts, as measured by the percentage of fourth-grade students meeting state standards by scoring either advanced or proficient. In each school, more than half of the tested students scored at the advanced or proficient level on the math MCAS, compared to 34% of fourth graders in the state. Finally, fewer than 10% of students failed the math MCAS, compared to 19% of fourth graders in the state.

Data collection

Data collection for each teacher included a two-part questionnaire, two interviews, a classroom observation, and document review. Except for one interview, which occurred in the spring of the 2000-2001 school year, all data collection took place in the fall of the 2001-2002 school year. The first part of the questionnaire asks for factual information about the respondents, such as age, teaching assignment, teacher preparation, prior work experience, and class schedule.

The second part, adapted from Kennedy, Ball, & McDiarmid (1993), addresses the teachers' beliefs about mathematics and teaching mathematics. (See Appendix B.)

The first interview was semi-structured so it would cover specific topics while still allowing for substantial follow-up questions. Topics included personal characteristics, school and district context, the math curriculum, and the available curriculum materials. (See protocol in Appendix C). Between interviews, I observed a mathematics lesson, watching for examples of the teacher using curriculum materials and for examples of math content and teaching behavior upon which to base questions in a second interview. (See protocol in Appendix D.) The second interview included questions about how the teacher used curriculum materials before, during, and after the observed lesson. (See protocol in Appendix E.) All interviews were transcribed verbatim. Tape recordings of each observation, except for one, were made for reference. Notes on classroom observations were typed based on handwritten running records.

I also reviewed several documents, including the mathematics curriculum materials available to the respondents and curriculum guides and materials from the school, district, and state.

Data analysis

Data analysis included single-case and cross-case analysis. After each teacher's initial interview, I composed an analytic memo describing the teacher's background, various school and district contextual factors, her use of curriculum materials, and her explanation for using the materials that way. I supplemented and revised this memo after completing the observation and second interview. Also, after each observation, I described the lesson and the teacher's use of curriculum materials, using a pre-formed set of questions to guide the analysis.

The starting point for all of my analysis was a "theoretical proposition" (Yin, 1994, p. 103) informed by the literature. With each case, I sought to test the proposition that the teacher's use of curriculum materials was influenced by particular individual and contextual factors. Each discrepancy between the theoretical case and the empirical case compelled me to look more closely at the factors unique to that teacher's experience and how they may relate to other factors.

Using the computer software *The Ethnograph*, I coded and re-coded transcripts according to themes generated from the literature and additional themes that emerged from the analysis. To facilitate cross-case analysis, I constructed a matrix with each teacher on the horizontal axis and various topics and themes, both theoretical and emergent, on the vertical axis. Using the coded data and the matrix, I wrote several cross-case analytic memos to capture my interpretations and comparisons. Several times I revisited the data to confirm, deny, or modify my hypotheses. I shared these memos and the supporting evidence with colleagues from my research project in order to get feedback on my own interpretations.

FINDINGS

Overall, I found that mathematics curriculum materials, particularly textbooks and teacher's guides, are central to the work of these four beginning teachers. To varying degrees, all four use their teacher's guides to plan and deliver instruction and, again to varying degrees, all four modify, supplement, and reorder the content and instructional strategies suggested by those guides.

They look to the materials for support in planning and delivering instruction, but the extent to which they actually experience support varies widely. Individual factors, including new teachers' beliefs about teaching mathematics, influence how beginning teachers use and experience their curriculum materials. In addition, and perhaps more important for policy considerations, contextual factors at the district and school levels influence whether beginning teachers benefit from the potential support of curriculum materials.

Use of curriculum materials and their perceived supportiveness

In this section, I first describe each teacher's reported – and to some degree observed – use of curriculum materials and her description of the support she receives. The discussion of support is divided into three themes that emerge from the interviews: 1) efficacy, or the teacher's perception of the instructional effectiveness of the materials; 2) ease of use, meaning the extent to which the materials alleviate or exacerbate the demands of planning and teaching mathematics; and 3) agency, the extent to which the teacher feels that she is choosing what to teach and how to teach it. Taken together, these three themes provide a composite picture of support for each teacher.

Karen

“So without a doubt, I use the *Investigations* curriculum, the materials, every day.” Of the four teachers, Karen, who teaches fifth grade, appears to most regularly and consistently use her mathematics textbook materials to plan and deliver instruction. *Investigations* generally recommends a single set of connected activities for each lesson (see Appendix A), and Karen almost always follows those lesson plans closely. In preparation, she reads through all of the teacher's notes and usually prepares her own written outline. During a lesson, she uses her notes and the teacher's guide as “reference tools.” She adapts questions from the teacher's guide to inform her ongoing assessment of individual students' understanding during the lessons. In her second year, she has decided that it makes more sense to her to follow the recommended sequence of *Investigations*, rather than the sequence suggested by her district.

Although Karen primarily uses her textbook and teacher's guide, she supplements them with other materials. Students start each morning with a problem solving exercise that Karen pulls from another book. She also schedules times during the week for computation practice. For enrichment, homework, and to fill time before holidays, she uses other problem-solving resources from the district. Before her fifth-grade students take standardized tests in the fall (*not* the state MCAS test), Karen spends three weeks on test preparation, including practice with the multiple-choice format. Except for the test preparation, Karen supplements rather than supplants her *Investigations* units with these additional activities.

Efficacy. Karen feels confident that her students learn mathematics when she uses the *Investigations* curriculum materials. She appreciates the hands-on activities and believes that the “open-ended” approach allows all students to progress, regardless of where they begin. Karen also thinks that *Investigations* helps her to develop as a teacher. In her second year, she feels that she is “able to use those materials more effectively this year to figure out if kids are learning what they're supposed to be learning.”

Karen does not uncritically accept everything about her curriculum materials, however. Her biggest concerns regard assessment. Looking beyond her own classroom, Karen worries that

Investigations inadequately prepares students for the reality of standardized tests, which she thinks emphasize computation and getting the right answer. Looking within her classroom, Karen has some doubts about how to assess whether students are ready to move past a lesson or unit. Overall, however, Karen's doubts and concerns neither derail her overall agreement with the approach of the curriculum materials, nor deter her from relying heavily on them.

Ease of use. Having a "concrete curriculum" is very helpful to Karen as a beginning teacher. Although she teaches several different subjects each day, math is the only one for which the curriculum is defined by the textbook. The demands of developing lessons for the other classes make her especially grateful that she has a "really strong" mathematics curriculum that is "very well laid out."

Although the *Investigations* materials make Karen's job easier, they do not make it easy. The explicit philosophy of these curriculum materials is that the teacher needs a deep, conceptual understanding of the mathematics being taught. The teacher's guide provides information that can help teachers to develop that understanding, but it requires more than a cursory glance through the pages. Karen finds that making full use of the resources takes time:

In terms of planning, there are some really easy parts to it, in that the *Investigations* curriculum has – there is a book for each unit, that not only talks about major goals and concepts of each lesson, but different ways to structure the lessons, and different extensions. They have teacher notes about specific points in each lesson, and they have examples of student conversations. So that is incredibly helpful, but it's also very time consuming to plan it because of the approach that the program takes. So in one sense it's all written out there, but I feel like if I'm going to do a really good job with a lesson, I have to spend a lot of time prepping it.

While the curriculum materials alleviate some of the demands of planning and teaching mathematics lessons, they come with their own demands. However, Karen does not complain in the interviews about the time it takes to prepare *Investigations* lessons. Even though she still must devote substantial time and energy to using these materials, she apparently feels that the demands are fewer and the rewards are greater than if she had to plan from scratch.

Agency. Karen says that one of the reasons she chose to teach in her district is "that there is flexibility and there is room to be creative." One might expect that she would feel constrained by district expectations that she use a particular textbook. To the contrary, Karen talks as though she is very much in charge of her day. She uses the materials because she values them, not simply because they are required:

[*Investigations* involves] a very developmental way of thinking about math. There is a lot of hands-on building of concepts that I think is exciting for me, and exciting for the students. And I feel like I'm making, I make conscious choices in how our day is structured to make sure that math is a priority in our classes.

She also chooses to use the materials in order to relieve the pressure of overwhelming time constraints:

I really enjoy planning and I like thinking about what the goals are and different ways kids can meet the goals, learn the concepts, explore new things. And if time

were not an issue, I wouldn't mind at all planning from, you know, sitting down with four different books and six different lesson ideas and all of this other stuff and figuring out then what specifically I want to do with those materials. That's part of the job that I do really enjoy. But it does, it gets kind of exhausting.

Given her willingness to critique certain aspects of the curriculum materials, her interest in lesson planning, and her developing confidence and ability in mathematics, it is likely that Karen will rely less on her teacher's guide in the future. For now, she views her curriculum materials as a great support. In short, she does not equate closely following the curriculum materials with a loss of autonomy or agency.

Teri

"I follow the lessons in the book. I follow exactly what's in the book." Like Karen, third-grade teacher Teri describes using her textbook to decide what to teach and how to teach it. The *Math Central* teacher's guide goes home with her every night. She prepares for each lesson by "getting the materials [including copies and manipulatives, if called for] ready, finding out what the skill is, and just going over that in my head." She will sometimes outline a warm-up activity, and "maybe jot down a few examples that I want to do on the board or on the overhead projector." During the lesson, she has her outline and the teacher's guide at the front of the room with her. She starts with a warm-up activity, and then she has students "take their book out, and we read the short introduction, and start doing the skill." She assigns worksheets from *Math Central* for seatwork and for homework.

Although Teri talks about "following exactly what's in the book," as though lessons were scripted for her, she actually exercises more discretion than that. Unlike *Investigations*, the *Math Central* teacher's guide suggests several teaching ideas in addition to the standard lesson in the student textbook (see Appendix A), so preparation for Teri involves picking and choosing from the various suggestions. As she says, "there's no way you could do everything in here." She sometimes chooses activities from outside the book that are still related to the topic. For example, I observed Teri teach a lesson on telling time using A.M. and P.M. in which she incorporated a timeline project from her math methods course. She also reports going sometimes to the *Math Central* web site to "look for ways to teach certain skills...because you can't always just sit and do the worksheets."

Teri regularly supplements the *Math Central* materials with problem solving materials from the district and with computation materials of her own. Because she feels that the first two chapters review skills from prior grades, including time, money, and place value, she likes to "add a bit of computation" early in the year by previewing skills from upcoming chapters. Teri says that in her first year, she did not supplement or deviate from the materials as much, rather she "just basically stuck to the teacher's manual." Like Karen, Teri makes the primary curriculum materials her first priority, and then fits the supplementary materials around them. Compared to Karen, however, Teri's use of her primary curriculum materials involves much more selection from a menu of options.

Efficacy. Teri feels confident that *Math Central* works well for her students "because of the tremendous amount of supportive material that they provide." She explicitly refers to enrichment worksheets, reteaching worksheets, games, and a diagnostic page in each chapter to help analyze student errors. Assessing students' progress does not pose the same challenges for Teri as it does for Karen, probably because Teri and the *Math Central* materials place greater emphasis on skills

and answers. Teri says that if she trusts the book and covers the skills in the sequence suggested by the book, she will be successful. This confidence developed partly because of her third-grade students' success on a standardized test in her first year (*not* the state MCAS test).

Despite her praise for *Math Central* because of the many resources it provides, and despite her confidence that her students will learn if she follows the book, Teri expresses some doubts about the textbook. In particular, she questions its approach to computation. She would like to see addition and subtraction introduced earlier in the book, and she would like to see "the old fashioned kind of worksheets with just repetitive computation." Teri also says that she was frustrated during her first year by the way the book skips from one skill to another, but she now agrees with that approach, seeing it as a way for her students to develop critical thinking. It is unclear in the interviews whether or not she has really dispelled these doubts, but it is clear that she does not allow the doubts to derail her use of the textbook. For example, she supplements the textbook with computation practice sheets and she introduces multiplication through warm-up activities earlier in the semester, rather than skipping textbook chapters or teaching them out of sequence.

Ease of use. Teri appreciates the structure and resources provided by *Math Central*, but she feels overall that the materials are not "user-friendly." She feels supported by the materials "because the work is all done for you, that you don't have to be creative; you don't have to invent something new." In her second year, she finds less need for this level of support than during her first year, when she would "stick more to the book and be a little less creative." Having gone through the textbook once, she is able to depend on it less.

With the "tons of material" provided with *Math Central*, Teri thinks she has too much of a good thing. She says, "I think they've done a good job at giving you everything you could possibly need, but there is a point where they're giving you too much." Navigating her way through the "15 to 20 different books" included with *Math Central* is a real challenge. There is too much to read if she wants to make use of all the resources. Viewed this way, these curriculum materials provide support to Teri as a beginning teacher, but also demand a lot from her. She feels that it will probably take her a year or two to "really feel comfortable with this program, to know where to go when I have a question."

For Teri, then, the potential support of the materials is far greater than the realized support. She has confidence that "everything's here" in *Math Central*, yet she sometimes feels uncertain where to find what she needs:

I mean, if you can take the time to read everything outside the margins in the teacher's manual, you'll find your answers. It's just sometimes you really have to look for it.

These are the concerns that make Teri wish that her curriculum materials were more user-friendly.

Agency. According to Teri, "there is a lot less freedom in math than there is in language arts or science." Asked whether that is "a good thing or a bad thing," she says it is both. In general, she does not mind creatively supplementing her curriculum materials in order to make stronger connections to her students. For example, she says that in language arts she is "always supplementing with things from outside, things from home, my own collection of books." But in math, she says having less freedom is a good thing because "it's all done for you; you don't have to reinvent the wheel." Pressed to explain why less freedom in math might be a bad thing, Teri changes her mind:

You don't – you can't be creative. You can't – I guess it's not really a bad thing, because you know – I mean, that math methods course that I told you about, back in college, and from my graduate program, we were asked to create a box of math manipulatives, math materials, and now when I look back on it, that was just an insane assignment to give us, because when you come into a district like this, and you're given all these programs, everything's done for you; you have all these great materials. You know, why would you need to be creative and create something new? I mean, there are people making things out of egg boxes and – I mean, that just seems kind of silly to me now, when I see all the great stuff that's provided for us. So, I guess that – you know, it's a good thing.

But would she want that same level of structure in other subjects?

No. Because I think you need to be more – no. They need to have more freedom to do different things. Otherwise [they're] going to be doing the exact same thing, and it's going to be much too rigid.

It seems that Teri generally values having the freedom to be flexible and creative, but she is willing to waive that freedom to some degree in math. By adapting and supplementing her materials, Teri appears to have as much discretion over her math curriculum and instruction as she wants.

Lindsey

“I don't have a solid curriculum. I mean, we have [*Investigations*] but it so needs to be supplemented....” Compared to Karen and Teri, Lindsey deviates much more from her textbook materials. She estimates that she uses the *Investigations* materials about two-thirds of the time in the fall and half the time from January until her fourth-grade students take the state's standardized MCAS exam in the spring. When teaching an *Investigations* lesson, Lindsey generally follows the teacher's guide, but she picks and chooses what to use and how to use it. She prepares by reading the information in the teacher's guide, but unlike Karen, she sometimes reads only the objective and the examples. Also unlike Karen, she rarely takes notes in advance or refers to the book during a lesson because she feels like she has “a sense of it.” In her first year, however, she was more likely to have the book with her as a “crutch.” Sometimes she uses the *Investigations* student sheets, sometimes she creates her own, particularly when she thinks she can make a stronger connection to her students' lives. She uses the recommended manipulatives “a fair bit,” but sometimes chooses not to. She sometimes lets her lessons go off on “tangents,” if she feels that the tangents are connected to the day's objective or to something else they are doing in another subject.

Lindsey regularly supplements her primary curriculum materials with several other resources. Although her district expects her to do this, nobody tells her specifically how, so she determines mostly by herself how to fill in the gaps between her materials and the state testing objectives. For practice with algorithms she uses the old district textbook. For homework a couple of days each week she uses a math review book of her own that covers many different skills, including algorithms, time, and geometry—the pieces she feels are missing from *Investigations*. In class and for homework, she uses two different sets of commercial test preparation materials provided by the district and past MCAS questions to teach “how to take the test.” She uses the test preparation materials more as the year progresses. Unlike both Karen and Teri, Lindsey

explicitly uses supplemental materials in place of her primary curriculum materials, so much of her planning and instruction happens without using those materials.

Efficacy. Although she likes the materials themselves, Lindsey doubts that exclusively teaching with *Investigations* will prepare her fourth grade students for the state's MCAS test. She says, "So I'm trying to do what I'm supposed to be doing with the curriculum, but at the same time realizing that's not going to get them there." She describes two problems in particular. First, there are gaps between the content covered by the curriculum materials and the content tested on MCAS, including certain standards related to geometry and time. Second, she feels that it often takes too long to teach a relatively simple concept with *Investigations*.

For her students to succeed on the test, Lindsey thinks she must extensively adapt and supplement her textbook materials. Left to make these decisions mostly on her own, she questions herself and the curriculum:

I mean, I think I teach lessons really well, but, as far as math as a whole, whether I cover everything and explore everything to what I'm supposed to do in a year, I don't – So that's where my feeling of kind of feeling inadequate or not feeling like I'm doing the best job, is partly because of the curriculum.

She explicitly relates this doubt to her inexperience, asking whether "being a new teacher too, did I skip something that was valuable that I should have taught?"

It appears that Lindsey's self-doubt is related to her doubts about the curriculum. If she had a complete curriculum in place, Lindsey feels that she could better develop her own confidence in teaching math:

Then the kind of, the self-doubt that I find myself in some times. Should I be doing this? Am I, – I would rather have the curriculum and then be creative within it, and trying to make it, and making more connections to the students' lives, and spending my time making it richer, versus developing and piecemealing and not feeling confident with it.

As it is, she feels a tremendous level of responsibility as a beginning teacher, and questions whether she is providing her students with what they need to be successful.

Ease of use. Lindsey feels overwhelmed by the demands of pulling together the various curriculum materials to supplement *Investigations*. She talks about "marrying all the pieces together" and "pulling things from all over." She says,

Yes, I definitely like [*Investigations.*] Again, I can't stress enough, I wish it was all together, so I didn't have to make so many of the decisions and how to connect everything and keep revisiting things and when to introduce things and I just wish it was a little bit more together so I could feel like my decisions really enriched the program versus creating it. Did that work? Did it not work? Did I make the best choice? That kind of thing. I wish I didn't have to question that quite as much.

Nothing is in place to alleviate the curricular demands that Lindsey feels. She has the same *Investigations* materials that Karen has, but she does not rely on them for guidance in the same way.

Instead of concentrating most of her efforts on learning to teach *Investigations*, she constantly questions what she should be teaching.

Lindsey has volunteered to serve on a committee to develop a more coherent math curriculum for her district. The committee's charge is "to help gather and put it all together and see which standards we're meeting." This is one more demand on Lindsey's time, when she would rather have had the curriculum in place at the start of her first year. Asked whether the process of serving on the committee and helping to develop the curriculum might in itself be a valuable experience, she replies,

I see what you mean. It has been a learning process for me. I think it's been valuable, but I could do without it. It's so time consuming. It really is.

It is difficult to understate the value that beginning teachers place on their time. Lindsey recognizes the value of the process, but also sees the reality of the demands she faces.

Agency. Lindsey feels that the state standards and the fourth grade testing requirements limit her ability to teach the way she would like to:

...what we have to teach and what's assessed, it's just the time, and being able to really do it the way you'd like to do it. In fourth grade you really have to teach the students how to take the test. The vocabulary piece is big. ... I would love the math to be a little bit more exciting and – I try to make it exciting for the students, but as far as just the amount that we're expected, and, like I said, with the curriculum not together, I don't feel that's where I want it to be.

Given the choice, Lindsey would follow *Investigations* more closely. She likes its approach, which she describes as being hands-on and multi-sensory, allowing multiple approaches and involving lots of problem-solving strategies. She thinks it works well for her students and she feels competent using it. As far as she can tell, that is not an option for her. Instead, she found herself "shoving it down their throats versus really teaching it, letting them explore."

Regardless of whether she uses *Investigations* or not, Lindsey feels that a more complete curriculum would allow her to make better choices about where she devotes her time and energy. Like Karen and Teri, Lindsey does not feel that she would abdicate her professional discretion if she were to follow an established curriculum:

You have a curriculum for a reason and you should be following it. It doesn't mean that you can't make it better by, you know, enriching it. That's where I'd rather spend, I'd like to spend my time.

If she were only responsible for teaching the curriculum well, perhaps Lindsey would feel that she has greater control over her own teaching. Instead, she feels overwhelmed by the responsibility of determining the curriculum itself.

Melissa

"I feel like this year, I know what I should be teaching based on the curriculum rather than just based on following this generic math book." Melissa, who teaches fifth grade, reports that her preferred approach to curriculum is to address state standards by picking and choosing content and

lessons from *Math Central*. The reality has been, however, that she has mostly followed the sequence of the textbook. In her first year, she started with chapter four, went back to the start, and skipped some lessons along the way. However, this was based on what she thought would be useful, not on the state standards. In her second year, she started with chapter one and has progressed chapter to chapter, again skipping over some lessons, but not really working off of the state standards documents. In planning for most lessons, she looks through the student pages in the teacher's guide and "think[s] about what makes sense to me." She says that she generally ignores "this whole bottom part of the teacher's guide [which] kind of tells what you should do," i.e. the teacher's notes. During the lesson, Melissa will sometimes use the example from the book, but she does not have the students open their books until they are ready to do practice problems. She usually uses the practice worksheets, and sometimes uses re-teaching and enrichment pages.

Melissa tries to incorporate more hands-on activities into the *Math Central* lessons when she wants a break from drill and practice, when a particular concept seems to lend itself to a more interesting approach with real-world applicability, and "when the motivation strikes" her. She does not regularly supplement her primary curriculum materials in the same way as the other three beginning teachers. When she does supplement, the ideas usually come from other teachers and from her own experience, but she sometimes draws from her own books about mathematics.

Efficacy. Melissa does not like the *Math Central* approach to teaching and feels that the content is poorly aligned with the state learning standards. In her opinion, the book is "traditional" and emphasizes procedures rather than concepts. She echoes Teri's first-year concern that the organization is unclear, saying, "I feel like it jumps around... I don't necessarily know or I don't agree with the overriding logic behind it." In contrast to Teri, who has begun to accept the jumpy nature of the textbook, Melissa still disagrees with it in her second year. Melissa wishes she could make her math lessons "more conceptual and more fun" for her students, but she is not sure how. She thinks that the curriculum materials do not support her in her two primary goals, to "connect it to real things" and to do more hands-on activities. Melissa also feels that her students are learning procedures, but not concepts.

Because Melissa has such little confidence in *Math Central*, she dismisses even trying to "use it just as it's laid out." But she does continue to follow the sequence of the book and, often, to use the student materials. She explains, "You assume that some of this was created with some sort of research so there's perhaps some grounding to it, but..." The primary explanation she gives, however, is that "I haven't figured out a different way that I would do it without it; so, I'm not ready to drop it."

Ease of use. Despite her distaste for *Math Central*, Melissa relies on it because "it's a resource and as teachers, we need resources." She acknowledges that

as a new teacher, too, that's a survival thing. I can't – I'm figuring out everything. I can't – if I had to spend another few hours a week planning out math, I just couldn't do it.

With a textbook, she can "just quickly kind of turn to something and do it... [whereas in other subjects] I really need to develop a lot more on my own or search around." While she dismisses some of the resources as "pretty obvious" or "wacky," Melissa does identify certain parts of the materials that might be useful if she were to use them; these include the math center, math journal ideas, and some math problems.

The curriculum materials bring their own demands, however. The basic student pages and worksheets are easy to use, but Melissa thinks that *Math Central* has “so much stuff in it,” it can be overwhelming. She says, “And when I look at it, I find sometimes I just don’t bother to look because there is so much stuff sometimes.” Like Teri, Melissa describes more potential support than she does actual support.

Agency. One of the most rewarding things about teaching for Melissa is “that I’m in charge of my day and that ... we’re given a lot of freedom to do things.” In deciding what to teach and how to teach it in math, Melissa is clearly in charge of her day, but finds that she is not able to teach the way she envisioned. She appears to be quite willing now to follow the guidance of curriculum materials, but finds that the only available curriculum materials are undesirable and challenging to use.

Summary

Together, these four teachers describe a range of support that they experience from their curriculum materials (see Table 2). Karen is very positive about her textbook materials, which are the primary determinants of her mathematics curriculum. She agrees with their approach and feels that they enhance her teaching and make her work easier. Teri appreciates her textbook materials, which also are the primary determinants of her mathematics curriculum. She feels that they support her work, but she thinks they could be more user-friendly. Lindsey is very frustrated with her mathematics curriculum. She generally likes her textbook materials, but does not feel very supported by them because of a perceived need to supplement them extensively. Melissa feels that her textbook supports her very little in teaching the way that she would like to teach; yet she relies on them in order to survive the demands of teaching.

Individual and contextual factors

As explained earlier, past research has identified various individual and contextual factors that influence *experienced* teachers’ use of curriculum materials. The dominant individual-level influences for the *beginning* teachers in this study are beliefs about mathematics and mathematics instruction, and particularly how those beliefs do or do not match the available curriculum materials. The most prominent contextual factors are institutional norms and expectations regarding the use of curriculum materials.

Individual factors: Teachers’ beliefs

These beginning teachers have ideas about what mathematics is, how children learn mathematics, and what instructional strategies are most appropriate for teaching mathematics. They are more likely to use the available materials and to find them to be supportive if their approach is consistent with their own beliefs – if there is a good match. To some degree, these beliefs may be shaped by the teachers’ experiences in their schools and districts, or with the curriculum materials themselves, but for the most part, the teachers appear to bring their beliefs with them.

Table 2: Use of curriculum materials and their perceived supportiveness

	Use	Efficacy	Ease of use	Agency
Karen Fifth Grade <i>Investigations</i>	...follows the textbook very closely, but also supplements it.	...feels confident that her students are learning and that her teaching is improving.	...thinks her materials are user-friendly and alleviate many of the demands of planning, but also require much effort to use them well.	...teaches like she wants to and does not feel constrained.
Teri Third grade <i>Math Central</i>	...follows the textbook sequence, but picks and chooses from the materials. She also supplements.	...feels confident that her students are learning and her teaching is improving.	...appreciates the many resources, but finds that they are not user-friendly.	...teaches like she wants to and does not feel constrained.
Lindsey Fourth grade <i>Investigations</i>	...follows the textbook more than half of time, but adapts and supplements it extensively.	...doubts that the textbook will prepare her students for state tests.	...thinks that the textbook is easy to use, but that developing her own curriculum is overwhelming.	...feels constrained by state testing demands.
Melissa Fifth grade <i>Math Central</i>	...reluctantly follows the textbook, deviating when possible.	...doubts that the textbook supports conceptual understanding.	...thinks the materials help with survival, but not in teaching how she would like.	...feels constrained by the approach of the materials.

Karen and Melissa express similar beliefs about the importance of “conceptual knowledge,” as opposed to “procedural knowledge.”² It is not enough for students to know the procedures that lead to a correct answer; they also need to understand the mathematical concepts and ideas involved. Both teachers emphasize the importance of their fifth graders’ developing conceptual understanding through hands-on activities. Melissa also emphasizes the importance of connecting mathematics to students’ experiences. These beliefs are relatively new for both teachers, marking a significant departure from how they learned mathematics. They attribute this transformed way of thinking about mathematics to their pre-service teaching methods courses.

Karen found her new beliefs about math instruction embodied in her textbook materials. By closely following *Investigations*, she feels that she regularly facilitates hands-on activities that help her students to develop conceptual understanding. The *Investigations* materials not only align with, but also reinforce, her new belief that “math is about how you get there” more than it is about “making sure your answer checks.” She explains the development of that idea:

I think it really started in the methods class, and it was totally overwhelming. It was a summer course, and I just thought, “This is so big,” and it all seemed so new. But that’s definitely where it started. And then it was fed last year in little bits and pieces, but really from teaching this year, has grown a lot.

Karen’s curriculum materials support her by helping her to put her new beliefs into practice.

While Karen found a very good match between her beliefs and her curriculum materials, Melissa did not. As described earlier, she explicitly identifies the disconnect, saying that she does not “agree with the overriding logic behind” *Math Central* and uses the materials reluctantly. She complains that “the kids just memorize so that they can do it, which is a very shallow learning.” Left to implement her new beliefs on her own, she doubts it can be done at all: “But then again, when you get to, I mean, multiplying three digit numbers by two digit numbers, there is not necessarily a whole lot that I can do with that, you know? I think maybe the conceptual has to start in the lower grades for that multiplication thing.” And again: “So, I try to connect it to real things. I kind of try to get them to understand why we’re learning it. Not all things you can do that with fifth grade math.” Melissa’s textbook materials do not reinforce the new beliefs in the way that Karen’s do. But Melissa does not know of any alternative materials that would support her in teaching math the way she wants to teach it. In describing the materials that she has repeatedly criticized, she says, “They’re all right. I mean, I’m not sure how they could do a better job.” She seems to doubt that any materials could match her beliefs about math instruction. This lack of alignment with her beliefs makes the materials less supportive than they could be.

Teri offers another interesting contrast. She follows *Math Central* much more closely than Melissa does and she describes feeling better supported. This is partly because the materials more closely align with Teri’s beliefs about math than with Melissa’s. While Teri would not disagree that students should understand math concepts, she talks mainly about mathematics as skills that

² Van de Walle (1994) defines the two terms: “*Conceptual knowledge* consists of relationships constructed internally and connected to already existing ideas. ... *Procedural knowledge* of mathematics is knowledge of the symbolism that is used to represent mathematics and of the rules and the procedures that one uses in carrying out routine mathematical tasks” (p. 22). This is the textbook used in both Karen’s and Melissa’s mathematics methods classes in their pre-service programs. I have no evidence that they either did or did not actually read sections of the book.

students learn through repetition.³ Although *Math Central* includes a variety of supplemental activities, the primary activity involves the teacher modeling a skill and the students practicing it. Teri did not have a conversion experience in her math methods class like Karen and Melissa did. Teri explains her beliefs about math and her appreciation for the textbook:

I think it's one of the easier subjects to teach, because it's very concrete. There is a skill that needs to be taught. There is a certain way to demonstrate whether or not the kids have mastered it. They either understand or they don't understand, and our text actually gives really good examples of if a child is making a mistake in this area, this is what you need to do. If a child doesn't understand this skill, they provide reteaching worksheets.

Teri would find the *Math Central* materials to be even more supportive if they included "the old-fashioned kind of worksheets with just repetitive computation." As they are, Teri's materials still support her in aligning her teaching practice with her beliefs.

Lindsey faces a situation similar to Melissa's, where she feels that she is not supported in teaching the way she would like. Although she agrees with the approach of *Investigations*, the context in which she teaches precludes her from using those resources as much as she would like. The next section of the paper examines these contextual factors.

It is important to consider that the curriculum materials might themselves influence teachers' beliefs over time. The authors of *Investigations* intend the materials to do just that (Russell, 1997). For example, Karen describes how her use of the materials reinforces her belief that understanding is more important than the right answer. It is beyond the scope of this study, however, to examine what teachers learn from their curriculum materials and how those materials may or may not influence their beliefs.

Contextual factors: Norms and expectations

In addition to their own assessments of the quality and appropriateness of the available mathematics curriculum materials, these beginning teachers attend to school and district signals about curricular norms and expectations. Is it okay to follow the textbook closely? Is it okay to adapt and supplement it? The norms and expectations communicate the degree to which the schools and districts endorse the use of the curriculum materials. The respondents report examples of district personnel, principals, and colleagues explicitly communicating these messages through face-to-face meetings and through curriculum documents. The data suggests that the messages are also communicated implicitly through professional development opportunities and responses to testing requirements.

Lindsey and Melissa provide examples of how the perceived district norms and expectations can prevent beginning teachers from seeking support from their curriculum materials. Both of these teachers believe that their principals and curriculum coordinators expect them to adapt and supplement the textbook materials regularly, using them as resources for teaching the state standards rather than relying on them to determine the curriculum. Both teachers hear the message that the textbooks are insufficient. This discourages them from working in the structure provided by the curriculum materials and modifying their instruction within that structure. Lindsey

³ In the interviews, Teri mentions math skills or facts 45 times, compared to 10 times for Lindsey, four times for Karen, and none at all for Melissa.

finds this to be overwhelming and would prefer to have the curriculum laid out more clearly for her during her novice years.

In contrast, Karen and Teri understand from their curriculum coordinators and principals that they are expected to use their textbook materials regularly. The materials themselves constitute the *de facto* mathematics curriculum. There is also an expectation that they supplement the materials, but in clearly defined ways and in a limited fashion. Their efforts to supplement are bounded by scope (math facts and problem solving) and time (a few minutes each day in addition to the regular lessons). Both spend class time on computation and problem solving, but outside of their regular lessons and using clearly defined resources provided by the district. Karen adds test preparation, but only during the three weeks prior to the tests. Beyond this, they feel they are permitted to follow their textbooks, supplementing and adapting them as they see fit.

In addition to the explicit communication of these norms and expectations by principals and district curriculum coordinators, beginning teachers' opportunities for professional development may convey the message that the district and school do or do not endorse the use of the curriculum materials. Only Karen had professional development that was specific to her curriculum materials. During her first-year, she attended unit-by-unit training sessions for *Investigations*, which she describes as "incredibly helpful." The sessions were open to new teachers and to teachers who were teaching the curriculum at a new grade. They addressed the specific fifth-grade units the teachers were expected to teach, just before they were expected to start them. The facilitator, an experienced teacher, would provide an overview of the unit and its goals, then lead the small group of four teachers through some of the student activities, allowing time to discuss both content and teaching strategies. Prior to her first year, Karen also attended three days of overview training about *Investigations*, sponsored by the district. This training probably contributed to Karen's capacity to use the curriculum materials confidently and effectively, and probably helped with her math confidence in general. Such professional development also represents a commitment by the district to these particular curriculum materials, signaling that it is acceptable, or even required, to use them.

In contrast, Lindsey and Melissa have had little or no professional development related to their mathematics curriculum materials. Lindsey thinks that her district may have offered an introductory course for *Investigations*, but she chose not to participate because of the demands of teaching and her concurrent enrollment in graduate education courses. Subsequent professional time in her district has addressed particular MCAS concerns, not *Investigations*. Melissa attended an optional mathematics session before her first year at which she and other teachers matched the state standards to sections of the math textbook, but she received no guidance about how to use the textbook resources themselves. By placing a low priority on learning to use the textbook materials, these districts and schools may be communicating the message that it is not important, or even appropriate, to use these resources regularly.

The norms and expectations are tied closely to the school and district approach to standardized testing and state standards. The rationale behind the standards movement is to identify the important content and skills that students should master, then to be sure that all students are being taught them. Lindsey and Melissa's districts are, in broad strokes at least, approaching state standards and assessment as state officials recommend: Start with the standards, then select appropriate curriculum materials to address them. One might say that Lindsey and Melissa are starting out the right way, learning to use their curriculum materials as supports rather than as scripts. The ongoing process is just beginning, however, which results in uncertainty and confusion for Lindsey and Melissa. Whether the textbooks align as closely to state standards as

they think they do or not, Karen and Teri are able to concentrate on learning to teach well before they are being forced to assess whether they are teaching the right thing. Of course, it is important to learn both – what to teach and how to teach it well. However, it seems as though the realities of the first years, in certain districts, force these teachers to do one or the other. Karen and Teri devote their energy to learning to teach well. Lindsey and Melissa spend their energy deciding what to teach.

Lindsey's fourth grade students take the MCAS math test in the spring, so she feels that she is expected to cover all concepts and skills that will be addressed on the test and to give the students ample opportunities to practice test-taking skills. Lindsey participates on a district task force that is trying to align the curriculum to the state standards.

In Lindsey's case, standardized testing has a powerful influence over the use of curriculum materials. Since she teaches fourth grade, she is the only one of these teachers whose students take the MCAS, the high-stakes accountability test in Massachusetts. More immediate pressure comes from the media attention given to each school's aggregate test scores; everyone in the state will know how the fourth graders in Lindsey's school fare on the MCAS math test. Those scores represent the efforts of teachers in all the grades leading up to the testing year, but the pressure is concentrated on the fourth grade teachers. Lindsey says, "I think in the district, no one wants this grade." For Lindsey, much of the pressure is self-imposed:

It's just a reality. It's there, and I think part of it is being new and wanting to be successful. The scores are an indicator whether you're, whether the fourth grade is meeting the expectations. I mean, some of it is personal, and like I said, I don't get too wrapped up, but I really want the students to be prepared.

The school sends powerful signals as well; much of the discourse in the school is around the MCAS. There is a concentrated effort in the school to identify the math vocabulary students need to be successful on the test, and to distribute responsibility for teaching that vocabulary among the various grades. At meetings, they analyze test scores to identify areas of strength and weakness. The district provides Lindsey with two different sets of commercial test preparation materials, in addition to past MCAS questions to use as practice.

Lindsey thus feels great pressure to look beyond the *Investigations* materials to be sure she covers everything on the MCAS:

When our curriculum doesn't cover a number of things, you know, I don't want to set them up for failure. It's going on the test, so if they've never seen it before, then it's not really fair that they're assessed on it. I do a lot of studying with the previous questions and trying to get every, you know, that we touch and that we explore the different areas.

As described earlier, Lindsey is left to do much of this work on her own. She would much rather have a complete curriculum in place so that she can adapt and be creative within that structure. Magdalene Lampert (2001), in an extensive analysis of several years of her own teaching of fifth-grade mathematics, points out the challenge of identifying the mathematical content addressed through a problem-based curriculum. She says, "With several years' experience as a fifth-grade teacher, I had a firmly fixed mental checklist of all the topics in the curriculum, and I was able to structure lessons to bring them into students' work" (p. 213). Compare this with Lindsey, who,

with barely one year of experience, finds herself deciding whether an *Investigations* unit will adequately cover an MCAS objective without the experience of having taught the unit or having really learned the subtlety and complexity of the content.

Melissa's experience is similar to Lindsey's, with expectations that she select the appropriate lessons and materials to teach the standards. A major difference, however, is that Melissa does not feel the same pressure regarding testing, perhaps primarily because she teaches fifth grade rather than fourth.

Karen and Teri have very different experiences altogether. The standardized tests their students take do not generate the same level of public pressure that the MCAS does. As described above, the expectations regarding preparing for those tests are bounded in scope and duration. In short, testing and standards do not prevent them from concentrating on effectively using their curriculum materials.

Summary

Table 3 represents the interaction between individual beliefs and contextual influences. The horizontal axis indicates the degree to which the beginning teachers' beliefs align with the instructional approach of their math curriculum materials. The vertical axis displays the degree to which the schools and districts endorse the curriculum materials as communicated through norms and expectations about their use. From the beginning teacher's perspective, the ideal situation would be to have curriculum materials that align with individual beliefs and that are endorsed by the school and district, as represented by Karen and Teri in the upper left quadrant of Table 3. Both of these teachers appear to feel supported by their curriculum materials and generally satisfied with their overall experiences with the mathematics curriculum.

Table 3: Interaction between individual and contextual influences

		<u>Match between teacher's beliefs and her curriculum materials</u>	
		More	Less
<u>School and district signals regarding the curriculum materials</u>	Stronger endorsement	Karen (<i>Investigations</i>) Teri (<i>Math Central</i>)	
	Weaker endorsement	Lindsey (<i>Investigations</i>)	Melissa (<i>Math Central</i>)

In contrast, neither Lindsey's nor Melissa's district and school encourage regular use of the available textbook materials. Whatever endorsement they do offer is undercut by an emphasis on supplementing the materials. Even though Lindsey likes the approach of *Investigations*, she and Melissa appear to feel much less supported by their curriculum materials and generally less satisfied with their overall experiences with the mathematics curriculum. Melissa finds herself following *Math Central* by necessity, even though she disagrees with its approach and is encouraged by her district to teach according to state standards instead.

This analysis is not meant to criticize any of these district approaches to testing and standards. It is meant, however, to showcase the experiences of beginning teachers. If beginning teachers are to feel supported by their curriculum materials, perhaps the school and district must authorize them to use those materials, at least at the start of their careers. If not, then it is incumbent upon the schools and districts to offer alternative forms of support. For Lindsey and Melissa, collaboration with their fellow teachers in the process of aligning the curriculum was inadequate support.

DISCUSSION

This study of the use of curriculum materials reveals that mathematics textbook materials are central to how these four beginning elementary school teachers approach their lesson planning and instruction. The teachers vary in how they use the textbook materials – one follows them closely on a daily basis; one follows them daily but picks and chooses from available activities; one follows them often, but frequently modifies the activities or uses different materials altogether; and one follows the textbook content sequence regularly while following the activities loosely – but they all rely on them to some extent.

The beginning teachers also vary in how supportive they find their textbook materials to be. Supportiveness is reflected in the degree to which the materials help the beginning teachers to teach effectively, the degree to which the materials alleviate the demands of planning and teaching, and the degree to which the beginning teachers feel that the materials help them to actively choose how they teach.

These findings cast curriculum materials in a new light, at least so far as beginning teachers are concerned. Much of the prior research on the use of curriculum materials focuses on the textbook as either a strong or a limited determinant of teachers' curricular decisions. Considerable research since the late 1970s suggests that teachers function as "policy brokers," each deciding for herself what parts of the adopted textbook to use and what parts to ignore (Schwille et al., 1983). Sosniak and Stodolsky (1993), in their detailed study of four experienced elementary teachers, observed textbook use within the broader context of the classroom and determined that the teachers "apparently viewed textbook materials as props in the service of managing larger agendas rather than as driving forces" (p.271). The findings from this study of four beginning teachers seem consistent with those researchers' findings, in that none of these teachers blindly followed her textbook. But there also appears to be a special role of curriculum materials for beginning teachers. The bigger issue for these novices appears to be the support provided, or not provided, by the materials. The daily challenge of managing a classroom and the nightly challenge of planning lessons for several subjects make the structured lessons of the math textbook appealing.

This makes sense when one considers the career development of teachers. According to Huberman (1992), a teacher's early years are typically marked by the "survival and discovery" phase. During this time, teachers actively seek support from various sources, including curriculum materials. When teachers enter the subsequent "stabilization" phase, typically after three or four years, it is likely that

One has worked up a rudimentary instructional repertoire that fits most situations encountered in the initial three to four years of teaching, and one is now adding to

it, refining it, moulding it to fit one's own, more congenial style of instruction (Huberman, 1992, p.124).

It is important to assess the consequences of pushing a beginning teacher prematurely into this stage of refinement and experimentation. Of course, one could also argue that the beginning years are the best time to allow a beginning teacher to be creative, before they are fixed in their ways and less susceptible to change and improvement. The experiences of these four beginning teachers, however, belie that interpretation. Of course, these teachers would have to be followed into their subsequent years to truly assess the impact of these beginning experiences.

In this study, I also found that school- and district-level norms and expectations, in combination with individuals' beliefs, influence how beginning teachers use their curriculum materials and the extent to which they find those materials to be supportive. These norms and expectations, as communicated by principals, curriculum coordinators, colleagues, professional development opportunities, and district documents, can strengthen or weaken beginning teachers' willingness to turn to their curriculum materials for support. Karen strongly feels that at her school and in her district, her top priority is to learn to teach by using the mathematics textbook materials. Lindsey, in contrast, perceives that the same materials are considered insufficient in her district and that she is to supplement them considerably. Although both beginning teachers view the curriculum materials favorably, Karen finds them to be much more supportive than does Lindsey.

These findings about the institutional influence on the degree to which beginning teachers focus on available curriculum materials are consistent with a recent analysis of first-year secondary language arts teachers' experiences (Grossman et al., 2001). Grossman and her colleagues suggest that

...district structures, intentional or otherwise, can either support or deflect opportunities for continued learning within a subject matter, while the strength of the lenses provided by curriculum policies, in particular, helps determine the depth and breadth of what teachers learn about teaching language arts (p. 19).

The emphasis of the district influences how new teachers view teaching, and may thus affect their initial and continued learning. If encouraged to focus on the particulars of teaching, they may have greater opportunities to learn more deeply.

Upon what are the four beginning teachers in this study focused? What is the quality of their learning opportunities? One might argue that Lindsey and Melissa are learning an important lesson – that curriculum materials themselves are limited and the role of the teacher is to strategically use those materials in conjunction with other materials to reach the desired learning outcomes. On the contrary, one might argue that the school and district emphasis on piecing together a curriculum is teaching these beginning teachers that coverage is more important than craft and that the work of a teacher is to choose appropriate content and instructional strategies, not to master their complexity. Karen and Teri may be learning to depend on the textbook, perhaps putting them at risk of being perpetually textbook-bound and “de-skilled” (McNeil, 1986). Conversely, they may be learning the curriculum well and beginning the process of fine-tuning their instructional strategies, establishing a foundation from which they can gradually adapt their lessons more and more to their particular students' needs. Based on their own words, it appears that these four teachers would prefer to have greater guidance in their novice years, in expectation that they will need less guidance as they gain more experience.

This leaves open the question of the type of curriculum materials that would best serve beginning teachers during their early years. Both *Investigations* and *Math Central* alleviate some of the demands of planning and teaching, while also making their own demands on teachers. Recent theory and research addresses the potential of the *Investigations* curriculum to educate teachers as they teach it, but this work does not specifically address new teachers (Collopy, 2000; Remillard, 2000; Russell, 1997). Do reform curricula like *Investigations* provide better learning opportunities for beginning teachers than do the traditional materials, such as *Math Central*? This study was not designed to adequately answer that question, but the teachers' responses to questions about their learning hint at what further research might find. Karen and Lindsey more enthusiastically report learning from *Investigations*, while Melissa says that she learns nothing from *Math Central*. Teri seems somewhat puzzled by the question about whether she is learning from *Math Central*, conveying the more traditional notion of a textbook as a guide for what should be taught, rather than as a tool for teacher and student learning. Clearly, further research is needed about whether, what, and under what conditions new teachers learn from different types of curriculum materials—in math and in other subjects.

Overall, this analysis suggests that districts and schools should pay careful attention to beginning teachers' experiences with curriculum materials. Does the district and school recruit and hire new teachers whose beliefs are compatible with available curriculum materials? Are there sufficient professional development opportunities and collegial support so that the beginning teachers can learn to use available materials effectively? Do colleagues and supervisors either endorse the use of those materials or provide intensive, on-going support in alternative approaches to the curriculum? One way or another, beginning teachers should be able to find the curriculum support that they are seeking.

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APPENDIX A: Features of TERC *Investigations* and Houghton Mifflin *Math Central*

TERC's *Investigations in Number, Data, and Space*

Source: Russell, S. J., Tierney, C., Mokros, J., Goodrow, A., & Murray, M. (1997). *Implementing the Investigations in Number, Data, and Space curriculum: Grades 3-5*. Palo Alto: Dale Seymour Publications.

1. Supports NCTM reforms
 - Supports flexible groupings of students
 - Values reasoning more than the right answer
 - Promotes various modes of communication about math
 - Emphasizes depth with a small number of problems, rather than rapid completion of many problems
 - Encourages students to use multiple strategies
 - Centers lessons around the use manipulative materials
2. Contains resources for lesson planning
 - Lesson plans
 - Materials lists
 - Reproducible student sheets
 - Family letters
 - Homework suggestions
 - Assessment activities
3. Includes “helpful information about what [teachers] are teaching and the ways students are learning” (p. 4)
 - Notes “about the mathematics content and how students learn it” (p. 13) – About the Mathematics in This Unit, Teacher Notes
 - Sample classroom dialogues that “demonstrate how students typically express their mathematical ideas, what issues and confusions arise in their thinking, and how some teachers have guided particular class discussions” (p. 14) – Dialogue Boxes
 - Guidelines, questions, and prompts for classroom discussions
 - Explicitly describes correlation to NCTM standards
4. Allows adaptation and decision-making by teachers
 - Suggests a “standard sequence” of units, but allows for adaptation; suggests principles to use in making these decisions; units designated with a grade range (p. 17)
 - “Investigations” within each unit are “designed for use as a cohesive block rather than as isolated projects,” but “extensions and excursions” allow tailoring (pp. 5-6)
 - Activities allow adjustment by changing numbers, repeating activities, and rearranging student groups
 - “Modular structure” allows use as “replacement units” (p. 17)

Houghton Mifflin's *Math Central*

Source: Houghton Mifflin. (1997). *Math central* (promotional booklet). Boston: Author.

1. Teaches mathematical concepts and skills to students
 - “The Here’s A Way box shows students in words and images how to approach a problem in an orderly way” (p. 9)
 - Shows how to use manipulatives to demonstrate concepts
 - Includes suggestions for extra support, alternate approaches, and Students Acquiring English
 - Includes ample opportunity to practice skills
 - Incorporates NCTM teaching standards—includes problems related to patterns, number sense, calculator use, critical thinking, creating your own problems; includes opportunities to talk and write about mathematics; each chapter contains a math investigation activity
 - Website offers additional resources for students

2. Provides guidance to teachers
 - Consistent three-step lesson plan: Introduce, Develop, Summarize
 - Includes key points to emphasize, questions to ask, possible correct and incorrect student responses, common student errors and suggested teacher’s responses
 - The Teacher’s Activity Bank (TAB), which includes a section on preparing for tests, math center activities, and cross-curricular connections
 - Reteaching, practice, and enrichment workbook pages
 - Offers assessment support: assessments book; performance assessments with rubrics; standardized testing; practice and assessment skillpad; test, practice, management program

3. Promotion materials include short essays about math by the authors

APPENDIX B: Questionnaire, Section II

Please circle the phrase that best expresses what you think about each statement:⁴

1. Doing math allows room for original thinking and creativity.
Strongly Agree Agree Not sure Disagree Strongly disagree
2. Doing math is usually a matter of working logically in a step-by-step fashion.
Strongly Agree Agree Not sure Disagree Strongly disagree
3. A lot of things in math must simply be accepted as true and remembered; there aren't explanations for them.
Strongly Agree Agree Not sure Disagree Strongly disagree
4. To be good at mathematics, you need to remember formulas, principles, and procedures.
Strongly Agree Agree Not sure Disagree Strongly disagree
5. To be good at mathematics, you need to think in a logical step-by-step manner.
Strongly Agree Agree Not sure Disagree Strongly disagree
6. To be good at mathematics, you need to have basic understandings of concepts and strategies.
Strongly Agree Agree Not sure Disagree Strongly disagree
7. To be good at mathematics, you need to be able to think flexibly.
Strongly Agree Agree Not sure Disagree Strongly disagree
8. When students can't solve problems, it's usually because they can't remember the right formula or rule.
Strongly Agree Agree Not sure Disagree Strongly disagree
9. If students get into arguments about ideas or procedures in math class, it can impede their learning of math.
Strongly Agree Agree Not sure Disagree Strongly disagree
10. It is important for pupils to master the basic computational skills before studying topics like probability and logic.
Strongly Agree Agree Not sure Disagree Strongly disagree
11. The most important issue is not whether the answer to any math problem is correct, but whether students can explain their answers.
Strongly Agree Agree Not sure Disagree Strongly disagree
12. To do well, students must learn facts, principles, and formulas in mathematics.
Strongly Agree Agree Not sure Disagree Strongly disagree

⁴ All statements in this section were taken verbatim from (Kennedy et al., 1993).

APPENDIX C: First interview protocol

Topics to address

- I. Personal characteristics: What they bring
 - A. Teacher preparation received prior to beginning to teach
 - B. Attitude toward and experiences with math (elementary, secondary, higher education, professional)
 - C. Beliefs about math and math instruction

- II. Institutional Context: What they encounter
 - A. Description (from their own perspective) of the math curriculum and curriculum materials, including state curriculum frameworks, district curriculum documents, school guidelines, test (e.g., MCAS) information and preparation materials
 - B. Formal and informal support available for teaching mathematics
 - C. Norms and expectations regarding the use of curriculum materials
 - D. Professional development, training, and induction related to math in general and the curriculum materials in particular

- III. Description of how they use curriculum materials: What they do with it
 - A. Whether and how they use the math curriculum materials. What influences decisions about what to follow, ignore, adapt, supplement? To which features of the curriculum materials do they attend?
 - B. Whether and how state standards and assessments influence their use of curriculum materials.

1. Before I get into the specific questions, I would like to get a general sense of your experience. How's it going?

[I want to get a sense of positive and negative. If necessary to get both, probe:

- ***What has been most rewarding so far?***
- ***What has been most challenging so far?***

[This is a “grand tour” question to determine what is foremost on their minds. I would want to listen especially for references to curriculum, pedagogy, support, and teacher learning.]

2. Can you describe the type of support, if any, you've received as a new teacher, either within the school or the district?

- **Is the support you received what you needed?**

[What they encounter: Formal and informal support available

I think it's important to know how the curriculum materials fit into the new teachers' broader experiences of support and decision-making. Are they teaching in a vacuum or receiving some help? If necessary, I could make this less open-ended by cutting it here and then asking it more explicitly later.]

3. The remainder of this interview focuses specifically on mathematics. First, I'd like to get a sense of how you feel about math in general. Can you talk about your experiences with math in school and college?

- **In general, do you like math? Why or why not?**
- **Are there some things you especially like or dislike about math?**

[What they bring: Attitude toward and experiences with math]

4. How do you feel about *teaching* math? [Prompt if necessary with:

- **Do you like teaching math? Why or why not?**
- **Do you feel comfortable with the material you're expected to teach? Why or why not?**
- **Compared to other subjects, is teaching math easy or difficult? Why?]**

[What they bring: Attitudes and experiences with math]

5. Are there certain topics in math you feel more comfortable teaching than others? Which ones? Why? Are there certain topics you feel less comfortable teaching than others? Which ones? Why?

[What they bring: Attitudes and experiences with math]

6. In math, how do you decide what and how to teach?

- **Where [else] do you go for information or advice about what and how to teach in math?**

[What they do with it: Whether and how they use the math curriculum materials – do they follow, ignore, adapt, supplement?

What they encounter: Formal and informal support available]

7. Do you have a math curriculum that you are expected to follow?

YES: **What kinds of things does it specify?** (general goals, specific topics, specific lessons, sequence, how to use time?)

Does anyone check to see that you're following the curriculum?

NO: **Does anyone monitor what you're teaching?**

[What they encounter: Description (from their own perspective) of the math curriculum and curriculum materials (including physical resources) at the school

What they encounter: Norms and expectations regarding the use of curriculum materials

8. Which of the following curriculum materials do you have available to you? [For each one they have, ask **Do you use it? Why or why not? What do you use it for?]**

- **A math textbook?**
- **Other math books?**
- **Math worksheets and materials from other teachers?**
- **The Massachusetts Math Curriculum Framework?**
- **MCAS questions?**
- **A district math curriculum guide?**
- **Internet sites about math?**
- **Any others?**

[What they encounter: Description (from their own perspective) of their math curriculum and curriculum materials (particularly books and documents)

What they do with it: Whether and how they use the math curriculum materials – do they follow, ignore, adapt, supplement?

What they do with it: How they make decisions about whether/how to use.]

9. Do you talk to other teachers about what to teach in math and how to teach it?

- **How often?**
- **Is this useful?**

[What they encounter: Formal and informal support available]

10. I'm particularly interested in your math textbook. Please tell me about it. [Skip any of following probes that the respondent answers in the open-ended response.]

- **In your view, is it a good book? Why?**
- **Do you use it? How often?**
- **Do you like using it?**
- **Do you agree with its approach to teaching math? Why or why not? What is the book's approach to teaching math?**
- **Does the book work well for your students?**
- **Are there parts of the book you find particularly helpful?**
- **Are there parts of the book you don't use? Why don't you?**
- **Is there anything else you would like to say about the book?**

[What they encounter: Description (from their own perspective) of their math curriculum and curriculum materials (particularly books and documents)]

11. Did you receive any training or guidance about how to use this math book?

YES: **Can you describe it?** [Prompt if necessary with:

- **What did it cover?**
- **What was the format?**
- **How long did it last?**
- **Who provided it?**
- **Was it useful?]**

NO: **Would you like some training or guidance about how to use the math book?**

[What they encounter: Professional development, training, and induction related to math;

What they encounter: Formal and informal support available]

12. Since being hired, have you had any professional development or training in math?

YES: **Can you describe it?** [Prompt if necessary with:

- **What did it cover?**
- **Was it useful?]**

NO: **Would you like professional development or training in math?**

[What they encounter: Professional development, training, and induction related to math in general and the curriculum materials in particular]

13. Please step me through a typical math lesson—before, during, and after.

- **How do you prepare for a lesson?** [Prompt for use of curriculum materials.]

- **What guides you and your students during a lesson?** [Prompt for use of curriculum materials, especially the book or worksheets.]
- **What do you do after a lesson? Do your curriculum materials help you at this stage?**

[What they do with it: Whether and how they use the math curriculum materials – do they follow, ignore, adapt, supplement?]

14. [If the respondent uses the textbook:] When you use the textbook, how closely do you follow it? Why?

If they modify: **How do you decide what to skip or modify?**

[What they do with it: Whether and how they use the math curriculum materials – do they follow, ignore, adapt, supplement?]

15. Do you find that you need to supplement your math book? Why?

If they supplement: **How do you decide what to add?**

[What they do with it: Whether and how they use the math curriculum materials – do they follow, ignore, adapt, supplement?]

16. Are there any tests about math that you are required to give to your students? [Prompt for MCAS or Stanford-9 if necessary.]

- **How closely are they aligned with your textbook?**
- **Do the tests affect what and how you teach?**

[What they do with it: Whether and how state standards and assessment influence their use of curriculum materials]

17. You've described various ways that you use [don't use] your textbook and other curriculum materials. Do you anticipate using them the same way as you gain more experience? What might change?

[What they bring: Beliefs about math and math instruction.

What they encounter: Norms and expectations regarding the use of curriculum materials.]

18. Curriculum materials are generally designed to help students learn. Some math books are [This math book is] designed with the goal of helping teachers learn as well. Do you think your math book helps you to learn?

YES: **What do you learn from it?** [Get open response, then prompt:]

- **Do you learn anything about how to do math?**
- **Do you learn anything about math itself—as a field or a subject?**
- **Do you learn anything about how children learn math?**
- **Do you learn anything about how to teach math?**
- **How else do you learn as a teacher?**

NO: **How do you learn as a teacher?**

[This is a pilot question to get a sense of whether the new teachers associate the math curriculum materials with their own learning.]

19. You've described how you use your math book and other curriculum materials. How does that compare to how you use your books and other curriculum materials in other subjects, like reading, writing, social studies, and science?

[Comparison.]

APPENDIX D: Observation protocol

I will draw a map of the classroom, paying particular attention to the seating arrangement and any math-related materials.

I will keep a handwritten running record of teacher and student behavior, paying particular attention to the questions presented below. I will also tape record the lesson for later review or to capture some dialogue verbatim, but I will not fully transcribe these tapes. Immediately after the lesson, I will write a lesson description in which I answer these questions:

Teacher activity

- What, if any, written materials (e.g., a written lesson plan, the textbook or other books, written notes, a worksheet) does the teacher refer to during the lesson?
- How does the teacher introduce the lesson?
- What math information does the teacher provide?
- What directives does the teacher issue?
- What questions does the teacher ask? Do the questions require exact answers, explanation, and/or opinions?
- Does the teacher check for understanding during a lesson? If so, how?
- What type of feedback does the teacher offer individual students and the whole class?
- Does the teacher modify the lesson midstream in response to students' successes and difficulties? If so, how?
- How does the teacher conclude the lesson?

Student activity

- What, if any, materials (e.g., the textbook, worksheets, calculators, math manipulative materials) do students use during the lesson?
- What are students doing? Possible categories of behavior include quietly sitting, talking to teacher, talking to other student(s), asking question, writing, reading, using math materials, standing, walking, sleeping
- Is there evidence that students are "on-task?"
- Are students working alone or in groups?

The lesson

- What are the stated or apparent goals or learning objectives of the lesson?
- What mathematics content is covered in the lesson?
- Does the lesson follow a predetermined format, e.g., a textbook lesson plan?
- Is there evidence that the lesson does or does not build on students' prior knowledge?
- Is there evidence that the activities within the lesson do or do not explicitly relate to each other and the learning objectives?
- Is there evidence that the lesson does or does not relate to previous and future lessons?

APPENDIX E: Second interview protocol

I will supplement the following questions with stimulated recall questions based on content, activities, dialogue, and decisions I observed during the lesson. I will probe for how the respondent made certain decisions and whether curriculum materials played a role. I may also present some hypotheses based on analysis of the first interview and ask for the respondent's response.

1. Before I get into the specific questions, I would just like to ask how it's gone since we last spoke on _____.

[This is a "grand tour" question to determine what is foremost on their minds—listen especially for references to curriculum, pedagogy, support, and teacher learning]

2. Since we last spoke, have you had any professional development or training in math?

(what type? duration? who provided? was it any good?)

[What they encounter: Professional development, training, and induction related to math;

What they encounter: Formal and informal support available]

[For questions 3-11, I will probe for the use of curriculum materials. These questions all pertain to
What they do with it: Whether and how they use the math curriculum materials – do they follow, ignore, adapt, supplement?

What they do with it: How they make decisions about whether/how to use.]

3. I'd like to talk about the lesson I observed. How do you feel it went?

4. Is this lesson typical for your classroom? How is it and how is it not?

5. What were your goals for this lesson?

6. How does this lesson fit in to the semester? [If necessary, prompt with:

- *How does it relate to what you taught yesterday?*
- *How does it relate to what you will teach tomorrow?*

7. Were your students successful in today's lesson? How do you know?

8. How did you prepare for this lesson? [Prompt for use of textbook and other curriculum materials.]

- **Is this typical for you?**

9. Did you use your textbook during the lesson? If so, how? Did you use other curriculum materials during the lesson? If so, how?

- **Is this typical for you?**

10. What did you [will you] do after the lesson? Did you [will you] use your textbook at that stage?

- **Is this typical for you?**

11. * Additional questions about content, activities, dialogue, and decisions in the lesson *****
· **When you said/did _____, where did that come from?**

12. Overall, I'm interested in how you use your math book and other curriculum materials. Given that, is there anything else you would like to say?

In addition to continuing to use Montessori lessons and materials, in Upper Elementary, we introduce the bar diagramming method of the Singapore Math program. This is particularly helpful when working with ambiguous, multi-step word problems. Singapore Math helps children visualize problems by turning abstract words into easy-to-understand pictorial models. A rich geometry curriculum is a unique strength of Montessori Elementary mathematics. Building upon their introduction to geometry in the Sensorial area in preschool, we introduce our students to congruency, similarity, and equivalence. Our students learn to draw, define, and describe lines, polygons, angles, circles, and geometric solids. He teaches courses for future teachers in the Mathematics Department. He served as the site director for the Show-Me Project, an NSF-funded project supporting the dissemination and implementation of standards-based middle grades mathematics curricula. He worked on the NSF grant Tinker Plots to develop new data analysis software and he serves on the Advisory Boards for several other national projects. From 1992-1997, he directed the NSF-funded Six Through Eight Mathematics (STEM) middle school mathematics curriculum project and is now directing the Middle Grades MATH Thematics Phase II Project. Studies of teachers' use of mathematics curriculum materials are particularly timely given the current availability of reform-inspired curriculum materials and the increasingly widespread practice of mandating the use of a single curriculum to regulate mathematics teaching. A review of the research on mathematics curriculum use over the last 25 years reveals significant variation in findings and in theoretical foundations. The aim of this review is to examine the ways that central constructs of this body of research—such as curriculum use, teaching, and curriculum materials—are conceptualized