REPLACING THE “TEACHER-PROOF” CURRICULUM WITH THE
“CURRICULUM-PROOF” TEACHER:
TOWARD A MORE SYSTEMATIC WAY FOR MATHEMATICS TEACHERS TO
INTERACT WITH THEIR TEXTBOOKS

A DISSERTATION
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FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY

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ABSTRACT

This research examines when and how secondary mathematics teachers adapt textbook curricula within “typical” cycles of planning and teaching over the course of a school year. The curriculum use of four middle and high school teachers was examined before (September) and after (December, March) engagement in a form of professional development called the Mathematics Curriculum Assessment and Adaptation (MCAA) process. Classroom materials were collected from teachers at three distinct points in the school year, at which time teachers were observed and interviewed about their planning and teaching practices. Overall, the number of textbook materials teachers used as-is dropped dramatically while the number of materials they adapted increased. This finding was true regardless of teaching experience, teaching context, textbook used or content taught, and was reflected in changes in teachers’ commentaries about their planning and teaching and changes in classroom practice. Furthermore, the types of adaptations teachers made to their curricula were more reflective of the MCAA process in March than they were in the beginning of the school year. This dissertation research sits within the broader domain of understanding how mathematics teachers use curriculum and raises new questions about how, when and why teachers make changes to textbook materials.
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INTRODUCTION

“Most schools and teachers cannot produce the kind of learning demanded by new reforms-- not because they do not want to, but because they do not know how” (as quoted in Ratner, 2002).

– James Hunt & Tom Carroll

Former chairman and president, National Commission on Teaching and America's Future

“It is not possible for most teachers to write a complete, coherent, mathematically-sound curriculum. It is not insulting to teachers as professionals to admit this…We do not sell teachers short by recognizing that they cannot do this job” (1997, p. 248).

– Susan Jo Russell

Curriculum writer, TERC

“What would you say if I told you that I would have LOVED a scripted curriculum last year?...I walked into that classroom with very little understanding of the content that I was supposed to teach and even less of an idea about how to make that content approachable to kids” (2008).

– Bill Ferriter

6th Grade teacher, North Carolina
“The state school board rejected the recommendations of two review panels…[and] the U.S. Department of Education…and chose instead twelve [other] textbooks, including two…specializing in skill-building through repetitive practice, books that are considered ‘teacher-proof’” (2004, pp. 122-123).

- Vivian Troen & Katherine Boles

Authors, Who’s Teaching Your Children?

“We have never invested in teachers in this country. We've created a system in which we regulate heavily and tell teachers what to do. We create teacher-proof curriculum. We pay teachers relatively little, and then we spend enormous sums creating a superstructure of supervisors to look over their shoulders” (as quoted in Novak, 1994).

– Linda Darling-Hammond

Professor, Stanford University School of Education

“Those who can, do. Those who can’t, teach” (as quoted in Shulman, 1986).

- George Bernard Shaw

Author, Man and Superman

*   *   *

The hunt for the “teacher-proof” curriculum continues in the United States.

Despite the fact that no one secondary mathematics curriculum has yet been proven to “work” significantly better than the rest (NRC, 2004), and despite adamant claims by
some that none ever will, new curricula for teaching mathematics continually emerge, each with the hope of being the reform panacea for the myriad problems with public mathematics education. At the same time, new teachers are completing credentialing programs every year believing that the best teachers create their own curriculum in lieu of following a given text, and with little understanding of what that might entail (Ball & Cohen, 1996; Remillard, 2005). This results, in part, in a population of teachers with a reluctant reliance on their textbooks and a smattering of lesson plans, activities and assessments they adapted or created with little system or formal expertise. Because the curriculum developers, educational researchers, mathematicians, politicians, school administrators, and teachers involved in mathematics education in this country arguably have the same goal – helping more students understand and be successful in mathematics – it is surprising how little progress has been made helping teachers use, adapt or write curricula more effectively, especially with alliances between these groups growing more and more common. Specifically, if there is no perfect mathematics curriculum, nor consensus about the best way to use a curriculum, shouldn’t one focus of the mathematics education community be on bridging this gap?

Despite lip service nowadays to teachers-as-experts and curricula-as-resources, many teachers still seem unsure about how to more flexibly use their given textbook(s) (Ball & Cohen, 1996). Many opportunities to learn this, such as in mathematics methods courses in teacher education programs, formal textbook trainings, or in-school professional development, focus either on how to most effectively use the existing textbook as written, or on planning and teaching in general, such as the principles of backward design from Wiggins & McTighe (2005) or Cohen’s (1994) complex
instruction model. It is unclear how many focus on the kinds of curriculum assessment and adaptation that empower teachers to actively assess the likelihood their textbook will meet the needs of their students and then systematically adapt it if necessary. Perhaps this is the case because no one process exists for helping teachers do this difficult and complex work. Perhaps this is complicated by a lack of confidence in teachers to learn how.

In this dissertation I take one step toward supporting a claim that the more deliberately and systematically mathematics teachers can interact with their curricula in planning and teaching, the more effective their planning and teaching will be. From existing research I conclude that though a teacher’s use of a curriculum clearly affects student outcome measures, it does so in ways that can be program or textbook independent. Additionally, it seems teachers’ more critical and creative uses of a curriculum can be arbitrary, arising more often from contextual and experiential factors than teachers’ deliberate analysis and adaptation of their materials. Here, I hypothesize that mathematics teachers who have a doable way to interact more meaningfully with their curriculum may view the interaction more positively, regardless of the textbook or other curricular materials they start with, and may be more effective in meeting the needs of their students.

As one specific way to test this, I examine one form of curriculum interaction currently named the Mathematics Curriculum Assessment and Adaptation (MCAA) process that a classroom teacher and I developed for use in the mathematics classroom, independent of the subject or given textbook. I argue this process both supports mathematics teachers’ more deliberate participation with their created or provided
mathematics curricula and empowers them to make planning choices that follow from thoughtful, on-going, curricular analysis. This paper attempts to justify why more research is needed on what “effective” curricular assessment and adaptation entails, how it can be made a consistent, doable part of the planning process, and most importantly, if and how students’ needs are better met in classrooms where teachers are actively engaging in this process.

The primary question I explore is: *How does teachers’ more systematic use of curricula affect their planning and teaching of secondary mathematics?*
CHAPTER 1

Review of Existing Research: Teachers and Curricula

“We are beginning to ask ourselves how we can see and describe the minor miracles of stunning teaching instead of prescribing how teachers should go about their work” (Eisner, 1988, p. 19).

The Need for Teacher in the Curriculum-Learning Connection

Throughout the existing research on curricula there exists an implicit linking of curriculum to subject matter instead of to classroom practice, which Clandinin and Connelly (1992) claim is responsible for the “means-end distinction that has characterized, and often plagued the field” (p. 365). These researchers’ perspective, that of teachers, is understandably defensive: this “means-end distinction” can ignore teachers and teacher practices by assuming the most important influence on student learning outcomes (the end) is the curriculum (the means). This sentiment is clear, for example, in Tyler’s (1949) description of curriculum making as “the primary intellectual, social and educational challenge,” but the realizing of it through instruction “an important, though lesser, task” (p. 366). Though the views on curriculum over time have gradually become more holistic - as exemplified by Schwab’s (1969) description of the four “desiderata” of curriculum: teacher, learner, subject matter, and milieu - it hasn’t been until recently that the literature on curriculum treats teachers as more than incidental parts of curriculum design and realization. This is problematic when considering teachers are the mechanisms...
in current U.S. educational systems for using these given curricula to promote student learning.

Exacerbating this separation of teacher and curriculum in existing research is the existence of the conduit metaphor that idealizes curriculum as a “container” for specific ideas or concepts, and thus that communication of these ideas or concepts to others just involves finding the “right” container for them. This perspective, supported in a wide swath of curriculum literature from the past century, treats curriculum-making as essentially the hunt for the best container, that once found will be the vessel with which to give a wide range of students access to content learning and that is largely teacher-independent. It promotes the idea of the existence of an ideal, “teacher-proof” curriculum that works for any group of students in any school. Research tells us, however, that no perfect curriculum container yet exists. The Rand Corporation Study of Change (Berman & McLaughlin, 1978), as an old but important example, was a study in which 293 federally-funded curriculum innovation projects were examined and evaluated by the U.S. government. The report concludes that “no class of existing educational treatments has been found that consistently leads to improved student outcomes” (p. v). Almost thirty years later, a 2004 National Research Council panel’s review of curriculum programs concluded the same thing, reporting “insufficient evidence of the effectiveness of any of the programs studied” (p. 3). These findings imply either that we haven’t found the right container yet, or that no such container exists. Either way, accurately describing and improving the curriculum-learning connection must include a more explicit and careful look at the teacher’s role in the process.
Teachers as Maximizers of a Curriculum’s Potential

Unlike the historical curriculum theories described above, the curriculum potential theory sees teachers as an inextricable part of the curriculum assessment, adaptation and implementation process, in which the teacher, learners, subject matter, and context are in “dynamic interaction” (Clandinin & Connelly, 1992). Without teachers actively analyzing and attending to their given curricula to realize their maximum potentials, they may not be teaching what they want to be teaching.

According to Ben-Peretz (1990), teachers can realize a curriculum’s potential by maximizing their pedagogical content knowledge, the blend of content and pedagogy expertise that enables teachers to design and implement curriculum most effectively (1986). Zumwalt might add the need for a teacher to have a comprehensive, long-term view of the curriculum, its purpose, and its place within the larger contexts of the department and school, or what she calls a curriculum vision (1989). The maximization of a curriculum’s potential seems to also depend on teachers’ perspectives on their roles in using published materials. Schnepp (2009) asserts that “one of the most significant factors in teachers’ use of curriculum materials is how they position themselves in relation to those materials” (p. 197), including how much they believe they should be changing or supplementing the curricula. Ben-Peretz reminds us that all “curriculum materials are far richer in their potential than is envisaged by their developers, and offer teachers a wide array of possible uses” (Ben-Peretz, p. xiv). Packaged curricula are more useful and complex, potentially, than outlined in their learning objectives or title-page mission statement. Connelly (1972) relays that “the developer cannot imagine, let alone
account for, the full range of teaching situations that arise” (p. 164), and thus it is the role of the teacher to bridge the provided curriculum with the needs of his/her students.

One Pole of Curriculum Use: Curriculum Fidelity

Today, despite the ideal of teachers as “curriculum maximizers,” most schools and teachers remain faithful to textbooks at some level. Jackson (1986) once went so far as to claim that “many teachers never trouble themselves at all with decisions about how the material they are teaching should be presented to their students. Instead, they rely upon commercially prepared instructional materials such as textbooks to make those decisions for them” (p. 20). Though this is clearly not true of all teachers, much research does support the idea that teachers follow given curricula more closely than not, especially mathematics teachers (Doyle, 1992; Stodolsky, 1989) and new teachers (Ball & Feiman-Nemser, 1988; Behm & Lloyd, 2009). In a study by Chval, Chavez, Reys, and Tarr (2009) measuring textbook “integrity,” though teachers did vary in how regularly they used their mathematics textbooks, teachers used their texts on average 87% of their planning time.

These findings are surprising when considering research showing that teachers feel strongly about their professional autonomy as textbook-users (Jackson, 1986; Lortie, 1975) and develop curriculum vision and trust as they gain “experience and expertise with a particular set of curriculum materials” (Drake & Sherin, 2009, p. 325). In mathematics education, Remillard (2005) compares today’s reform efforts with those of the 50’s and 60’s in that both are focused on “teacher-proof,” textbook-based curricula designed by non-teacher experts such as mathematicians and researchers, which may
make it especially difficult for teachers to enact this valued autonomy. She reports research finding that mathematics teachers view these non-teacher-created textbooks as authoritative, inflexible and, especially when linked to state standards, having more weight than their own beliefs about what students should learn.

Perhaps teachers’ adherence to published textbooks, despite desires for curricular autonomy, may be because of the messages textbooks, schools, districts and the larger society send teachers about whether they should adhere or not. These messages include that curriculum developers possess valid knowledge and expertise that was used to write the textbook and that there may not be additional themes and principles of importance beyond what the textbook authors have included. In California, for example, this message is emphasized by the fact that state-approved mathematics textbooks are written to specifically address the state standards to which teachers and students are held accountable on the high-stakes tests given each May (CDE, 2006). A teacher’s faith in his or her textbook thus mirrors, in many ways, mathematics education’s “long history of faith in curriculum programs…as a means to improve student achievement” (Larson, 2009, p. 93).

Another salient explanation for teachers’ bottom-line faithfulness to textbooks comes in part from a lack of professional expertise or confidence in assessing and/or adapting the materials. A teacher’s curriculum literacy (Rudduck, 1987) or use of curricular reasoning (McDuffie & Mather, 2009) refers to how he or she assesses, plans with, adapts, and implements curriculum. It is reasonable for teacher preparation programs not to prioritize the development of this reasoning when schools either provide a textbook to use and/or require the use of a particular book, in both cases books that
directly address the standards tested on high-stakes state and national exams. This is problematic when considering how many new teachers emerging from teacher education programs believe high fidelity to textbooks is a quality of only “bad” teachers’ practice (Ball & Feiman-Nemser, 1988), and complicated by teachers’ “underdeveloped understanding of their role as active agents in mediating the interaction of students and content through curriculum materials” (Silver, Ghousseini, Charalambous, & Mills, 2009, p. 251). This disconnect between what teachers believe about textbook use and how they are expected to use textbooks may also contribute to the wide array of mathematics curriculum use practices.

**Toward Another Pole: Teacher as Curriculum Maker**

Clearly teachers’ reliance on textbooks to teach mathematics courses, whether required to or not, is not cut and dry – while some teachers use texts verbatim, as scripts, others use them more as guides or resources. Remillard (2005) discusses the various ways research defines and examines textbook use, from mathematics teachers simply subverting or following the textbook (the positivistic stance) to teachers actively interpreting or participating with a given text. Drawing on similar distinctions, a continuum of curriculum innovation adoption was proposed previously by Hall & Loucks (1977) identifying seven stages of curriculum use moving from “non-use,” a stage where the curriculum is ignored completely, to “renewal,” in which teachers use the curriculum critically and flexibly (Table 1.1). Some research avoids describing teachers as “users” of texts completely because of the possible implication that curricula are to be simply pulled off a shelf and applied in some way to the planning and teaching cycle (Lloyd, Remillard,
Megan W. Taylor

More common in the curriculum research literature is the description of teachers as “interacting” with texts, which conveys a more dynamic and complex relationship.

Table 1.1.

Levels of Use of the [Curricular] Innovation (Hall & Loucks, 1977)

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Nonuse</td>
<td>State in which the user has little or no knowledge of the innovation and has no involvement with it</td>
</tr>
<tr>
<td>1: Orientation</td>
<td>State in which the user has recently acquired or is acquiring information about the innovation</td>
</tr>
<tr>
<td>2: Preparation</td>
<td>State in which the user is preparing for first use of the innovation</td>
</tr>
<tr>
<td>3: Mechanical Use</td>
<td>State in which the user focuses most effort on the short-term, day-to-day use of the innovation with little time for reflection</td>
</tr>
<tr>
<td>4a: Routine</td>
<td>Use of the innovation is stabilized.</td>
</tr>
<tr>
<td>4b: Refinement</td>
<td>State in which the user varies the use of the innovation to increase the impact on clients within the immediate sphere of influence</td>
</tr>
<tr>
<td>5: Integration</td>
<td>State in which the user is combining own efforts to use the innovation with related activities of colleagues</td>
</tr>
<tr>
<td>6: Renewal</td>
<td>State in which the user reevaluates the quality of use of the innovation and seeks major modifications to achieve increased impact on clients</td>
</tr>
</tbody>
</table>
Closer to the “renewal” end of Hall & Louck’s continuum is teachers’ active creation of curricula. In their 1992 review of research examining teachers as curriculum makers, Clandinin and Connelly describe various cases of teachers as action-researchers creating their own materials. According to these authors, the literature on teachers as curriculum makers is not yet adequately covered by the literature on teaching, and within the research that does exist, usually in curriculum reform research, the perspectives about teachers’ roles in curriculum design widely vary. This may be in part because few (if any) teachers actually create entire curricula from scratch without using existing curricular resources in some way, thus blurring the line between “curriculum-user” and “curriculum-maker.” But this also depends on the definition of “maker;” while Clandinin & Connelly might define the term in the designing-from-scratch sense, others would extend it to a teacher who simply uses resources effectively in the construction of his/her own scope, sequence, and plan of instruction.

**How Teachers Should Use Curricula: What is Ideal?**

The research reviewed to this point implies a few things about the teacher-curriculum interaction. First, teachers and curriculum are not universally seen as partners in maximizing student learning of mathematics. Second, this is problematic when the maximization of a curriculum’s potential depends on how a teacher interacts with the curriculum to plan and implement classroom instruction. Third, teachers interact with their curricula in different ways, to different ends, and thus, with different outcomes. So if an ideal curriculum doesn’t exist, and if a curriculum’s success depends on the teacher, perhaps an ideal use of curriculum does. It seems plausible that if teachers are shifting
between an allegiance to a textbook and textbook-independent improvisation in creating and implementing curricula, there may be some practices, for some mathematics texts and subjects, that are better than others in facilitating student learning.

The problem with research findings such as these, however, is that they give us a myriad of ways that certain teachers have used certain curricula more effectively than before, but do not necessarily define any generally “effective” process(es) for mathematics curriculum use that transcend school, text, teacher or subject. Across these best practices, perhaps, there are more universal processes that teachers can use, as mathematics curriculum, content and pedagogy experts, to more systematically assess, adapt and supplement their given curricula. In essence, instead of trying to create a “teacher-proof” curriculum, we should be helping teachers be more “curriculum-proof:” whatever curricular materials they interact with to plan and teach a course, they have processes to do so most effectively. This research is based on the assumption that such processes do exist, and that their effectiveness will likely depend on helping teachers see that a more deliberate and flexible participation with their textbook (versus unidirectional participation [i.e. following the text as a script]) is manageable and has significant effects on student learning. It is unreasonable to expect teachers to learn new processes of curriculum use that don’t fit into their typical planning and implementation cycles or that don’t improve students’ mathematical understandings. The next question, then, is what might such processes look like?
CHAPTER 2

A Conceptual Framework

“The song Take the A Train…was the signature tune of the Duke Ellington Orchestra, and was performed by countless others. If you compare Duke’s rendition to one by Ella Fitzgerald, we have little difficulty identifying each rendition as being the same song. Yet, despite their essential similarities, the songs sound distinctly different…This relationship is similar with curriculum materials and teacher practices. In both cases, practitioners bring to life the composer’s initial concept through a process of interpretation and adaptation, with results that may vary significantly while bearing certain core similarities” (Brown, 2009, p. 17).

In this chapter an argument is advanced that to be most effective in maximizing students’ learning of mathematics, teachers’ curricular reasoning must be more deliberate and that this role is possible for them to take on. This argument assumes that the most ideal use of a mathematics curriculum involves a more systematic interaction between teacher and curriculum, involving at least three processes: a prioritization and stratification of expected student understandings, an assessment of how well the curriculum will provide access to those understandings, and a deliberate adaptation or replacement of curriculum. In this chapter, the selection of these processes is described and situated in the developing framework. In Chapter 3, one, developing model for how
mathematics teachers can engage in these three processes is defined that draws on existing learning theory and professional development research.

In Remillard’s (2005) review of a large swath of curriculum-use research she warns that though its “variation in perspective and focus” allows researchers to “reveal distinct dimensions or angles of a complex phenomenon” much of the research “rests on varied theoretical assumptions” (p. 223). Thus, the conceptual framework developed in this chapter is largely an adaptation of Remillard’s (2009) conceptual model of teacher-curriculum interactions, a model for how teachers interact with curricula that attempts to blend four recent frameworks into one.

**An Existing Framework: Conceptual Model of Teacher-Curriculum Interactions and Relationships**

Math teachers use different curricula from school to school, and as no one curriculum has been linked to the greatest changes in achievement, this research argues that teachers must be able to maximize the potential of the curriculum they already use. As stated earlier, this may mean teachers must actively participate with their curriculum on a consistent and deliberate basis. Remillard (2005) reminds us that “from a practical perspective, it is impossible for curriculum developers to address all the needs of individual schools and classrooms” (p. 230). Thus, teachers must be able to bridge the objectives and resources of the textbook with the needs of their students in meaningful, effective and manageable ways.

From her study of two mathematics teachers’ first-time use of given textbooks, Remillard (1999) developed three arenas of curriculum development, which when taken
together describe how teachers organize the content of their mathematics curricula (Figure 2.1). Remillard describes the “mapping arena,” or the place where the teacher makes the design choices that “determine the organization and content of the mathematics curriculum over the year” (p. 226), as consisting of a “design arena” and “construction arena.” The former describes how teachers choose and design tasks for students, and the latter describes how they enact them in the classroom and respond to their use by students. Teachers’ adaptations to curricula during its enactment, or “unrehearsed” changes, happen in the construction arena. This adaptation is in direct response to students; it involves a teacher assessing how students are interacting with tasks, then making on-the-spot decisions about how they may be changed or used differently to better promote learning.

Figure 2.1. Remillard’s (1999) Three Arenas of Curriculum Development.

From their research of patterns in teachers’ use of reform-based mathematics curricula, Sherin & Drake (2009; 2004) also describe the ways teachers adapt materials,
naming adaptation as one of three “interpretive activities” teachers engage in: reading, evaluating and adapting. The authors found that teachers engage in all three activities before and during instruction, placing this work within both the design and construction arenas of curriculum development. In comparing her research and theirs, Remillard (2005) comments that “their findings reveal that using a novel curriculum is a complex and multifaceted process of interaction with materials” (p. 227). Specifically, perhaps the most “effective” curriculum strategies may be those where teachers’ shifts between different interactions with their curricula are deliberate and goal-oriented.

In a recent collection of research on mathematics teachers’ use of curricula, Remillard brings together four existing frameworks into “one synthetic representation of the teacher-curriculum material terrain” (2009, p. 88) (Figure 2.2). Remillard builds primarily on Brown’s (2009) Design Capacity for Enactment Framework, a model relating key factors that mediate the “teacher-tool relationship.” The model values Brown’s concept of pedagogical design capacity, or a teacher’s “skill in perceiving the affordances of the materials and making decisions about how to use them” (Brown, 2009, p. 29), as a potential teacher resource, as well as human and social capital (Stein & Kim, 2009) and agency and status (McClain, Zhao, Visnovska, & Bowen, 2009).

In a former framework, Remillard (2005) describes the “teacher-text interaction” at the center of the model as the “participatory relationship between the teacher and the curriculum” (p. 236), a collaborative relationship focusing on “the dynamic relationship between the teacher and curriculum” (p. 221). Though this interaction is clearly a “pivotal component” of the model, Remillard emphasizes that “we know little about how teachers interact with curriculum resources,” (p. 89, emphasis added) and asks for future
research to explore this important piece.

Figure 2.2. Reproduction of Remillard’s (2009) Conceptual Model of Teacher-Curriculum Interactions and Relationships.

Figure 2.3. Modified reproduction of Remillard’s (2009) Framework. This shows “Processes of Adaptation” as a proposed part of the participatory relationship between teacher and text.
“Adaptation” as an Addition to an Existing Framework

This research assumes that analogous kinds of curricular adaptations to those Remillard describes as part of the construction arena of curriculum development are formal and important components of the design arena, where teachers are selecting and designing mathematical tasks (see Figure 2.3). This research also assumes that the more systematic these adaptations are, the more effective a teacher’s curriculum strategy will be in facilitating student learning. This is because if there is some “ideal” process for using mathematics curricula that involves a teacher’s flexible use of the materials, it should require a teacher to purposefully evaluate and adapt materials before enactment as much as during. If this is true, then there must then be some process or set of processes teachers engage in that impacts their on-going participatory relationship with their curriculum materials.

An expanded version of the framework proposing some set of processes of adaptation is a part of the teacher-text interaction provided in Figure 2.4. The impact of this addition on the facets of teacher and curriculum resources that might come into play in the interaction between teacher and text is considered, again building from the existing framework. Remillard’s (2009) framework is also drawn from to describe the teacher-text interaction as “participatory” and to detail the “instructional outcomes” as including the planned and enacted curricula, outputs that impact this participatory relationship. Each of these adaptations is expanded in detail below.
Figure 2.4. Detailed, modified reproduction of Remillard’s (2009) Framework. This shows an expansion and reorganization of the “Curriculum Resources” and “Teacher Resources” dimensions.

The changes to the “teacher resources” and “curriculum resources” boxes are either novel or expansions on or regroupings of Remillard’s (2009) existing dimensions. The main factor taken into account for modifying these descriptors was what impacts how, when and why a teacher adapts his or her curriculum in the design arena of curriculum development. The dimensions have been regrouped such that “curriculum vision” and “beliefs and experience” are primary categories for the teacher arena, and
"content and structure" and "use" are primary categories for curriculum. This is to emphasize, for the former, the difference between the content/pedagogy-focused and personal dimensions of planning and teaching, and for the latter the difference between the as-designed and as-implemented dimensions of curriculum. These groupings and additions are explained in detail below. The greater number of additions to the curriculum arena than to the teacher arena is not symbolic of the weight of one over another: the teacher and curriculum are equally important in the planning, teaching and learning process.

First, in the “teacher” arena, Zumwalt’s (1989) concept of “curriculum vision” was added as a category for five of the characteristics because it appears often in more recent research examining how comprehensively teachers see, design and implement curricula (Drake & Sherin, 2007; Zumwalt, 2005). Teachers with strong curriculum visions view their curricula as cohesive wholes, such that their choices about curricular features like topic sequence and concept depth are made in line with a long-term mental model of what they want students to understand and be able to do. In a recent study by McDuffie and Mather (2009), as teachers developed a curricular vision, their “decisions to add activities were motivated by interactions with students and their state’s learning expectations” (p. 317). Also, teachers with a clearer curriculum vision begin to see their curriculum more positively and as a resource that can be used (Drake & Sherin, 2009).

It is not hard to justify why developing a strong curriculum vision involves considerable subject matter and pedagogical content knowledge, a deep pedagogical design capacity, and an understanding of students’ needs and understandings. It is equally clear why a teacher’s curricular, managerial and professional priorities are important.
Curricular priorities directly affect the teacher-curriculum interaction and, according to Clark and Yinger (1977), range from comprehensive to incremental. In a personal interaction, a colleague contrasted these two categories of priorities by describing one as the forest and the other as the trees: comprehensive strategies involve seeing the curriculum as a connected whole, while incremental strategies involve looking at specific topics or units one at a time. A teacher’s managerial and professional priorities affect all choices the teacher makes in planning and teaching, in part because they mediate how a teacher will spend his or her planning and teaching time. These priorities affect everything from the activity structures he or she uses in a class and how much time will be spent giving students feedback to how teachers view professional development opportunities and how long a teacher intends to continue teaching.

Teaching experience and beliefs about teaching and learning mathematics were added to the “beliefs and experience” category. Considering how much new teachers are learning to manage on top of their planning and teaching (e.g., classroom management, administrative duties), it seems likely that curriculum use would be different with respect to how long a teacher has been teaching. We also know that teachers’ beliefs about teaching and learning affect the choices they make in their classrooms, particularly as teaching experience increases (e.g., Fang, 1996). New teachers, for example, tend to believe they should be writing their own curriculum as much as possible (Ball & Cohen, 1996), and experienced teachers’ beliefs and classroom practices are highly correlated (Stipek, Givvin, Salmon, & MacGyvers, 2001).

In the “curriculum” arena, the overarching scope and sequence of a curriculum were added to the category of curriculum content and structure. Fullan (1983) asserted
that curriculum scope is one, clear mediating factor in how successfully an implemented curriculum will lead to positive student outcome measures. Sequence of topics may be an equally important factor for teachers to consider, especially since many mathematics textbooks for a given subject follow the same, predictable orders as other books (Schmidt, McKnight, Valverde, Houang, & Wiley, 1997). Blindly following the given order of a text can be problematic: in one study of elementary mathematics teachers’ use of textbooks, for example, the percent of all course topics not addressed at all simply because they came at the end of the textbook and were not reached before the end of the school year ranged from 21% to 57% (Freeman & Porter, 1989).

The range of cognitive demand is another addition to the curriculum structure arena because it addresses how the text asks students to think about mathematics. Specifically, different curricula have different priorities for what depths of cognitive engagement are appropriate and necessary for students to learn content standards. One way to think about this is in terms of Bloom’s (1956) taxonomy, which specifies deepening levels of thinking from knowing and comprehending a topic’s basic principle(s) to being able to synthesize and evaluate it against others. Some curricula focus largely on declarative and procedural knowledge that arguably coincide with the lower levels of thinking defined by Bloom. Other curricula also require students to consistently apply concepts to real-world situations or be metacognitive about what processes they are using to solve a problem and why. Frykholm’s (2005) research, for example, focused on bolstering mathematics teacher preparation via engagement in problem-solving from a middle-school mathematics curriculum the teachers would later use in their planning and teaching. Frykholm relays that one of the most important factors
in better preparing teachers for the task of using reform curricula was an alignment between the curriculum’s structure and approach and the teacher’s own beliefs about teaching and learning mathematics. Thus, perhaps the range of cognitive demand required of students by a curriculum affects both how teachers view the curriculum and their interaction with it.

The level of specification or support a curriculum provides the teacher is a final addition to Remillard’s (2009) framework in the curriculum use arena. This may be one of the most impactful characteristics of a curriculum on how a teacher engages with it, especially if it is a curriculum a teacher is using for the first time. Stylianides (2008), from research on how curricula should help teachers help their students develop an understanding of mathematical proof, relays that along with first equipping teachers with curriculum materials that provide rich learning opportunities, we need to also “provide teachers with the guidance necessary to enact these opportunities with their students” (p. 21). In Loucks-Horsley’s (1998) identification of the main contributors to a curriculum’s successful implementation, two of the factors are the amount and type of professional support provided to teachers in the first three years using a curriculum, and the support systems existing within the school among administrators, other teachers and outside consultants. Some curricular programs provide or even mandate training before a teacher begins using the materials (e.g., Interactive Mathematics Program (IMP) or College Preparatory Mathematics (CPM)), while others provide only a “teacher’s guide.” In addition to this, some teachers are asked to use curricula that no other teachers in their school or district have used before (e.g. pilot situations, initial adoptions). These facts imply that how teachers are supported using their texts might have huge effects on
whether or not their curricular interactions are purposeful.

**Processes of Adaptation: From Haphazard to Systematic**

Mathematics teachers may naturally engage in myriad adaptation processes when developing or supplementing given curricula, processes that vary in purposefulness from haphazard to systematic and that may support or interfere with student learning. Though there may be an infinite number of ways mathematics teachers can interact with curricula, three are put forth here that may be crucial but difficult for teachers to do systematically, and for which specific ways to engage in them have yet to be clearly defined (Table 2.1). The argument that processes are possible for teachers to use their curricula more effectively specifically posits that deliberate engagement in these three processes is a significant first step toward a teacher’s more systematic interaction with curricula.

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**Table 2.1.**

<table>
<thead>
<tr>
<th>Three Processes of Adaptation Teachers Can Engage in When Interacting with Curricula</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Prioritization of goals and identification of expected or possible ranges of student understanding</td>
</tr>
<tr>
<td>• Assessment of how well curriculum will meet students’ needs and maximize learning</td>
</tr>
<tr>
<td>• Adaptation of curriculum (if necessary), including supplementation or replacement of materials</td>
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</tbody>
</table>
First, a mathematics teacher may interact more systematically with a curriculum by using his or her learning goals and content standards more critically and flexibly. Specifically, teachers should prioritize their learning goals so they and their students know which are more essential to an understanding of the content than others. The Center for the Study of Mathematics Curriculum, in a comparison of the content of different sets of states’ standards, recommends shrinking and prioritizing content standards in part to help align teachers’ prioritization and sequencing decisions (Reys, 2006). Specifically, the report suggests the need to “identify a small set of primary goals for each grade level” and to “limit the number of grade-level learning expectations to focus instruction and deepen learning” (p. 10). One implication of this recommendation is that if teachers know which standards are more essential to particular mathematics content than others, they will more universally address those standards and address them well.

Teachers can then work to predict the ranges of understandings students might bring with them to a course and that might develop in different ways over time. Any Algebra teacher can tell you that the student scores on a test of systems of linear equations are not likely to be all 100% or 0%. Students do not either just “get” systems of equations or not, and what they do “get,” and to what depth, is dependent on a variety of factors, including their prior experiences with the topic and the ways teachers have asked them to engage with it. Considering standards in terms of levels of complexity instead of just items to be checked off involves at least predicting the ranges of understanding that might exist among a group of students, and perhaps formally assessing them, in order to adapt curriculum and instruction to students’ diverse needs. Unfortunately, these ranges of understandings are difficult for teachers to take into account. This is, in part, because
of the treatment of topics in standards, textbooks and high-stakes assessments as black or white, and in part because there is no accepted process for doing so. Thus, if teachers are going to take ranges of understandings into account more deliberately in planning and teaching, they must have a process to do so.

Second, a more systematic use of curriculum may involve mathematics teachers assessing a curriculum’s appropriateness for a specific group of students’ needs before, during and after implementation, which should involve both comprehensive and incremental assessments of the material and should be directly tied to the learning goals. This process is dependent on a teacher already having assessed students’ needs and understandings in some way, which happens at least informally and at best through specific assessment as a course progresses. Though working to understand students is not a process focused on here, it is clearly a crucial piece of a teacher’s meaningful interpretation and implementation of his or her curriculum. Ball (1997) reminds us that though “much can be known about students in general…particular students -- not the faceless students of general theory, or even the real and remembered students of previous classes -- are the actual terrain of our work as teachers” (p. 732). This dissertation research assumes any curriculum must be assessed with respect to the students it will serve, no matter how many times a teacher has used it previously or what previous, positive student outcome measures may have been achieved (e.g. high California Standards Test (CST) scores, number of passing grades). This is because curriculum developers cannot capture the on-the-spot choices teachers make in direct response to students every day, choices that depend on a plethora of interacting contextual factors and that will never follow predictable scripts.
Third, a more systematic use of a curriculum involves making choices about the supplementation or replacement of existing standards, units or activities in the most deliberate ways possible, taking into account the identified needs and developing, varying understandings of students. Clearly, if we expect teachers to assess how well their curricula meet students’ learning needs and provide access to mathematics content, we should also expect teachers to adapt the materials if necessary. This could involve everything from small adaptations to existing problems or structures to replacements of entire units of instruction, and this should depend on both the two processes discussed above and on the teacher’s priorities. Additionally, while two Algebra teachers might work together to predict the same ranges of understandings of students with respect to learning how to solve systems of linear equations, the individual adaptations they make to their curricula to take into account these ranges might be fundamentally different. This also makes sense also when considering the teachers teach different groups of students and must take these possibly different needs into account in planning and teaching.

These three particular processes were chosen because they reflect the work teachers typically engage in when planning and teaching to different degrees. In a study by McDuffie and Mather (2009), for example, teachers analyzed curriculum materials from learners’ perspectives, mapped learning trajectories, and adapted curricula accordingly within the work of a professional development project focused on teacher learning. In fact, many models of professional development that focus on teacher learning, such as lesson study (Lewis, 2002) and video club (Sherin, 2004), focus on these processes to varying degrees because they are assumed to be typical and important parts of teachers’ work with their curricula. The existing curriculum framework, with the
addition of these three processes as one, possible, more systematic part of a teacher’s participatory relationship with the text, is shown as Figure 2.5.

**Figure 2.5.** A conceptual framework for one, systematic teacher-text interaction.

**Processes of Adaptation: Universal and Manageable**

If processes do exist that help teachers more systemically analyze how well a curriculum will meet students’ needs, identify and predict ranges of content understandings and then adapt their curriculum as necessary, they *must* be easy to learn,
manageable, and fit into their existing practice. In one study of mathematics teachers’ curriculum use, teachers’ reasons for integrating pieces of a new, given curricula before replacing them included wanting to use different kinds of activities and wanting to maintain the use of activities from previous years (Drake, 2006). These reasons seem to capture the feelings of many teachers when faced with adapting curricula and legitimately: being able to use already-created materials effectively and efficiently is certainly as important as being able to create new materials from scratch, especially given the demands on a teacher’s time, energy, intellect and emotion. However, it is not unreasonable to expect that teachers’ decisions for adapting, replacing or supplementing a piece of curriculum should be based first and foremost on how well the lesson will maximize students’ learning of mathematics.

In the research reported here, this kind of curriculum adaptation is referred to as “systematic” because it involves the changes a teacher makes to his or her curriculum being as purposeful as possible. This is especially true when considering that teachers’ natural shifts between reading, evaluating and adapting their curricula are not necessarily deliberate (Sherin & Drake, 2004), as discussed in the beginning of this section. Thus, part of an ideal, systematic process for curriculum use must help teachers to determine which standards, lessons, activities, and so on - are more valuable than others and in which ways, and then to determine whether to use them as is, or adapt, supplement or replace them.
CHAPTER 3

Mathematics Curriculum Assessment and Adaptation (MCAA)

“The role of the teacher...is as a curriculum developer who, together with his or her students, grows ever more competent in constructing educational experiences” (Snyder, Bolin, & Zumwalt, 1992, p. 418).

Stodolsky and Grossman (2000), in their research examining why individual teachers do or do not change their practice in response to a changing student population, offer the following caveat to the idea that assessing and adapting curricula is an important aspect of meeting students’ needs:

All adaptations are not equal. We believe that the most effective adaptations are those that continue to uphold high expectations for student learning in the subject matter…the potential for lowering subject matter standards may accompany efforts to adapt to new students even among highly committed teachers. Such trade-offs present a major challenge to teachers and teacher educators as they deal with today's students (p. 162).

An argument has been made so far that though there is neither a perfect curriculum nor a perfect use of curriculum, there are certain processes of adaptation within best curriculum-use practices that, when engaged in most systematically, may
maximize student learning of mathematics. Stodolsky and Grossman point out that “effective” adaptations of curricula must focus *primarily* on maximizing students’ learning of content. Though some teachers gain impressive fluency adapting curricula to address learning styles or to motivate and engage students, among other outcomes, the most important focus for mathematics teachers in participating with their curricula is on what students will *learn*. Here, a teacher’s “more systematic” interaction with a curriculum is operationalized with one, developing process called Mathematics Curriculum Assessment and Adaptation (MCAA). This process, initially designed by and with teachers in high school mathematics classrooms, attempts to define a more systematic interaction between mathematics teachers and curricula by outlining specific ways to engage in the three processes of adaptation described in the previous chapter. Its end goal is to help teachers use their curricula more effectively and thus help more students learn mathematics. An overview of the process is provided in Figure 3.1.
Figure 3.1. An overview of the MCAA Process in four steps.
Theoretical Justification for the Design of the MCAA Process

The Mathematics Curriculum Assessment and Adaptation (MCAA) process involves selecting, assessing and adapting existing curriculum materials. The process is based on the assumption that at any time, in any class, and for any topic, different students’ understandings will range in complexity and correctness. This process takes place within an environment of constant assessment of what students know and can do and requires direct and consistent use of this information at each step. The design of the process is based on a schema for how current tenets of learning theory, curriculum theory, and measurement theory may fit most meaningfully together. This schema, and its influence on the MCAA process, is described briefly here.

Though proposing that the current, dominant paradigm for school-based learning links “cognitive and constructivist learning theories” with reformed visions of assessment and curriculum (see Figure 3.2), Shepard (2000) describes a lingering dissonance between theory and practice. Specifically, Shepard points out that while there has been a general willingness to adopt these new views of learning and the new curricula written to address them more effectively, the ways we assess what students learn have changed little. She says the best way to understand why current assessment practices have do not match reformed curricula is “to realize that instruction (at least in its ideal form) is drawn from the emergent paradigm, while testing is held over from the past” (p. 4). In other words, while general learning theory has shifted away from a hereditarian theory of intelligence (i.e. you’re either born a “math person” or not) and behaviorist learning theories (i.e. practice makes perfect), assessment practices remain fixed in the “scientific measurement” paradigm of the 20th century.
Figure 3.2. A model for the interlocking tenets of curriculum theory, learning theory, and measurement theory characterizing the current paradigm of “effective” teaching and learning.

A tenet of the MCAA process is that the most effective teaching and learning can only occur when views about learning, curriculum, and assessment are aligned meaningfully and guide practice, as Figure 3.2 suggests. In fact, the MCAA process attempts to facilitate a shift in teachers’ views of learning and curricula that results in, among other things, a “modernization” of their assessment practices. Teachers are asked to approach their curricula with perspectives on teaching and learning that may be foreign
or even uncomfortable to them, such as the view that all students can learn the mathematics content the teacher is required to teach, regardless of prior experience or knowledge, or the view that learning happens best in diverse social and cultural contexts. In alignment with the claims of Shepard, teachers tend to welcome these constructivist views of learning and reformed visions of curricula, and are willing to incorporate these perspectives into their planning and teaching.

To maximize the effect on student learning, however, it is not enough for teachers to adapt their views on learning and curricula; these adaptations must impact their practice as well. The MCAA process is built on the assumption that assessment practices in particular must be closely aligned with the kinds of learning and curriculum perspectives described above in order for student learning to be maximized. Wiliam and Black (1998), in a review of assessment research, found that existing assessment practices “encourage superficial and rote learning,” poorly reflect what is intended to be assessed, over-emphasize grading, under-emphasize learning, and overwhelmingly use normative approaches that “emphasize competition…rather than personal improvement” (p. 8). Engagement in the MCAA process is intended to help teachers reconceptualize their assessment practices such that learning is facilitated when students know what learning goals they are working toward; have frequent, varied opportunities to show what they know and can do mathematically; and receive consistent, qualitative feedback on their progress. A detailed description of the MCAA process in teacher practice follows this section.
The MCAA Process in Practice

In most cases, the MCAA process begins with taking a textbook lesson or unit on a particular topic and determining how well it will meet the needs of a particular set of students. This step is supported by research showing that teachers already engage in informal phases of reading, evaluating and adapting curricular materials (Sherin & Drake, 2004), as mentioned above, and proposes that teachers simply be more deliberate in their participation with and analysis of curriculum in these phases. The MCAA process overall follows backwards-planning theory, which says starting with the standards is a crucial part of making sure activities and assessments are aligned to the goals teachers want to help students reach (Wiggins & McTighe, 2005). Teachers following textbooks closely can use the standards printed with each lesson or assessment provided and may not need or want to think carefully about which standards should be addressed in which ways and when in a course. This belief, however, is problematic considering the vast ranges of student learning needs and understandings that exist in increasingly heterogeneous mathematics classrooms.

After determining the learning objectives for a unit or course (step 1 of Figure 3.1), teachers begin a process of prioritizing the standards based on their students’ needs, their beliefs about what the big ideas of the course should be or any of a number of other factors (step 2a). According to Grotelueschen and Gooler (1972), prioritizing goals is about determining the priorities of a course as a cohesive whole. These authors describe processes of prioritizing, such as sorting goals into categories of importance, rating them along a continuum of importance or linking them with given resources, as ways of thinking carefully about which goals are more important than others and why. Some sets
of standards actually do this prioritization for teachers: the Benchmarks for Science Literacy (AAAS, 1993) and the National Science Education Standards (NRC, 1996), for example, relay which topics “can be postponed or excluded so that there is time to teach core topics well” (Stern & Ahlgren, 2002, p. 890). But California mathematics standards offer only the testing blueprints to teachers, documents that show how many items on the California Standards Test (CST) will assess each standard. Thus, the MCAA process asks teachers to think carefully about which standards are more important than others and to use their decisions to place more focus on some standards than others. This approach is justifiable because, as Connelly (1972) argues, if a teacher “knows what he is doing, and why, there is little reason to expect, or want, a teacher's allegiance to the goals of even the best programs. Interpretations will be, and should be, made” (p. 169).

After prioritizing standards, teachers determine ranges of understanding for the given or compiled standards and assess if and how the materials provide access to all ranges of understanding specified (step 2b). This step is the core of the MCAA process because it provides a way for teachers to manageably and thoughtfully assess how well the curricular materials they plan to use will “work” for their students. It is difficult because it requires extensive prediction, pre-assessment and formative assessment of what students know, or pedagogical design capacity: teachers must consistently gather information about what students understand and can do mathematically, then use it both to adjust the pre-specified ranges and to inform their planning choices. It is especially difficult for new teachers or teachers teaching a subject for the first time to do this, as their predictions about what students’ understandings look like have no experiential basis.
One example of an intensive use of ranges of understanding comes from a recent science education project in California (Kennedy, Brown, Draney, & Wilson, 2005). The research team defined “progress variables” similar to the learning progressions of Gagné (1983) to design a science assessment that was implemented in thirteen middle schools. One of their goals was to “determine how students are progressing from less expertise to more expertise in the domain of interest, rather than limiting the use of assessment to measuring competence after learning activities have been completed” (p. 7). The researchers determined specific progress variables to represent the central learning trajectories of the curriculum and assessments they were using, then delineated specific “outcome spaces,” which were used “to facilitate identification of student responses corresponding to a particular level on a progress variable” (p. 7). Teachers used these outcome spaces to gain information about student understanding and to assign scores to work. Thus, like progress variables, the ranges of understanding teachers delineate in the MCAA process have the potential to be meaningful and practical tools for maximizing student access to content and for planning future learning experiences.

After determining possible or expected ranges of understandings that students have about the relevant topic, teachers engage in a process of assessment and adaptation in order to validate or improve a chosen assessment or task. This process involves going back and forth between steps 2c and 3, where a teacher asks herself specific questions about the materials, then adapts or supplements them as necessary using knowledge of her students. Fullan and Pomfret (1977) describe adaptation as a process where teachers “look for modifications of curriculum materials according to specific classroom situations” (as described in Ben-Peretz, 1990, p. 7). This orientation brings the needs of
students into the curriculum-use process such that teachers’ adaptations of curricula are not arbitrary but dependent on specific information about their class’ understandings. Again, this depends on using assessments of what students know to inform these decisions directly. In the MCAA process, once a teacher can say “yes” to all the questions outlined in step 2c, he or she can move to Step 4 and begin lesson-planning and implementing the material(s) with students.

Japanese mathematics educator Akihiro Takahashi once said “teachers spend a lot of time trying to get their students to understand them. What they should be doing is trying to understand their students” (personal communication, July 2005). Because teachers engaging in the MCAA process have thought more carefully about which standards must be emphasized, in what ways, and what ranges of understandings might exist about them, these teachers might have more power to assess students meaningfully, both formatively and summatively. As emphasized previously, a vital part of the process as a whole is that teachers consistently use cycles of formative assessment and formal assessment to learn about what students know and provide them with opportunities to show it.

One positive outcome of this component of the process is that MCAA teachers know more about their students’ understandings that they can use to inform future practice. Another is that these teachers can relay more to students about where their understandings lie (e.g., giving a student a 67% on a test by adding up points for “right” and “wrong” versus specific, qualitative feedback about his or her understandings). Much assessment research - such as that which drove the theoretical shift in education from scientific measurement to broader definitions of assessment - considers this use of
assessment to be just best practice; teachers should be actively seeking to understand what students know and can do and providing feedback to students as they progress in a course (Black, Harrison, Lee, Marshall, & William, 2002) (see Figure 3.2).

**Place of the MCAA Process in the Conceptual Framework**

In contrast to the concept of a single, ideal curriculum or interaction with curriculum, Bridgham (1971) described an “envelope” in which some set of ideal curricula or uses of curricula exist. This research situates the MCAA process within this envelope as one possible way for teachers to participate more systematically with their materials (see Figure 3.3).
Figure 3.3. Conceptual framework for the MCAA process.

This research investigates how teachers engage in the MCAA process to assess their curriculum and adapt it to provide students with more access to content. The assumption is that by learning the MCAA process teachers will be able to use prioritized learning goals and predicted ranges of understanding to adapt and supplement their existing materials more meaningfully and manageably than they had before engaging in MCAA. Eventually, as teachers become more expert at applying the process to more parts of their interactions with their curricula, perhaps changes in student achievement in
mathematics will also occur. Furthermore, teachers may also gain new confidence in their planning and teaching.

**Ideal Professional Development for Mathematics Teachers**

An important consideration in the development of any innovation for teachers is how they will be supported in learning and implementing it. Because the MCAA process is intended to impact how teachers use their curricula, teachers must be able to learn it via professional development that is embedded in their existing practice and that fits easily into their existing planning and teaching routines. In this section a brief review of what makes professional development most effective is presented, followed by a detailed description of the professional development model used in this research.

On the most general level, Garet and colleagues (2001) determined general components of the most effective professional development programs from a study of over one thousand teachers. The best programs were those that were ongoing, substantial, specific, hands-on and integrated into the daily life of the school. In terms of MCAA, this implies that teachers must learn the MCAA process within the typical proceedings of their professional lives and must be provided with consistent feedback and support, especially for those with the most fidelity to an existing curriculum.

Specifically in terms of professional development surrounding teachers’ interaction with curricula, two existing frameworks may be appropriate to consider for predicting how to help teachers use the MCAA process most manageably and effectively. First, Loucks-Horsley (1998) identified the most important factors in the success or failure of a curriculum’s implementation. These include a teacher’s ability to use the
materials; how well-designed and effective the materials are known to be; how much training is provided in the first three years of use; how much support exists from other teachers, administrators and other school staff; and how much attention is paid to the task of institutionalizing the materials. The second framework to consider was defined by Aikin (1942) and focuses on the role of the individual teacher. He proposed that in order to build a curriculum “successfully,” many factors needed to be maximized, including teachers’ time, willingness to change, freedom, and responsibility.

**Teaching and Learning the MCAA Process**

A semester course on the MCAA process was created over a two-year span of iterative design-pilot-revise cycles. The initial course outline came from what the designers learned informally about what was most important for teachers to learn in order to retain and implement the process. These important take-aways were supported by what is known about effective professional development, described above: (1) teachers must be able to use the process immediately in their practice; (2) teachers must be able to sustain this use with little external support; (3) teachers must be able to use the process in ways that compliment how they already plan and teach; and (4) teachers must be able to use the process to address the self-identified “big issues” in their practice, specifically issues with differentiation and assessment. This section describes how the four sessions of the course were designed to maximize teacher learning and to address these four foci. The detailed teaching plan for the MCAA course is attached as Appendix A.
Immediate Use

It was important that the work from each session of the MCAA course was directly applicable to teacher practice. Specifically, teachers were given examples of teacher-created work for every step of the process, and were asked to bring work from their own practice each session. In the beginning of the course teachers spent time prioritizing and breaking down content standards and assessing different pieces of their textbook curricula with respect to them (see Appendix B for one example). By the end of the course the majority of session time was spent by teachers sharing and discussing chunks of materials they had assessed, adapted, and used with students. In addition, teachers had homework assignments that asked them to try specific types of assessment, adaptation or differentiation in their classrooms and bring evidence of their observations. Every activity teachers engaged in during the course was meant to be immediately adaptable to their ongoing planning and teaching.

Autonomous Use

Though one important goal of each session was for teachers to use what they were learning and thinking about immediately in their practice, it was equally important for teachers to be able to continue engagement in the MCAA process between sessions and after the end of the course. Furthermore, it was a goal of the design of the course that teachers were intrinsically motivated to continue their engagement in the process because of observed, positive effects on their planning and teaching. While teachers engaged in considerable small group work in the course, such as finding evidence of understanding in student work samples and critically analyzing textbook chunks, it was crucial that teachers could continue this kind of thoughtful work on their own.
Manageable Use

It could be argued that with enough time any teacher could change his or her practice. Because most teachers work long hours and tend to be unwilling to add additional responsibilities to their plates (e.g., Hargreaves, 1994), a third consideration for the design of the course was that the work teachers were asked to do did not add extra time to their existing planning and teaching. One way this was approached was by distinguishing between “more” work and “more effective” work – the course was not meant to add new tasks to the teacher’s day but to change the quality of tasks teachers already engage in. For example, teachers were not encouraged to design more assessments in order to gain more knowledge of what their students knew and could do, but to rethink how the activities they were already asking students to engage in could be used as assessments.

Another way the course design attempted to minimize teachers doing additional work was to encourage teachers to take up the pieces of the MCAA process that made most sense to them. For example, some teachers spent all of their energy prioritizing their content standards and adapting their year-long calendars to change what content they taught and when (step 2a of Figure 3.1). Other teachers wanted their day-to-day teaching to be more effective, so they spent time practicing to read their textbooks more critically and flexibly (step 2c). This flexibility in how teachers focused their engagement in the MCAA process was important in order for teachers to feel the work they were doing in and for the course was directly applicable to their practice.
Addressing Personal Goals and Challenges

Finally, teachers volunteering to engage in professional development want to change their practice on some level. Most teachers have specific pieces of their planning and teaching they want to address, including short- and long-term professional goals. The course allowed these goals to be articulated and personal plans were created for meeting them. Furthermore, to contribute to teachers’ motivations to continue engagement with the process and participation in the course, specific progress measures were used so that teachers could see changes in their practice and the instructors could tailor successive course sessions to the participants’ needs. One example of this came from the goal of a majority of the teachers to change their assessment practices. Teachers brought work samples from a quiz into an early session and small groups looked for evidence of student understandings in the work. Two sessions later teachers repeated the exercise, but many had adapted the quiz in some way, affecting what evidence could be collected and thus how much the teachers learned about what the students knew and could do. During this particular activity, one teacher exclaimed, “I did learn something!”

Design of the MCAA Course

The first, full MCAA course was piloted the year before the course used in this research through two local universities partnered with two high school districts. Seventeen teachers from six high school mathematics departments enrolled in the four-month course in which teachers actively participated in the MCAA process and were provided on-going support to experiment with it in their planning and teaching. From an analysis of the course evaluations, teachers were positive about the usefulness of the
MCAA process: 93% agreed or strongly agreed that the topics presented in the course were relevant to their classrooms and that the course met their expectations, and teachers relayed thirty-eight specific practices they would implement in their classrooms immediately and from then on “on a daily basis.”

What actual changes in teachers’ curriculum use there were, however, was unclear from the informal data gathered from the pilot. Even assuming the process was taught to teachers following the professional development “best practices” mentioned earlier in this chapter, it was not obvious how many teachers continued to use the process in planning and teaching after engaging with it initially, and in what ways. How did the participating teachers view their changed participation with their curricula? What effects did these changes have on their students? The research design described here is a first step in answering these questions.
Research Methods and Considerations

“We know little about how teachers interact with curriculum resources. What verbs best describe teachers’ work in curriculum use: following, reading, interpreting, transacting with, participating with?” (Remillard, 2009, p. 89)

Research Questions

How does teachers’ more systematic engagement with textbook curricula affect their planning and teaching of secondary mathematics?

1. How does teachers’ engagement with the MCAA process affect their material use for teaching secondary mathematics?

2. How does this engagement affect teachers’ descriptions of their planning and teaching?

3. How does this engagement affect teachers’ classroom practices?
Basic Research Design

To understand differences in teachers’ interactions with curricula before and after engaging in the MCAA process, the research design involved describing mathematics teachers’ planning and teaching over time, focusing particularly on teacher-reported and observed changes in their materials use. “Materials” here refers to lesson plans, worksheets, homework, tests, quizzes, projects or anything else used by the teacher in planning and/or teaching. These include both what Stein & Kim (2009) refer to as “base programs,” or materials meant for student use (e.g., in-class worksheets), and “teacher materials,” or materials meant for teacher use (e.g., lesson plans). In order to understand teachers’ planning decisions, including the reasons behind these decisions, teachers were observed in practice before, during and after a five-session, semester-long professional development intervention, and were interviewed to query about specific choices they made for the observed lessons. Table 4.1 highlights the main pieces of the design.
Table 4.1.

Overview of the Research Design

**Sample:**

- 4 focus teachers voluntarily enrolled in a fall semester MCAA Course through Bitner University¹
  - Class met four times during the fall semester of 2008 and once during the spring semester of 2009
  - Course was designed and taught by Shoba Farrell and Megan Taylor

**Methods:**

- Teachers observed and interviewed within three “instructional segments” during the 2008-09 school year
  - September 2008 – before MCAA course began
  - December 2008 – immediate end of MCAA course
  - March 2009 – three months after end of MCAA course
- Each “instructional segment” consisted of a 3-4-lesson segment of instruction addressing a particular goal or topic
- Materials were collected from all days in the instructional segment
- Teachers were observed, videoed and interviewed before and after each focus lesson

**Focus of Analysis:**

- Comparison of teachers’ use of curriculum materials, planning choices and curriculum enactment before and after participation in the course

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¹ “Bitner University” and the names of the four focus teachers are pseudonyms.
Samples and Sampling Methods

Participants

The MCAA course was open to teachers from three suburban high school districts and all feeder middle schools. The districts paid for their teachers’ enrollment, and upon completing the course, teachers received credit from Bitner University equivalent to 2 semester units. Eighteen teachers enrolled in the course by August 2008 and fourteen completed the course to earn credit. In August of 2008 an email was sent to the teachers formally enrolled in the course or who were intending to enroll, explaining the purpose of the study and what participation in it would entail. Seven teachers enrolled in the course volunteered to participate in the study, and four of these became the focus teachers for this research. These four were chosen to be an eclectic, though not formally representative, sample of the teachers enrolled in the course overall. One of the seven was immediately discounted because she had worked with the researcher previously. The number of participants was capped at four to ease the time demands of data collection and analysis. A demographic overview of the course participants and the four focus teachers is provided in Table 4.2.
Table 4.2.

Demographic Overviews of Teachers from the MCAA Course and Four Focus

<table>
<thead>
<tr>
<th></th>
<th>Overall (N=14)</th>
<th>“Maggie”</th>
<th>“Juliana”</th>
<th>“TJ”</th>
<th>“Tama”</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td>Male = 3</td>
<td>Female</td>
<td>Female</td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td></td>
<td>Female = 11</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td>Anglo/White = 8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Asian = 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Eastern Indian = 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hispanic = 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Middle-Eastern = 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Prior Teaching Experience</strong></td>
<td>1-3 Years = 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Experience</strong></td>
<td>4-7 Years = 2</td>
<td>13 Years</td>
<td>25 Years</td>
<td>0 Years</td>
<td>1 Year</td>
</tr>
<tr>
<td></td>
<td>8-11 Years = 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;12 Years = 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Publisher/ Curriculum Used</strong></td>
<td>McDougal-Littell = 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Used</strong></td>
<td>College Preparatory</td>
<td>CPM</td>
<td>McD.-CPM</td>
<td>McD.-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mathematics (CPM) = 6</td>
<td>Littell</td>
<td>CPM</td>
<td>Littell</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other = 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Focus Course</strong></td>
<td>Algebra = 9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Geometry = 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Subject</strong></td>
<td>Other = 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Data Sources and Initial Analyses

The data for this research were collected to provide a clear picture of teachers’ use and perception of curriculum before and after engaging in the MCAA process. Four data “chunks,” described in detail below, were collected three times from each focus teacher over the course of the 2008-09 school year. As shown in Table 4.3, each data source was selected to provide information relevant to at least one of the research questions. All of these data sources could potentially also contribute to a future assessment of how effective the form and content of the MCAA process is, as delivered via the course.
Table 4.3.

Data Sources and Addressed Research Questions

<table>
<thead>
<tr>
<th>Data Sources:</th>
<th>RQ 1: Changes in material use</th>
<th>RQ 2: Changes in descriptions of planning and teaching</th>
<th>RQ 3: Changes in classroom practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Focus teachers’ planning and teaching materials</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Interviews with focus teachers</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>c. Classroom observations of focus teachers</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>d. Activity structures used by focus teachers during observations</td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

All data sources were collected three times during the year from separate instructional segments, and from each focus teacher, to gain an understanding of both short-term and longer-term changes to teacher practice after learning the MCAA process in the fall course. These segments, based on Drake & Sherin’s (2009) “cluster visit” observation methodology, consisted of a nucleus of a few, consecutive lessons of instruction on a particular topic. The length of the instructional segment depended solely on the time the teacher spent on the topic before moving on to something new. The topic
of the instructional segment depended on the week in which the lessons could take place and the teachers’ preferences. For example, teachers were typically given five to eight days notice that the researcher would be coming to begin observation of an instructional segment. Teachers then looked at their schedules and reported when they would be starting the next new topic and how many days they intended to spend on it. These class periods became the instructional segment observed for that teacher. A timeline of when these visits occurred in relation to the teachers’ teaching schedules and the four sessions of the MCAA course is provided in Table 4.4.
Table 4.4.
Timeline for Schedules of Teachers, the MCAA Course and Data Collection

<table>
<thead>
<tr>
<th>Teacher/School Schedule</th>
<th>MCAA Course Schedule</th>
<th>Data Collection Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>August 2008</td>
<td>Instruction begins</td>
<td></td>
</tr>
<tr>
<td>September</td>
<td>Interview #1</td>
<td>Instructional Segment #1</td>
</tr>
<tr>
<td></td>
<td>Session #1</td>
<td></td>
</tr>
<tr>
<td>October</td>
<td>Session #2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Session #3</td>
<td></td>
</tr>
<tr>
<td>November</td>
<td>Session #4</td>
<td></td>
</tr>
<tr>
<td>December</td>
<td></td>
<td>Instructional Segment #2</td>
</tr>
<tr>
<td>January 2009</td>
<td></td>
<td></td>
</tr>
<tr>
<td>February</td>
<td></td>
<td></td>
</tr>
<tr>
<td>March</td>
<td>Interview #2</td>
<td>Instructional Segment #3</td>
</tr>
<tr>
<td>April</td>
<td></td>
<td></td>
</tr>
<tr>
<td>May</td>
<td></td>
<td></td>
</tr>
<tr>
<td>June</td>
<td>Instruction ends</td>
<td></td>
</tr>
</tbody>
</table>
Focus Teachers' Planning and Teaching Materials

DATA SOURCE(S): “Planning and teaching materials” included teachers’ lesson plans, tests, photocopies of textbook pages, lecture notes, quizzes, etc. - essentially any materials teachers used in planning or teaching their focus course. A sample of materials from each of the three instructional segments for each focus teacher was collected in September 2008, December 2008 and March 2009. These collection times were chosen for a few reasons. First, “baseline” data were important to collect from teachers before exposure to the course. Second, data from immediately after the course had finished were collected to be able to compare practice before and after engaging in the MCAA process formally. Third, delayed data were collected to see how changes in curriculum use were sustained or evolved over time. Because the beginning and end of the school year can be especially busy for teachers, and curriculum use might be different during those periods than throughout the rest of the year, data collection did not begin until mid-September (5-6 weeks into school year) and ended in late March (8-9 weeks before end of school year).

All materials were collected: if a teacher mentioned something to the researcher in class or in an interview that had impacted the observed lessons in any way, a copy was collected of the artifact for the instructional segment. For example, one teacher grabbed a new overhead sheet during class to sketch a graph a student was trying to describe, so the overhead was photocopied and included in the collected materials for that instructional segment. Another teacher mentioned to the researcher in a post-observation interview that she had gotten one of the warm-up problems from a worksheet she had used last year. This teacher was asked for a copy of the worksheet and it was collected as well. All materials were collected this way for each instructional segment to be sure the final
stacks of materials most accurately represented what teachers had used to plan and teach that set of lessons.

ANALYSIS: In labeling, organizing, coding and analyzing the materials collected from teachers, this research borrowed heavily from the methods and findings of the Center for Research on Evaluation, Standards, and Student Testing’s (CRESST) “Scoop Notebook” (Borko, Kuffner, et al., 2007; Borko, Stecher, & Kuffner, 2007). The procedures here differ from theirs primarily in that fewer types of artifacts were collected from each teacher in order to examine and compare them in greater detail. The majority of labeling and organizing the collected materials was done by the researcher, with input from teachers when necessary, in order to put less strain on the teachers between observations. Most materials collected (e.g., lesson plans, worksheets, homework) could be categorized by the researcher easily and reliably; in cases where materials were more difficult to sort and label (e.g., informal assessments, standards documents), teacher input was requested at the time of collection.
First, each material collected was labeled to signify the teacher, type, intended day/date of use, and actual day/date of use. These labels were pre-made on sticky notes so that the teachers and the researcher could easily fill them out and apply them to each material sample (Figure 4.1). “Type” categories were created by sorting teacher work from the 2007 course into like piles, then determining a category name for each pile that best reflected its contents. “Like” was defined by the curriculum’s or teacher’s intention for use. For example, materials students would use as worksheets, as task cards or as some other guide for in-class work were categorized as “in-class tasks/activities.” Given these types, teachers in this study were often asked to specify the closest category for a material collected from their classrooms, or to confirm a category used by the researcher. Because of this, final designations best reflected how the teachers saw and defined their own work.

For materials addressing more than one of the lessons (e.g., a lesson plan), all dates were noted; for materials not addressing any lesson, “none” was written. The
distinctions between “intended” and “actual” reflected teachers’ plans as they prepared for a lesson, not what they actually ended up using. Checkboxes were used to signify whether the material was prepared before the lesson (materials the CRESST team called “Artifacts of Practice”) or during the lesson (“Constructed Materials”), and whether the material was meant only for teacher use (e.g., lecture notes). The purpose of labeling materials in general was to document information about each material collected that might be forgotten or remembered differently later on. In fact, early in the first instructional segment it became clear that information about whether the collected material had been taken from an existing resource directly, adapted from something else, or created from scratch was important to note while the teacher could provide the information accurately, and thus the codes “E,” “A” or “C” were also noted on each material’s sticky note. Data from the sticky-note, as well as a randomly-generated three-digit material ID number and a brief description of the work, were inputted into an Excel spreadsheet for each material collected. The use of a random ID number was important so that the coders scoring the materials did not know which teacher or instructional segment each material had been collected from.

The analysis of curriculum materials involved describing changes in which and how materials were used across the three instructional segments, then looking for evidence of MCAA (in terms of the three processes of adaptation) within those general changes. Because the intention was to understand how teachers’ curriculum use changed generally, and because teachers were expected to engage in the MCAA process for different reasons and in different ways, the teachers were focused on as one group for the majority of these analyses.
In stage 1 of the materials analysis frequencies of “Existing,” “Adapted,” and “Created” materials and type of material for each instructional segment were counted. These groups were then broken apart to examine more qualitatively what each entailed. Within each type, for example, materials were sorted into sub-types of materials, and categories were created flexibly as the materials were grouped. This was done to better understand how changes in frequencies of different categories of materials (i.e. existing, adapted, or created materials) were mediated (or not) by the types of materials they consisted of (i.e. standards/goals documents, lesson plans, lecture notes/documents, assessments, in-class tasks). Perhaps, for example, a majority of “adapted” materials early in the year consisted of textbook-based assessments, while later in the year they consisted of standards-based assessments.

In stage 2 of this analysis, materials were examined again for evidence of the MCAA process (Table 4.5). Because the steps of the MCAA process were designed to provide a system for engaging in each of the three processes that are hypothesized here to be crucial to teachers using their curricula purposefully, evidence of the processes in teachers’ materials should have also demonstrated engagement in the MCAA process. Teacher work from the 2007 course had been used to identify what evidence of MCAA in materials might look like for each type of material (left-hand column of Table 4.5). These descriptions were created initially by the researcher, edited by Shoba Farrell (the co-designer of the MCAA process), then collaboratively refined over a period of a few months. This refinement included the continued addition of new teacher work samples in order to be sure all potential evidence of MCAA in work samples was identified. This evidence was then linked to the three process of adaptation as both a final “check” that
they represented the MCAA process and for their usefulness in describing the deliberateness of teachers’ changes to their work. For example, for “standards/goals documents,” a “deliberate prioritization of some standards/goals over others” was reflective of the MCAA process and also of the first and third processes of adaptation.
Table 4.5.
Evidence of MCAA in Teacher Materials, by Type of Material and Which Process(es) of Adaptation Each Addresses

<table>
<thead>
<tr>
<th>Evidence of the Three Processes of Adaptation</th>
<th>1.</th>
<th>2.</th>
<th>3.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prioritization of goals and identification of expected or possible ranges of student understanding</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

- Deliberate prioritization of some standards/goals over others
- Standards/goals broken down into advancing levels of understanding
- Levels of understanding accurately reflect the range of the class
- Each level requires different types of understandings
- Each level requires higher-order thinking (different levels of cognitive demand)
- Inclusion of non-CA standards/goals (NCTM, department, etc.)

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2 For example, Li & Shavelson’s four types of knowledge: procedural, declarative, schematic and strategic.
<table>
<thead>
<tr>
<th>Lesson Plans</th>
<th>Lecture Notes/ Documents</th>
<th>Assessments</th>
</tr>
</thead>
<tbody>
<tr>
<td>based directly on high-priority goals of course/unit, broken down into advancing levels of understanding</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>goals reflect variety of types of understanding</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>activities are tied directly to goals of the lesson</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>evidence of spiraling/ builds on previous lessons</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>takes knowledge of student understandings into account</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>specifies activities, procedures or materials that will be used to gain “updated” knowledge of student understandings</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Lesson Plans</td>
<td>Lecture Notes/ Documents</td>
<td>Assessments</td>
</tr>
<tr>
<td>based directly on high-priority goals of course/unit, broken down into advancing levels of understanding</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>built-in check-ins about student understandings</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>incorporates opportunities for students to make sense of information on their own</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>incorporates opportunities for students to show what they understand</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>existence of standard-specific pre-assessments, formative assessments</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>based directly on high-priority goals of course/unit, broken down into advancing levels of understanding</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>opportunities provided for students to show what they know</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>review/grading structure provides specific</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>
In order to code their collected instructional practice data, the CRESST team first developed dimensions of “reform-oriented instructional practice,” then used them to develop descriptive “rating levels” that denoted the degree to which a teacher’s practice met each of the characteristics. The rubrics, describing in detail “high,” “medium”, and “low” ratings, were used to score the collected teacher materials on a five-point scale ranging from low (1) to high (5). The design and use of rubrics in this research were based on the CRESST model. A rubric was created for each of the five types of teacher materials specifying what “clear,” “possible/partial” and “minimal” evidence of the three processes in teacher work might look like (see Figure 4.2, as one example). Evidence classified as “clear” examples of the MCAA process came directly from the second

<table>
<thead>
<tr>
<th>In-class tasks</th>
<th>X</th>
<th>X</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>feedback to students</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>review/grading structure provides specific information to teacher about students’ understandings, progress</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>based directly on high-priority goals of course/unit, broken down into advancing levels of understanding</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>provides multiple opportunities for students to progress toward goal(s)</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>accessible to students at any level of understanding</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>requires multiple types of understandings of all students</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>requires higher-order thinking of all students</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>provides specific information to teacher about students’ understandings, progress</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>
column in Table 4.5 above. Each collected material was given a “holistic” score from 1 to 5 reflecting increasing evidence of the MCAA process.

In addition to this qualitative scoring, a “checklist” score for each piece of work was recorded. Scores from the holistic rating scales do not provide information about the existence of specific and crucial components. Thus, for some more objective pieces of evidence of MCAA for each material, such as if goals were prioritized or not, or whether goals were leveled or not, each material was given an additional score from 0 to 6, 0 to 7 or 0 to 8, depending on the rubric. All rubrics are attached as Appendix C.
Checklist:

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

Evidence of adaptation
Evidence of goals
Evidence of prioritization of goals
Evidence of determination of different levels of understanding
Evidence of accessibility to all students
Evidence of multiple opportunities for students to show what they know
Evidence of qualitative feedback available via grading
Evidence of opportunities for teacher to gain new knowledge of students’ understandings

Checklist Score: _______/8

Holistic Rating Levels:

<table>
<thead>
<tr>
<th>Clear (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Assessment is based directly on high-priority goals of the course/unit that are broken down into advancing levels of understanding, and these levels are made explicit to students in some way.</td>
</tr>
<tr>
<td>• Assessment is accessible on some level to all students and provides multiple opportunities for students to show what they know and can do.</td>
</tr>
<tr>
<td>• The review/grading structure of the assessment will provide specific, qualitative feedback to students about their understandings and specific, qualitative information to the teacher about students’ progress toward meeting each standard addressed, specifically the high-priority goals of the course/unit.</td>
</tr>
</tbody>
</table>

EX: A unit test is designed to address two essential goals of the course and three sub-goals particular to the unit. These goals are all broken down into advancing levels of understanding and made available to students as the cover-sheet of the test. Problems were specifically crafted to address the five goals, and each is written such that a student at any level of understanding can at least start it. Problems are designed to provide students opportunities to show what they know, instead of just to expose what they do not know. The teacher grades the test by looking for evidence of understanding of each goal in the work and highlighting where the student’s understandings lie along each of the goals continua. In reviewing the test with the class, the teacher focuses exclusively on helping students understand which problems provided opportunities to show which understandings.

Possible/Partial (3)

| • The assessment’s goals are broken down into advancing levels of understanding and these levels are made explicit to students in some way. |
| • Assessment is accessible on some level to all students OR consistently provides multiple opportunities for students to show what they know and can do. |
| • The review/grading structure of the assessment will provide specific, qualitative feedback to students about their understandings OR specific, qualitative information to the teacher about students’ progress toward meeting each standard addressed. |

Minimal (1)

| • The assessment’s goals are made explicit to students in some way. |
| • Assessment is accessible to most students but excludes at least one particular sub-group (e.g., most struggling students or most advanced students) and does not consistently provide multiple opportunities for students to show what they know and can do. |
| • The review/grading structure of the assessment will provide limited feedback to students about their understandings and/or limited information to the teacher about students’ progress toward meeting each standard addressed. |

Holistic Rating: _______/5

Figure 4.2. Descriptions of MCAA materials rating levels for assessment documents.
At each level, the design of the rubrics minimized the number of features of each
description without “compromising the essential nature” (Borko, Kuffner, et al., 2007, p. 57) of that material type’s descriptions. This was important in order to be able to specify precise decision rules for scorers choosing between two ratings, and to account for possible differences in rating reliability based on material type. Two doctoral students in mathematics education volunteered to assist in scoring materials using these rubrics, and both were given minimal information about the purpose and design of the research. After a brief training meeting in which the coders were introduced to the rubrics and shown four sample materials with corresponding scores, eight new pieces of work from teachers outside the study were scored. The scorers were in agreement for seven of the eight holistic and six of the eight checklist scores, and clarified decision-making guidelines for future scoring. From there, all three coders individually scored all materials from the study designated “adapted” or “created.” The same packet of work, from which identifying information was removed (i.e. teacher’s name, date) and ordered by material ID, was given to each coder, along with a scoring sheet to record holistic and checklist scores for each material. The packet consisted of 74 materials in all from the focus teachers.

When all three coders had finished coding the materials individually, they came together to discuss discrepancies. Three-way inter-rater reliability was satisfactory for all checklist scores ($\alpha_K = 0.77, N=74$) and all rubric scores ($\alpha_K = 0.83, N=74$), and for no

3 The CRESST team reported that differences in raters’ subject-matter knowledge “were associated with differences in perceived difficulty of ratings and in rater confidence” (p. 61). This point highlights the important of having final coders “matched” in some way in terms of teaching experience and subject-matter expertise.
piece of work were all three coder’s scores different. Furthermore, there was
disagreement between the two coders for both the holistic and rubric scores for only two
materials. In the discussion of the discrepancies (N=12), the material ID and three scores
were provided for a piece of work, then the two coder volunteers discussed the work and
came to an agreement on the final score. The initial scores given by different coders were
not relayed, nor did the researcher participate in the discussion. In cases where the two
coders had agreed on the score and the researcher’s score was the outlier (N=4), the
coders’ score was assigned to the work without discussion.

Mean checklist and holistic rating scores were calculated for materials from each
instructional segment and broken down by teacher and the five types of materials. The
latter was calculated to examine whether certain types of materials’ scores changed more
than others (e.g., changes over time in assessment ratings vs. lesson plan ratings), or
whether one type of material was “more accurately” rated in general than another. The
CRESST team, for example, found that some of the rubrics’ dimensions used for both
mathematics and science notebooks “seemed to operate better in one subject area than the
other” (p. 60), such as the “Connections/Applications” dimension being “well defined” in
mathematics reform materials but not so in the science reform materials.

Interviews with Focus Teachers

DATA SOURCE(S): Each focus teacher was interviewed at five different periods
throughout the school year. One beginning-of-year (BoY) (September 2008) and one end-
of-year (EoY) (April 2009) interview was conducted with each teacher to get a
comprehensive sense of their planning and teaching. The same interview protocol was
used for both of these interviews (see Appendix E), using the same follow-up questions that had arisen organically in the BoY interview in the EoY interview. A set of interviews was also conducted immediately before and after each instructional segment. As mentioned above, the questions and probing in these instructional segment interviews were designed to address materials use observed in the lesson, specifically with regard to planned or unplanned use.

For the first and final interviews of the school year a preliminary interview protocol was designed attempting to map the questions asked onto the research questions and onto the three processes of adaptation making up MCAA. The interview protocol, which was designed to stand alone, was piloted and revised twice with two different sets of two mathematics teachers. Teachers were told that the goal of the interview was to develop an understanding of their planning and teaching, specifically with respect to how they use their curricula. At the end of the EoY interview teachers were also asked whether they thought their practice had changed at all over the course of the year and if so, to describe how it had changed. Teachers were encouraged at the end of both interviews to contact the researcher by phone or email if they wanted to add anything else, and were left with a blank copy of the interview protocol.

ANALYSIS: The main purpose of the interview data was the same as the observational data – to document patterns of change in teachers’ materials use. All interview data was used as a bank from which to pull quotes highlighting conclusions about changes in practice, and specific quotes that marked changes in a teacher’s discourse were noted. The BoY and EoY interview data, however, served the more specific purpose of highlighting changes in teachers’ descriptions of their own curriculum
use as linked (or not) with the MCAA process. These eight interviews were audio taped and later transcribed.

The second and third steps of the MCAA process had been used as a basis for developing a preliminary coding scheme for the BoY and EoY interview transcript data. It was important to know how often and in what ways teachers talked about goals, students’ understandings, assessing their materials, changing their materials or using materials as is, in order to best describe changes in their descriptions of curriculum use with respect to the MCAA process. The final set of codes used, including examples of teacher talk coded with each, is shown in Table 4.6.

The first-degree codes in the right-hand column, codes marking teacher-talk most reflective of the MCAA process, were used to capture moments when teachers were linking goals, understandings, assessments and adaptations directly and specifically to students. This is a primary focus of the MCAA course. Comments coded with these codes generally involved teachers describing making changes to a particular piece of curriculum (i.e. a worksheet, a chapter test) based on specific understandings of particular students from evidence collected in their classrooms that year (e.g., ‘I didn’t use page 86 as is today because yesterday I learned five students are still using guess-and-check, ten students can perform substitution but don’t know when, and eight students are already using elimination. Instead I adapted the launch problem so that students have to solve it in two different ways and describe which way is more efficient.’).

The difference between the second and third-degree codes is primarily a matter of type or amount of justification; in general, second-degree codes mark excerpts where teachers justify assessments of and changes to their curricula with either material-focused
comments (e.g., ‘I didn’t use page 86 because the wording is confusing and it is unclear if you’re supposed to solve with guess-and-check or substitution.’) or links to general student understandings (e.g., ‘I didn’t use page 86 because last year my students really struggled with solving linear equations the way the text presents it.’). Third-degree codes denoted comments wholly separate from students, which were usually assessments of materials without any link to students’ understandings (e.g., ‘I didn’t use page 86.’).

Excerpts addressing one of three themes were highlighted first: discussion of student understandings (N=54), assessment of materials (N=79), or justifications for adaptations (or lack thereof) (N=127). Within each thematic group, excerpts were again split into one of three sub-themes based on degree of evidence of MCAA. The same coders who scored the materials code-checked these final groupings and twelve codes were changed (of 260). Frequency comparisons were then made between percentages of all excerpts from each sub-theme, within each larger theme and for each teacher.
Table 4.6.

Interview Transcript Codes for Teachers’ Descriptions of their Planning and Teaching

<table>
<thead>
<tr>
<th>Steps of the MCAA Process</th>
<th>Degree of Reflectivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Third-degree: Not Reflective of MCAA</td>
<td>Second-degree: Minimally Reflective of MCAA</td>
</tr>
</tbody>
</table>

**Step 2a:** Prioritization of Learning Objectives
- **Use of Standards or Goals:** e.g., ‘I used the California state standards.’
- **Prioritization of Standards or Goals:** e.g., ‘I focused on standards 5, 10 and 11.’

**Step 2b:** Determination of Ranges of Student Understanding
- **Discussion of Understandings:** e.g., ‘Lots of kids got it.’
- **Discussion of Polarized Understandings:** e.g., ‘Half the kids got it and half the kids didn’t.’
- **Discussion of Ranges of Understandings:** e.g., ‘A few kids got everything, about a third got at least the main points, only three were really lost.’

**Step 2c:** Assessment of Materials Access to All Ranges of Mathematics Content
- **Interpretation of Materials:** Assessment of Materials’ General Access to Mathematics Content
- **Assessment of Materials’ General Access to Mathematics Content:** Assessment of Materials’ Specific Access to Mathematics Content
<table>
<thead>
<tr>
<th>Student Understanding</th>
<th>Assessment of Materials</th>
<th>Assessment of Materials’ General Meeting of Students’ Needs</th>
</tr>
</thead>
<tbody>
<tr>
<td>e.g., ‘Pg. 86 is a lesson on factoring.’</td>
<td>Assessment of Materials</td>
<td>Meeting of Students’ Specific Needs</td>
</tr>
<tr>
<td>e.g., ‘Pg. 86 isn’t going to help kids get factoring.’</td>
<td>Assessment of Materials’ General Meeting of Students’ Needs</td>
<td></td>
</tr>
<tr>
<td>e.g., ‘Pg. 86 isn’t going to help kids learn the area model for factoring.’</td>
<td>Assessment of Materials’ General Meeting of Students’ Needs</td>
<td></td>
</tr>
</tbody>
</table>

**Step 3: Adaptation or Supplementation of the Existing Materials (if necessary)**

<table>
<thead>
<tr>
<th>Adaptation</th>
<th>Adaptation Linked to Materials Assessment</th>
<th>Adaptation Linked to Student Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>e.g., ‘I changed Pg. 86.’</td>
<td>e.g., ‘I changed Pg. 86 to make the opening problem less confusing.’</td>
<td>e.g., ‘I rephrased the opening problem on Pg. 86 because the day before a few students got stuck reading the problem and couldn’t start.’</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Creation</th>
<th>Creation Linked to Materials Assessment</th>
<th>Creation Linked to Student Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>e.g., ‘I made a worksheet.’</td>
<td>e.g., ‘I replaced Pg. 86 with a factoring worksheet because the opening problem was’</td>
<td>e.g., ‘I replaced Pg. 86 with a factoring worksheet because the day before a few students got stuck reading the problem’</td>
</tr>
<tr>
<td>Use of Existing Materials</td>
<td>Use of Existing Materials Linked to Materials Assessment</td>
<td>Use of Existing Materials Linked to Student Assessment</td>
</tr>
<tr>
<td>---------------------------</td>
<td>------------------------------------------------------</td>
<td>------------------------------------------------------</td>
</tr>
<tr>
<td>e.g., ‘I used Pg. 86.’</td>
<td>e.g., ‘I used Pg. 86 as is because the activity is rich and teaches factoring well.’</td>
<td>e.g., ‘I used Pg. 86 as is but know I’ll have to support some of my ELL students starting the opening problem because of what happened yesterday.’</td>
</tr>
</tbody>
</table>

**Observations of Focus Teachers**

DATA SOURCE(S): All lessons were observed and videotaped from each focus teacher’s three instructional segments. During these observations, extensive notes were taken that focused primarily on in-class material form and use that might have guided the post (e.g., when and how teachers introduced different materials to students was noted or when teachers decided not to use something they had planned to use) (see Appendix D). Going into each lesson the teacher met with the researcher to relay the goals of the lesson, what materials would be used, which materials students would interact with, and so on - information that sometimes came only from a formal lesson plan. Following each lesson the teacher met with the researcher again to clarify choices he/she had made during the class period and to prepare used materials for collection. The following section of this chapter describes these interviews in more detail.

For the video data collection, guidelines for taping and storing video from the 1999 International Mathematics and Science Study (TIMSS) (Jacobs, Kawanaka, &
Stigler, 1999) were followed. These recommendations included consistency of camera placement, expedient digitization of footage and storage in multiple databases. The camera was placed in the same location in each teacher’s classroom in successive visits, and “equivalent” places were used in different teachers’ classrooms. The video was digitized soon after each focus lesson and a copy was saved to DVD.

Two data sets about how the curriculum materials were implemented in the observed lessons were also collected to provide another perspective on changes in teachers’ curriculum use. First, every five-minute chunk of the observed period was given a code representing the primary class activity structure for that segment. Nine codes were used in all, describing different types of teacher-led instruction, groupwork, individual work, and class discussion. The final names for these codes were compared with Grossman’s (2009) codes for student participation so that codes describing the same structure could be synced. These codes are described in Table 4.7.
Table 4.7.
Final Codes for Activity Structures Used to Describe Snippets of Classroom Practice

<table>
<thead>
<tr>
<th>Code</th>
<th>Brief Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small Group Work, Unstructured</td>
<td>Students worked in groups of three or more organically, without direction from the teacher.</td>
</tr>
<tr>
<td>Small Group Work, Structured</td>
<td>Students worked in groups of three or more because of direct request by the teacher.</td>
</tr>
<tr>
<td>Individual Work</td>
<td>Students worked individually, interacting only with the teacher (if at all).</td>
</tr>
<tr>
<td>Whole Group Discussion, Teacher-Led</td>
<td>Whole class engaged in a discussion about a certain topic; teacher facilitated who spoke, when, and the content of the discourse.</td>
</tr>
<tr>
<td>Whole-Group Discussion, Student-Led</td>
<td>Whole class engaged in a discussion about a certain topic; students guided the discourse; teacher was a participant or observer only.</td>
</tr>
<tr>
<td>Interactive Direct Instruction</td>
<td>Teacher led the activity of the class directly, consistently using ideas, suggestions and questions from students.</td>
</tr>
<tr>
<td>Non-Interactive Direct Instruction (Lecture)</td>
<td>Teacher led the activity of the class directly with no input from students beyond questions.</td>
</tr>
<tr>
<td>Logistics-Focused Direct Instruction</td>
<td>Teacher dealt with bureaucratic, logistical needs.</td>
</tr>
<tr>
<td>Student Presentation/ Sharing</td>
<td>Students (individually or in small groups) presented or shared work with the class either as volunteers or as asked by the teacher.</td>
</tr>
</tbody>
</table>
ANALYSIS: The frequency of each activity structure was calculated, as well as the percent of all class time spent in each structure. These totals were broken down by instructional segment and by teacher, and were compared quantitatively. The rest of the summative observation notes and video data were used only as resources to supplement the out-of-context material analyses described above and inform the interpretation of data.
CHAPTER 5

Results and Interpretations:

Changes in Teachers’ Curriculum Use, Descriptions of Planning and Teaching, and Classroom Practice

“Curriculum adaptation is inevitable and difficult” (Schnepp, 2009, p. 199).

The form of analysis described in the previous chapter, namely looking at the four teachers as one group, was chosen in order to understand and describe changes in teachers’ practice reflective of their engagement in the MCAA process in general over the course of a school year, the primary question of this research. However, for each analysis the data were also broken down by teacher. In some of these individual analyses, one or more teachers stuck out as being markedly different from the general pattern; in these cases, the contrast was described. In analyses where individual teachers all largely reflected the general pattern, individual teacher vignettes were left out. This chapter describes changes in the teachers’ use of curriculum resources, descriptions of their planning and teaching, and use of activity structures in classroom teaching, and how these changes were reflective (or not) of teachers’ engagement in the Mathematics Curriculum Assessment and Adaptation (MCAA) process.
Changes in Teachers’ Curriculum Use

Changes in Categories of Materials

Figures 5.1 and 5.2 show the frequencies of all collected materials categorized by adaptation category and by material type over three data-collection points. Materials labeled “homework” were not included in these analyses because all teachers used standardized homework assignments within their departments that they had no flexibility in adapting. A small set of collected materials that were generally insignificant to the planning and teaching of the course or that were rigid in form and content (e.g., teachers were not allowed to change them) were also excluded from these analyses. These included content-irrelevant materials (e.g., homework point tracking sheets) and materials that were relevant to the lesson and/or referred to by the teacher but that were not used in the planning or teaching of the lessons directly (e.g., an appendix page of the textbook with the formula learned during the class period). These omissions were made to focus analyses on curricular materials teachers had the freedom to change (e.g., representative of the teacher’s work and not the department’s), even if not encouraged or expected to, and that were linked to mathematics content. These omission decisions were made both before any materials were collected and during the first instructional segment, then guided material collection in successive segments. This approach was important to be sure the same materials were included in and omitted from different instructional segments without subjective influence.

4 In a few, isolated cases two of the four teachers adapted or replaced homework assignments despite the departmental standard. These adaptations were not included in this analysis for consistency.
Figure 5.1. Frequencies of all collected materials by instructional segment and adaptation category.

102 materials were used in the analysis in all: 36 materials from instructional segment 1 (IS1) in September, 35 materials from IS2 in December, and 31 materials from IS3 in March later that academic year. “Existing” materials (N=28) refer to those that remained unchanged by the teacher; these materials may have been pulled directly from a textbook or used exactly as provided by a colleague. “Adapted” materials (N=27) refer to those the teacher made changes to in some way, such as materials where problems were re-ordered, re-worded or omitted. A material was categorized as “adapted” if the teacher made any change to its content. “Created” materials (N=47) refer to those designed by the teacher from start to finish that did not originate directly from other curricular sources.
While the proportion of “created” materials varied little across the three instructional segments, the proportion of “adapted” and “existing” materials inverted from September to December, a change that remained relatively stable in March (see Figure 5.1). Specifically, the number of “adapted” materials rose from 3 (8% of all) to 12 (35%) from September to December, while “existing” materials decreased from 16 (43%) to 5 (13%). Comparing just materials used as-is to materials influenced by the teacher, in September 56% of the materials collected were “created” or “adapted,” a percentage that increased in December and March to 86% and 78% of the materials, respectively.

*Changes in Material Types*

*Figure 5.2. Frequencies of all collected materials by instructional segment and material type.*
Figure 5.2 shows the frequencies of all collected materials by instructional segment and material type. “Assessments” (N=21) refer to formal quizzes and tests given during a period, but also to anything else the teacher used specifically to understand students’ understandings (e.g., exit ticket, journal entry, outside-of-class project.). “In-class tasks” (N=48) refer to mathematics content-specific activities students engaged in during a period that were not considered formal assessments. “Presentation/lecture” (N=11) documents refer to materials the teacher used to prepare for or conduct a formal lecture, such as powerpoint slides or hand-written outlines. “Lesson plans” (N=20) refer to materials the teacher used to prepare for or conduct the course of a class period, including daily, weekly or monthly outlines. “Standards/goals” (N=2) documents refer to materials used solely for organizing information about learning outcomes, such as a list of the goals for a unit or a breakdown of a daily lesson goal into skills and concepts.

In general, the proportions of “assessment” (AS) and “presentation/lecture” (PN) materials increased from September to December, remaining stable in March. In both cases, the number of materials in December and March were at least double the number of materials in September. The number of “in-class tasks” (IT) documents decreased in December but increased in March, exactly the opposite of the general pattern for “lesson plan” (LP) materials.

Changes in Material Sub-Types

To have a better idea of the make-up of these general categories, sub-types were created by first sorting all materials into piles by like kind, then naming each pile to most accurately reflect its contents. Piles were named only after all materials had been placed.
Table 5.1 presents the initial and final lists of sub-types. Some of the initial sub-types were combined with others because the specificity did not contribute anything extra to an understanding of changes in sub-types across instructional segments, and in some cases made patterns in sub-types more difficult to see.
Table 5.1.

Sub-Types of Materials

<table>
<thead>
<tr>
<th>Type of Material</th>
<th>Initial Sub-Type</th>
<th>Final Sub-Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assessment</td>
<td>Formative Assessment</td>
<td>Formative Assessment</td>
</tr>
<tr>
<td></td>
<td>Goal Tracking</td>
<td>Goal Tracking</td>
</tr>
<tr>
<td></td>
<td>Project</td>
<td>Project</td>
</tr>
<tr>
<td></td>
<td>Chapter Quiz</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Topic Quiz</td>
<td>Quiz/Test</td>
</tr>
<tr>
<td></td>
<td>Chapter Test</td>
<td></td>
</tr>
<tr>
<td>In-Class</td>
<td>Task Launch</td>
<td>Task Launch</td>
</tr>
<tr>
<td>Task/Activity</td>
<td>Class Warm-up</td>
<td>Class Warm-up</td>
</tr>
<tr>
<td></td>
<td>Manipulative/Resource</td>
<td>Manipulative/Resource</td>
</tr>
<tr>
<td></td>
<td>Textbook Problems</td>
<td>Textbook Problems</td>
</tr>
<tr>
<td></td>
<td>Worksheet from Colleague</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Worksheet from Curriculum</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Worksheet from Scratch</td>
<td>Worksheet</td>
</tr>
<tr>
<td></td>
<td>Worksheet from Textbook</td>
<td></td>
</tr>
<tr>
<td>Lesson Plan</td>
<td>Formal Lesson Plan</td>
<td>Formal Lesson Plan</td>
</tr>
<tr>
<td></td>
<td>Monthly Calendar</td>
<td>Planning Calendar</td>
</tr>
<tr>
<td></td>
<td>Weekly Calendar</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Textbook Guide</td>
<td>Textbook Guide</td>
</tr>
<tr>
<td>Presentation/Lecture Notes</td>
<td>Lecture Notes on Overhead</td>
<td>Lecture Notes</td>
</tr>
<tr>
<td></td>
<td>Lecture Notes on SmartBoard</td>
<td></td>
</tr>
<tr>
<td>Standards/Goals</td>
<td>Adapted Standards</td>
<td>Adapted Standards</td>
</tr>
</tbody>
</table>
To identify patterns in sub-types of materials used across adaptation categories, sub-types appearing in various combinations of instructional segments were examined. For example, twelve materials appeared in the “adapted” category in both the second and third instructional segments (twenty-four in all), but the material make-up of these two groups was quite different. Because change in teachers’ curriculum use over time (specifically from before and after engagement in the MCAA process) is the focus of this research, two specific patterns were examined: sub-types of materials appearing in all three instructional segments and sub-types that first appeared in either instructional segment 2 or 3.

Figure 5.3 shows each section of Figure 5.1 broken down by material sub-type, and for each adaptation category highlights the sub-types that appeared in all three instructional segments and just in IS2 and IS3. Frequencies of each material sub-type are shown within each adaptation category and instructional segment in separated bars. The size of each section within a given bar reflects the proportion of materials in the whole bar group of a particular material type (e.g., in-class task, assessment). For example, of “created” materials from the first instructional segment (top-left bar), one “assessment” material was collected (“quiz/test”) and ten “in-class task” materials were collected (“class warm-up” N=6; “task launch” N=1; “worksheet” N=3). The difference in size of the “assessment” and “in-class task” sections reflects their representative proportions of all “created” materials collected in the first instructional segment.

Sub-types in italics in Figure 5.3 appeared in all three instructional segments for their respective adaptation category. Overall, five of fourteen (36%) sub-types appeared in all three instructional segments for at least one adaptation category of materials. Sub-
types “quiz/test” and “planning calendar” appeared in each instructional segment within the group of “created” materials. This was the same for “adapted” materials with the exception of the “planning calendar” sub-group. Materials from the textbook were more prevalent in “existing” materials; the sub-groups “textbook problems” and “textbook teaching guide” appeared in all instructional segments of the “existing” materials group. Materials from the sub-type “worksheet” appeared in every adaptation category, in every instructional segment, the only sub-type to do so.

While nine different sub-types of materials appeared in the first instructional segment across all three adaptation categories, all fourteen sub-types appeared in the second and/or third instructional segments. Ten of these fourteen (71%) material sub-types appeared exclusively in the second and third instructional segments (shown in bold in Figure 5.3) and none of them were within the group of materials categorized as “existing.”

Though there was little variation in the proportion of all collected materials the four teachers created across the instructional segments, the make-up of these materials in each segment was very different. “Created” materials was the only adaptation category where the make-up of materials from instructional segment one (IS1) and three (IS3) were most similar. In fact, all the sub-types from IS3 appeared in IS1. Additionally, nine sub-types of materials appeared in the second instructional segment (IS2) that did not appear in the first or third. Three of these nine sub-types within the “created” adaptation category for IS2 were types of assessments, and five were formal lesson plans.
Note: Frequencies follow each sub-type in parentheses.

Figure 5.3. Breakdown of Figure 5.1 by material sub-type.
In looking at individual teachers, there was a great deal of variation in sub-types of materials used, but little variation in frequencies of types of materials. For example, in the “in-class task” type for “created” materials in the first instructional segment (top-left bar in Figure 5.3), the ten materials were split between all four teachers. However, materials of the “class warm-up” sub-type came from two of the teachers, and the “worksheet” materials were split between a different pair of teachers. The types where this was most true were “assessments” and “in-class tasks” overall.

Looking at this a bit more closely, the sub-types of materials teachers used seemed to be aligned with teaching experience across instructional segments and adaptation categories. The materials TJ, the first-year teacher, used within “in-class tasks” were primarily of the “textbook problems” sub-type for all three instructional segments, a similar trend for Tama, the second-year teacher. The “in-class task” materials from the veteran teachers, Juliana and Maggie, included a much more diverse cluster of sub-types, including a variety of “worksheet” and “class warm-up” materials. These consistencies along lines of teaching experience were maintained as sub-types changed from one instructional segment to the next. For example, the origin of Juliana’s “in-class task” materials shifted away from her textbook from the first to second instructional segment, a pattern that was true for Maggie but not for TJ or Tama.

*Changes in Materials’ Reflectivity of the MCAA Process*

Changes in mean MCAA checklist and rubric scores for all “adapted” and “created” materials are shown in Table 5.2. While the mean checklist score was 2.79 for materials collected in the first instructional segment in September, in December and
March the scores’ means rose to 4.00 and 4.39, respectively. The mean rubric scores also increased significantly from September, rising from 1.29 to 1.76 in December and to 2.11 in March.

Table 5.2.
Changes in Mean MCAA Checklist and Rubric Scores for All “Adapted” and “Created” Materials

<table>
<thead>
<tr>
<th></th>
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<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>IS1 (September) (N=20)</td>
<td>2.79</td>
<td>--</td>
<td>--</td>
<td>1.29</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>IS2 (December) (N=30)</td>
<td>4.00</td>
<td>1.21</td>
<td>--</td>
<td>1.76</td>
<td>0.47</td>
<td>--</td>
</tr>
<tr>
<td>IS3 (March) (N=24)</td>
<td>4.39</td>
<td>1.60</td>
<td>0.39</td>
<td>2.11</td>
<td>0.82</td>
<td>0.35</td>
</tr>
</tbody>
</table>

Note: The highest possible checklist scores ranged from 5 to 8, depending on the material type. The highest possible rubric score was 5. N values refer to the total numbers of materials coded in that instructional segment.

Interpretation of Results

The decrease in teachers’ use of curriculum materials as-is (“existing” materials) and increase in teachers’ decisions to change materials (“adapted” materials) over the
three instructional segments suggests a marked shift in textbook use over time (Figure 5.1). Specifically, teachers took more liberty with assessments and in-class tasks in December and March, modifying textbook provisions or replacing them entirely with materials they created from scratch. It is not especially surprising that these teachers changed, supplemented or replaced materials for classroom activities more as the school year went on considering some teachers (e.g., experienced teachers) may be better able to assess how effective a particular material is in facilitating learning later due to increased knowledge of their students over time. It is surprising, however, that there would be a similar increase in modified and created assessments, for the same reason; teachers know the least about their students’ needs and understandings at the beginning of the year and should arguably be assessing the same amount and with the same variation then, if not more.

The fact that the most obvious increase in proportion of one type of material over successive instructional segments was in “assessment” materials contradicts previous research findings (Figure 5.2). For example, Borko, Davinroy, Bliem, and Cumbo (2000), in a study of veteran teachers participating in a reform-based professional development effort, describe that though the assessments teachers in their study used emphasized conceptual understanding more over time, they changed far less overall than their instructional practices did. The authors interpret this finding by saying “teachers generally have more experience and expertise related to instruction than assessment…[so] it may be more difficult to help teachers change their assessment than their instructional practices” (pp. 295-296). If this is true, the shift in all four teachers’ assessment practices is especially striking.
The sub-types appearing in all three instructional segments - quiz/test, worksheet, textbook problems, class warm-up, planning calendar and textbook teaching guide - may reflect “core” pieces of a textbook-based curriculum (Figure 5.3). That is, both McDougal-Littell and College Preparatory Mathematics, the textbooks used by the four teachers in this study, offer these materials for every chapter or unit, and often in malleable forms (i.e. test generator software on a given disk). This helps explain why these sub-types appeared across adaptation categories, as well; if these materials are considered the skeleton of a textbook curriculum, we’d expect that teachers would use some of them as-is or with a bit of adaptation. Sub-types that did not appear in all instructional segments, such as “formative assessment” and “goal-tracking” may be materials that textbook writers consider supplementary or a matter of teaching style; while a mathematics teacher does not have to start his/her class with a warm-up, for example, every mathematics teacher uses quizzes or tests in some form or another.

This reasoning may also help to explain why the sub-types of materials that appeared exclusively in the second and third instructional segments were what they were. With the exception of “task launch, “planning calendar,” and “lecture notes,” all sub-types of materials from the first instructional segment were standard materials included in every chapter of both textbooks. The teachers added to and adapted their textbook curricula in novel ways more frequently in later instructional segments, using materials such as “goal tracking” and “adapted standards” for the first time. Assuming the teachers were generally using materials that did not come directly from their texts more frequently over time, we’d expect to see the bulk of these new sub-types in the “adapted” and
“created” adaptation categories. In fact, all materials appearing only in the second and third instructional segments were “adapted” and “created.”

The difference in sub-types composing “created” materials between the second instructional segment and the first and third instructional segments is striking. This may be explained in part by the fact that IS2 followed the end of the MCAA course directly, and there may have been some interference of social desirability in materials collected due to the course teacher and researcher being the same person. For example, variation in assessment and the importance of lesson planning were two main themes of the course. Almost half of the “created” materials collected in this instructional segment were assessments or formal lesson plans. Possibly teachers were especially motivated to demonstrate what they had learned in the course in IS2, a motivation that petered out by the March instructional segments. Or possibly teachers tried to change many pieces of their planning and teaching at once (evident in IS2), settling on one or two pieces that they maintained changed (evident in IS3).

Looking at this explanation from another angle, assuming the work of adaptation is more difficult and complex than the work of using a material as-is or replacing it entirely, perhaps this spike in “created” materials actually reflects a midpoint of an observed curriculum-use trajectory from “existing” to “adapted.” That is, perhaps as teachers begin to take more liberty in critiquing their textbook’s lessons and problems, they initially dismiss those deemed sub-par for use with their students entirely. As teachers continue this process, however, perhaps they become more adept at assessing the lessons in more nuanced ways, or even just more positive ways, such as assuming every lesson has potential for use. This would especially make sense for new teachers, as we
know they typically begin the year using their textbook with high fidelity (Remillard & Bryans, 2004), while also believing the best teachers create everything from scratch (Ball & Feiman-Nemser, 1988).

The fact that materials from the teachers with more teaching experience tended to be more varied in sub-type may reflect the increased comfort a teacher feels over time teaching the same content or grade-level. Experienced teachers may worry less about classroom management and organization, for example, and have prior experiences and materials to draw on when approaching a topic they plan to teach (e.g., Behm & Lloyd, 2009; Remillard & Bryans, 2004). Juliana referred often to her “blue binder” in which she kept photocopies of activities, worksheets and assessments she’d used in her teaching over the years, and Maggie talked about knowing which teachers in the department were the best resources for different parts of her content. We know that new teachers use their textbooks much more faithfully than experienced teachers in part because they are still defining their role as a curriculum adapter and writer (Silver, et al., 2009).

The positive change in mean checklist and rubric scores from instructional segment 1 to 2 and 3 reveals more about the increase in “adapted” materials over the course of the year and about the make-up of the “adapted” and “created” materials in general. First, because the rubrics were designed specifically to assess evidence of the MCAA process in individual curriculum materials, the change shows that teacher work from the second and third instructional segments was more reflective of student-focused curriculum assessment and adaptation than it had been at the beginning of the school year. This means that not only were teachers taking more license in changing, supplementing or replacing their curricula as the year went on, but also that these
adaptations specifically reflected an attention to the MCAA process. Furthermore, the use of checklist and holistic scores was intended to capture both nuanced and big-picture characteristics of materials’ reflection of MCAA. Thus, the fact that both sets of means increased bolsters the claim that teachers’ work in the middle and end of the year was more reflective of the MCAA process than it had been in the early fall.

Second, the fact that the changes in material scores from September to December were sustained in March suggests that teachers’ material-based curriculum use related to the MCAA process was not just observed coincidentally at one point in the year. Because the second instructional segment took place after the MCAA course in the same teaching semester, teachers may have been especially motivated to interact with their curricula then in MCAA-specific ways. This is in part why the instructional segments were chosen, so that they did not coincide with the time periods teachers in the course chose to focus on (January and early February). The fact that the same kinds of material changes were still evident in March, however, suggests that changes were sustained in some ways through the end of the school year.

Third, when looking at the materials sorted by teacher, these changes in mean material scores were evident in all four cases to varying degrees. This is crucial to the integrity of the claims about the group of teachers as a whole. It suggests that for these four teachers, the increase in material adaptation and creation reflecting the MCAA process may have transcended individual characteristics that impacted the interview and activity structure data described in the previous section, such as teaching experience and classroom context.
These findings tell us more about the kinds of curriculum adaptations teachers were making more of in December and March and potentially contribute to our understanding of what a “trajectory of typical curriculum use” might look like. These four teachers not only shifted away from using their existing curricula as-is, they also shifted toward a more deliberate and student-focused engagement with their materials over time.

**Changes in Teachers’ Descriptions of Curriculum Use**

To understand how and whether or not changes in teachers’ classroom practice were reflected in changes in their descriptions of practice over time, interviews from the beginning (September) and end (March) of the school year were compared. This section first presents general patterns of change in categories of teacher-talk between September and March, followed by comparisons of sets of interview excerpts highlighting specific changes.

**Categorical Changes in Teachers’ Descriptions of their Planning and Teaching**

Figure 5.4 shows changes in frequencies of teacher-talk from interviews about curriculum use, broken down into three degrees of evidence of the Mathematics Curriculum Assessment and Adaptation (MCAA) processes and by time of year (September 2008 or March 2009). As described in chapter 4, these degrees of evidence were aligned with general teacher-talk about planning and teaching (3\(^{rd}\) degree), teacher-talk focused on curriculum materials (2\(^{nd}\) degree), and teacher-talk focused on students (1\(^{st}\) degree) (see Table 4.6 in Chapter 4 for detailed categories). Overall, the frequency of teacher-talk focused on general or unjustified planning and teaching decisions decreased
from 50.3% of all coded excerpts in the September interviews to 35.2% in March. The frequencies of teacher-talk about decisions based on an assessment of curriculum materials increased from 28.1% to 36% of coded excerpts, and the frequencies of teacher-talk about student-focused decisions increased from 21.6% to 28.8% of all coded excerpts.

![Figure 5.4](image-url)

*Figure 5.4. Overall changes in foci of teachers’ curriculum use-related responses to interview questions, by degree of evidence of MCAA and time of interview.*

The interview protocol used in interviews with teachers in September and March covered four main categories of curriculum use, where up to five questions were asked to address each. These categories were: typical lesson planning process; assessment of materials; adaptations made to materials; and student understandings. As described in detail in Chapter 4, these categories of questions were chosen to understand how teachers talked and thought about their planning and teaching generally, and for the last three in
particular, provide links directly to teachers’ engagement with the MCAA process.

Changes in the degrees to which teacher-talk reflected the MCAA process within each of these three categories reflect the general patterns shown in Figure 5.4: overall, general or unjustified teacher-talk (no evidence of MCAA) decreased from September to March, and materials- and/or student-focused teacher-talk (evidence of MCAA) increased.

Figures 5.5 and 5.6 show changes in frequencies of three categories of teacher-talk from interviews about curriculum use, again broken down into three advancing degrees of evidence of MCAA and by time of year. These categories were drawn directly from the steps of MCAA and include teacher-talk focused on students’ understandings, assessment of curriculum materials and justification for a materials’ use (if any). Beneath the middle and right-hand sets of bars in each graph shown are the percentages of time spent in the fall MCAA course directly addressing each sub-category. These two sub-categories were focused on exclusively because they reflect a focus on the MCAA process, the content of the course.
The largest change in focus of teacher-talk occurred in how teachers talked about students’ understandings, which included talk about what students know and are able to do mathematically and what students are expected to know and be able to do after some period of time (goals) (Figure 5.5.). The percentage of teacher-talk in this category that merely mentioned students’ understandings (third-degree evidence of MCAA) (e.g., “we did this intro to algebra tiles lesson, and...I don't think they were solid enough on that.” TJ, September 2008) dropped from 37.9% to 20% from September to March, while the percentage of teacher-talk focused on specific students’ understandings (first-degree...
evidence of MCAA) (e.g., “On the lower end there are students that still consistently mess up integer operations and a good number of them hate fractions.” TJ, March 2008) increased from 17.2% to 40%. Percentages of teacher-talk focused on general students’ understandings (second-degree evidence of MCAA) decreased only slightly from September to March (-4.8%).
A. Assessment of Materials

<table>
<thead>
<tr>
<th>Sub-category</th>
<th>IS1 (September)</th>
<th>IS2 (March)</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Interpretation or Assessment of Materials</td>
<td>34.9%</td>
<td>25.0%</td>
</tr>
<tr>
<td>General Assessment of Materials’ Access to Students</td>
<td>37.2%</td>
<td>41.7%</td>
</tr>
<tr>
<td>Specific Assessment of Materials’ Access to Students</td>
<td>27.9%</td>
<td>33.3%</td>
</tr>
</tbody>
</table>

% of course time addressing this sub-category: 43.8% 73.1%

B. Justification for Material Use

<table>
<thead>
<tr>
<th>Sub-category</th>
<th>IS1 (September)</th>
<th>IS2 (March)</th>
</tr>
</thead>
<tbody>
<tr>
<td>General or Unjustified Material Use</td>
<td>56.5%</td>
<td>41.4%</td>
</tr>
<tr>
<td>Material Use Linked to Assessment of Material</td>
<td>38.5%</td>
<td>34.5%</td>
</tr>
<tr>
<td>Material Use Linked to Assessment of Students</td>
<td>20.3%</td>
<td>23.2%</td>
</tr>
</tbody>
</table>

% of course time addressing this sub-category: 53.1% 38.5%

Figure 5.6. Categorical changes in foci of teachers’ discussion of their assessment of curriculum materials (A) and justifications for material use (B), with corresponding proportions of MCAA course dedicated to each topic.
The changes in percentages of teacher-talk from both the “assessment of materials” and “justification for material use” categories reflected a large decrease in third-degree teacher-talk (-9.9% and -15.1%, respectively) and a small increase in 2nd and first-degree teacher-talk (Figure 5.6). First-degree teacher-talk about “assessment of materials,” excerpts where teachers explained how well a particular curricular material would “work” in their classrooms, increased from 27.9% to 33.3%. Teacher-talk about “justification for material use,” in which teachers explained why they choose to use, adapt, supplement or not use a particular curricular material, rose slightly, from 23.2% to 24.1%. Despite the tiny change in first-degree teacher-talk for the latter category, second-degree teacher-talk rose substantially from September to March (+14.2%).

Overall, the magnitudes of the shifts in teacher-talk from third-degree to second- and first-degree mirrored the amount of course time addressing the topic. For example, 73.1% of the course directly addressed an assessment, prediction and/or use of general students’ understandings, and 100% of the course addressed a focus on specific students’ understandings (this was the primary theme). These percentages exceeded those from the “assessment of materials” and “justification for material use” categories. The “students’ understandings” teacher-talk category reflected the largest shift from third-degree toward first-degree teacher-talk.

Taking a Closer Look

This section looks at the changes in teacher-talk described above, as well as changes in teachers’ big-picture descriptions of their planning and teaching, by

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5 These percentages were calculated by dividing the four sessions of the course into activity chunks, then categorizing those chunks and calculating the percentage of all course time spent in each.
comparing excerpts of teachers’ interviews. These micro comparisons are important to make in order to understand the more nuanced distinctions between teacher-talk from the beginning and end of the school year.

The general patterns in teachers’ descriptions of their planning and teaching are consistent with the analysis from the previous section. Considering the categories taken together, in March teachers described using their textbook more flexibly in planning, including a prioritization of which supplemental resources they used and when. Though teachers tended to describe the textbook less positively, the description of their use of the textbook was richer, focusing on more critical and specific explanations of which parts worked better for their students and why. Only the two experienced teachers in the study also specified what they did with this information in terms of adapting or replacing pieces of their text in planning. Finally, all teachers described more specific and varied mathematical understandings of their students in March than they had in September. Each of these changes is described in detail below.

Typical Lesson Planning Process

While the ways teachers described their planning processes varied greatly, reflecting the variation in their actual planning styles, there were many similarities in how their descriptions changed from September to March. At the beginning of the year, TJ’s discourse focused on how he relied heavily on his textbook to plan, including the suggestions and pacing of the provided teacher’s guide. This was true to some degree for Juliana as well, despite the vast difference in years of experience between the two
teachers. Juliana described using her textbook as her primary resource for teaching due to how thoroughly it addresses the state standards.

TJ (September): This year it’s been different because we have the CPM and we’re pretty much following it lesson by lesson. So the teaching guide is helpful in that it has a commentary on how you should present each lesson… I’ve been using CPM a little bit as a crutch right now.

Juliana (September): This is a brand new text for us so I would be looking at what I want to include and what I don’t want to include and probably I would say I’d probably want to include most of this because this is a 6th grade standards-based book.

By March, however, all four teachers described using the textbook much more flexibly in planning, emphasizing the importance of assessing lessons in some way before adapting or replacing them as necessary. These kinds of changes in teachers’ practice are reflected in these comments from TJ and Tama:

TJ (March): I’ll look in the teachers’ guide, but what I like to do is read what the students would read first, like either in the textbook or even in the teachers’ guide, but not read the little intro of how they would teach it first, so go through that and see, okay this makes sense, this makes sense… trying to think, why are we doing
this problem? Why does it make senses? What’s useful about it? What are the students going to learn from it?

Tama (March): The first thing now I think about is what is the big idea I want them to learn…and then what kind of investigation or inquiry-based kind of exploration I could create that would help them understand that big idea….Luckily the book does [have inquiry-based explorations], but if it doesn’t, I go and find ways to do it.

Though Maggie’s discourse also reflected more independence from the textbook in March than in September, she was the only teacher who initially emphasized that having flexibility in pacing and depth of content coverage were crucial to her being able to reach her students. She attributed this in part to the class being composed exclusively of students taking Algebra for the second or third time:

Maggie (September): What’s different about the Algebra class is it’s a repeat Algebra class. So I’m using the book as a guide for the topics to study with them, but then I’m not going lock-step with CPM. I really can’t do that.

Another change in all four teachers’ descriptions of their planning processes was in how they used resources from and outside of their textbook-based curriculum. In September, teachers mentioned many resources at their disposal, including components of the textbook curriculum apart from the book itself (e.g., teachers’ guides, test and
worksheet generators, disposable workbooks, transparencies), work from other teachers in their department, resource books (e.g., “Pre-Algebra with Pizzazz”), online problem banks, and work from previous years (for all teachers but TJ). Juliana and Maggie, the teachers with many years of teaching experience, both mentioned specific resources they use or planned to use on a consistent basis, commenting on why the material would be appropriate for their students, while TJ and Tama were more general:

Maggie (September): I’m thinking I’m going to use these quite a lot, these Pizzazz worksheets, because they’re skill-based and they like figuring out the riddles, and it’s a whole page of just subtraction of negative numbers.

Juliana (September): They’re a worksheet of practice problems, but the cool thing about those are that they really do scaffold. Maybe one of those pages hits in on, hones in on one piece of the concept and one skill. And the kids love those.

TJ (September): In the back of CPM there’s resource pages, so I’ll usually print those out…then there’s one thing from my student teaching that I printed out…they’ll be quizzes either take formal ones or CPM has a repository that I’ll probably take problems from.

Tama (September): I might make some kind of review sheet….I’ll make a visual organizer, or a graphic organizer, but those are infrequent. They’re not regular.
By March, however, all four teachers were commenting more specifically on which resources were consistent parts of their planning and teaching and why. Most strikingly, teachers consistently linked resources they chose to use with specific student understandings they expected students to develop, often explaining in detail why a particular material would “work” the best for students to access learning. An example of this comes from Tama, commenting on why she had chosen to adapt an activity she had found from one of the textbook curriculum’s resources to make it more discovery-based and linked to students’ prior knowledge:

Tama (March): So they knew how to find area. They knew they could find a fixed area in multiple ways. That I knew was a given, something a pre-understood idea. But that they could use that idea to create an inverse variation curve, not even knowing that’s what they were doing, and the fact that they could on their own with what they knew create something that then they didn’t even know how to analyze…I didn’t have to prove to them that inverse variation curves look the way they look because they had already figured that out for themselves.

In this example, Tama was considering that her students already had some understanding of area and decided to use that knowledge as a jumping off point to introduce inverse variation. She made this decision in lieu of a non-contextualized approach taken by her textbook in which students graphed different functions and compared them. While Tama could have decided to adapt this lesson in this way for many reasons (e.g., she’d used the area entre previously, she thought it would be a fun,
motivating), she made the decision based on the fact that her students had an understanding of area that would support its application to new content.

Assessment of Materials

When the teachers talked about how they assess their curriculum materials, and how much, they spoke much more positively about their textbook curricula overall in September than they did in March. Though none of the four teachers ever reported using the textbook exclusively, in the beginning of the year their assessments of their textbooks were approving and for some, reverent. For example, TJ said he thought the CPM book would “meet [students’] needs well” and Juliana said her book came “pretty close to ideal.” By March, however, teachers were much more critical of their texts, and could speak with greater specificity about which parts generally worked well and which consistently needed adaptation or replacement. This is reflected in the following excerpt from Maggie, answering the question of how well she thinks her textbook would reach students without any changing:

Maggie (March): Totally depends on the activity. What can I say? It totally depends. [Pointing to a problem in her textbook] well this is a really good thing right here, finding an equation without a table or a graph. So CPM would have students read through this and answer the questions on their own…I would never dream of putting this in front of this group and have them work through, find the equation of the line without graphing. So all these discovery activities that CPM has them do are great but I think they are very wordy.
The fact that Maggie said “all these discovery activities…are great,” but admitted she “would never dream of putting this in front of this group,” reflects her increased evaluative stance on her curriculum use. In March Maggie was approaching her textbook more positively, but still accepted that some of the activities she would use with her students might need adaptation of some kind to most effectively meet their needs.

Consistent with the change in teachers’ general descriptions of their planning and curriculum use, the ways they described how they assessed particular materials became more specific as the year went on as well. Specifically, teachers consistently linked how effective they thought a particular activity or lesson would be to their particular students’ needs and understandings.

Juliana (March): I think McDougal-Littell’s really thorough, and there’s tons of activities, the technology…but you have to look at your clientele. You have to see where they fit in the realm of what’s there.

Maggie (March): Like this thing right here, forget it! It’s kind of a cool activity for like 8th graders who are taking Algebra…but for this class I think that would be way too open-ended.

Adaptations Made to Materials

Though in September all four teachers were talking on some level about how they assess their curriculum materials, only Juliana and Maggie, the experienced teachers,
were also talking about how they then adapted, supplemented or replaced the materials, if necessary.

Maggie (September): Some of the [textbook] activities could use more resource pages, so I will actually create a page for them to write their answers down, or a blank table for them to write their answers in…so they can really sink their teeth into the content and the concepts. So that’s one adaptation I do a lot.

Interestingly, there was little change in how teachers talked about adaptation in the March interviews. Juliana and Maggie continued to talk specifically about how they assessed a material’s effectiveness in helping students learn something, then what they did with that assessment to make the material better suited for their class. TJ and Tama, despite the fact that their descriptions of assessments had expanded and became more specific, did not articulate adaptations they made to materials linked to these assessments, even when asked the question directly. Their descriptions of adaptations to curricula were general and often unjustified:

Tama (March): Homework assignments I may pick and choose from what’s in the text, but I’m not changing the nature of the problems. I’m not writing my own homework assignments. Those are direct from the text. But I might omit sections, ‘oh, they don’t need to bother with this.’
TJ (March): The quizzes and an occasional worksheet or something I modify or change.

While Tama and TJ were talking about adaptation more in March than in September, they provided fewer reasons for their adaptations than Juliana and Maggie at either point in the school year and their descriptions of adaptations were typically shorter and less detailed.

**Student Understandings**

The most obvious and common change in the teachers’ discourse was how they talked about students’ understandings. The specificity with which all four teachers assessed and described what their students knew and could do mathematically was far greater in the March transcripts than in September. In the beginning of the year, teacher-talk about student understandings revolved around two foci, each of which will be described below: informal learning about student understandings or misconceptions mid-lesson, including via “accidental” assessments, and polarized, general understandings evident from the class as a whole (“they get it, they don’t” mentality).

In September interviews, teachers often relayed anecdotes from their classrooms where they had found out something about students’ understandings via some mid-class-period action. For example, Juliana described a point in one class period when she realized not everyone knew how to move the decimal point to convert a decimal to a percent, and so did a quick, formative assessment to find out who could do it and who couldn’t. Sometimes, this kind of realization came from an “accidental” assessment,
where the teacher learned something about students’ understandings, often something
surprising, when not formally trying to. The following quote from TJ illustrates this well:

TJ (September): Even groups that usually have students on the ball had
misunderstood what it meant to find the perimeter. It’s the one where you put the
algebra tiles and you find the perimeter. And they were adding the area instead of
adding the perimeter. Luckily I caught a couple of students, or groups, that hadn’t
done it correctly.

The second focus, polarized understandings, was something all four teachers
focused on at some point in September. This refers to instances where teachers talked
about a group of students, often the entire class, falling into two groups: those who “got”
something, and those who didn’t:

Juliana (September): And the kids that I think, there’s like six of them, that I think
are on the higher plane.

Maggie (September): I guess about half the students…definitely have some holes
in their mathematics background. They come into Algebra not having a good feel
for fractions, not having good number sense, some of my students don’t know
their multiplication tables, all of those things.
In March, however, teacher-talk about what their students knew and could do had expanded and deepened. First, the teachers simply took more time to describe their students’ understandings and focused on smaller, more nuanced differences. Additionally, the teachers tended to focus on mathematical understandings instead of highlighting generally “high” or “low” performing groups of students, as they had before. The following quote from Tama, in which she is describing her whole class, illustrates this well:

Tama (March): So as an Algebra part II teacher, I already have a more homogeneous group. In terms of the range within that subset, I have some kids whose computations skills are weaker. I have some kids who have much better number sense than others, and then there’s also the difference of processing speed. I mean there are kids who are capable of the same level of mathematics, but some for whom mastery comes quickly. Like conceptual understanding develops quickly and their ability to demonstrate what they know computationally comes quickly. And there are some for whom it takes twice as long. And that doesn’t mean they don’t belong in my class or in the same group, but they just need more time.

Most noticeably, all four teachers talked more often about ranges of understandings evident in their students than polarized understandings, descriptions that were often linked to specific assessment evidence. Teachers tended to link assessments of their materials automatically to how they looked for these ranges of understandings,
including partial or developing understandings, instead of whether students simply “got” a standard or not. TJ, for example, talked about how he spent more time looking for evidence in “F” work of specific understandings linked to his goals. As he explained, by doing this, he learned much more about what those students really did know, which ended up changing his assessment practice:

TJ (March): Well I think the students on the lower end don’t get penalized as much, if they show some sort of partial understanding, then in my mind, okay, that’s probably a “D.” Right, that doesn’t mean they’re proficient but they have some sort of partial understanding.

As another example, Maggie described the differentiated assessments she developed and began using in order to provide students more access to showing her what they knew and could do. In these assessments, Maggie provided all students with multiple quiz versions from which students chose one to complete. For one assessment she described, for example, the “A version” had no scaffolding and was the most challenging. The “C version” had a few, worked-through examples and some of the problems were started with partial work and fill-in-the-blank sections. Students who chose the A version could receive 100% on the assessment, while students who chose the C version could earn a B+ at best. Maggie described using this system to motivate more students to try on the assessments so she could learn something about what they really knew. This learning seemed to be evident in her description of these assessments in general, as in this specific case:
Maggie (March): The students who chose the A version tended to do better…and then students who chose the C version tended to leave a lot of problems blank, except for three students who filled in the whole page and you could tell they were following the examples. If I’d just given them one test, I’m pretty sure the kids who had chosen the C version would have left the whole entire thing blank, except for maybe one or two problems.

Interpretation of Results

Drake & Sherin (2009), in a study about how teachers come to better understand and trust their materials, described how three teachers “moved from approaching the curriculum program as something that needed to be changed to viewing it as something that could be used” (p. 334) over the course of their school years. The authors assert that this is expected with any curriculum because teachers might “buy in” to the “underlying structure” of their textbook more as they become familiar with it over the course of a year. In this study, it could be argued that the shift from teachers using a majority of materials as-is to their consistent adaptation of their existing curricula required that, over time, they view the textbook as something that could or should be changed more, a shift that was indeed evident in changes in their teacher-talk.

Teachers’ “buy-in” to curricula over time may not automatically manifest in an increase in teachers’ choices to replace or adapt curricula, however. Reconsidering the previous argument that teachers might be on a “trajectory” from using materials as-is to a deliberate adaptation of materials, a path along which creation of new materials might
fall, another perspective is that teachers’ shifts along this trajectory are not at all natural. That is, perhaps it cannot be expected that teachers normally and automatically move away from using textbooks as-is over time. A teacher might evaluate an activity in his or her text with students’ needs in mind and decide to use the activity as printed, for example. Thus, perhaps while the “natural” shift in teachers’ views of their textbooks that Drake & Sherin describe *can* facilitate a shift in how much, how often and in what ways teachers change textbook materials throughout a school year, perhaps there are other mechanisms at work when these shifts happen that reflect more deliberate adaptation. If this is true, what are these mechanisms?

Overall, the decrease in general or unjustified teacher-talk and increase in materials-focused and student-focused teacher-talk supports the inference that teachers naturally gain understanding of their curricula and know more about their students’ understandings and needs as a school year goes on. But because part of the MCAA process is to carefully examine and assess curricula based on an examination and assessment of students, these findings could also reflect an increase in teacher engagement in the process more over time.

One piece of evidence that supports this claim is that the greatest, positive change was in the amount of teacher-talk focused on specific students’ understandings. The substantial increase (+23%) in amount of coded interview data focused on what students know and can do is partially explained by the fact that every course session dealt in some way with predicting, assessing and/or building on students’ mathematical understandings in curriculum use. In fact, possibly the most important part of the MCAA process is the
determination of what students know and can do in specific, qualitative terms in order to guide more deliberate choices about curriculum use.

The small change from second- to third-degree teacher-talk for the “justification for material use” category can be explained partially by at least two factors. First, only about half the time (53.1%) did the course specifically focus on linking adaptation choices about materials to students’ understandings. In terms of MCAA theory, the justification of why a teacher chooses to use a material as is, supplement it or replace it should ideally be linked directly to his or her assessments of what students know and can do. Though this was generally the case in how these four teachers talked about their practice, and though there was clearly an increase in how they talked about these understandings, it was rare for any of the teachers to explicitly link why a particular material was used to particular student understandings. Without having formally done this exercise in the course, perhaps it cannot be expected that teachers would automatically link the two. This raises the question, however, of what the more developed thinking about students’ understandings is affording these teachers, and how it is really affecting their curriculum use choices. It also raises the question of whether the increase in student understandings talk was solely because teachers had learned that it was important to the MCAA process and/or to the researcher, and either intentionally or subconsciously reflected that in their interviews. Though no evidence of this kind of social desirability was explicitly visible in collected materials or recorded in interview data, it is an important consideration in the interpretation nonetheless.

The second factor that helps to explain the large first- to second-degree changes in teacher-talk for the assessment and justification categories may also shed some light on
these questions. Just as creating a material from scratch or using a material as-is may be easier than adapting it, perhaps learning to link students’ understandings to an assessment of a materials’ appropriateness is a simpler or more “natural” part of curriculum use than teachers being able to justify why they are doing what they’re doing. After all, teachers assess students and adapt curricula all the time as “typical” parts of planning and teaching, but rarely, if ever, need to justify these choices explicitly. Theoretically, the justification piece could expose weaknesses in teachers’ curriculum use reasoning that reflects arbitrary or generalization-based decisions. Especially if a teacher has never been asked to think through these justifications before, he/she may not have a schema for doing so.

Changes in Teachers’ Classroom Practice

The following section reports on observed changes in activity structure use from classroom observations. As mentioned above, these data were collected and analyzed in order to examine one piece of teacher practice that may be related to changes in material use. These data are not only meant to provide new information toward the question of how teachers use curriculum over the course of a year and how this use might be affected by their engagement with the MCAA process, but also addresses the question of what mechanisms might support this change. If the changes in material use and teacher-talk about planning and teaching described so far are evidence of more systematic curriculum use, we may see complementary changes from within the classroom. What might these changes be? How might they support the changes in material use and teachers’ reflections on this use?
Classroom observations revealed that there were many changes in teachers’ use of activity structures. Figure 5.7 shows all observed classroom time for the four teachers, broken down by minutes spent in each of eight activity structures. Because total minutes of observed classroom time varied by instructional segment, percentages were used on the y-axis to be able to compare the proportional amount of time spent in each activity structure in an instructional segment. For example, though there were exactly fifteen five-minute segments (75 minutes of class time) coded as “small group work, unstructured,” from both the first and second instructional segments, the frequency represents 12.5% of all observed class time in IS1 and 15% of all observed class time in IS2 because more minutes of class time were observed in IS1 than in IS2.

The percent of time teachers spent in “small group work, structured,” whole group discussion,” and “interactive direct instruction” increased from IS1 to IS2, then either continued to increase in IS3 or remained stable. Time in “individual work” and “logistics-focused direct instruction” remained relatively stable across instructional segments, while “non-interactive direct instruction (lecture)” and “student presentation/sharing” segments decreased. “Small group work, unstructured” was the only activity structure that increased from IS1 to IS2, then decreased in instructional segment three.
Figure 5.7. Observed classroom time spent in each activity structure, by instructional segment. Each unit represents the primary, observed activity structure in a 5-minute segment of instruction. Every observed segment was coded.
Figure 5.8 shows these same results within larger categories of activity structures, namely if the structure used was teacher-directed or student-directed, and if the activity structure involved student interaction or not. The word “directed” is used here synonymously with guided or facilitated, and is defined to describe who led (intentionally or otherwise) the substance of that portion of the lesson. The “teacher-directed” category included all three direct instruction activity structures, and the “student-directed” category included both groupwork activity structures. In all three instructional segments, teachers used more teacher-directed activity structures than student-directed structures. However, the difference between the two shrunk from 33% in IS1 to 25% in IS2 and IS3.

The “no student interaction” category included “non-interactive direct instruction,” “logistics-focused direct instruction,” and “individual work,” and was used to describe structures in which students were not intended to interact with each other nor were intentionally exposed to each others’ thinking. The “student interaction” category included all other activity structures, intending to capture structures in which interaction between students was intended or in which students were otherwise exposed to the contributions and questions of their peers. In the first instructional segment teachers used equal proportions of both types of activity structures. In the second and third instructional segments, however, the proportion of structures involving student interaction exceeded the comparison category by 36% (IS2) and 35% (IS3).
Figure 5.8. Observed classroom time spent in each activity structure within larger categories of teacher-directedness (A) and student interaction (B).
The activity structure that varied the most in use across all four teachers was “student presentation/sharing” (Table 5.3). In fact, no single pattern could be identified for more than one teacher, and when these data were removed from the results shown in Figure 5.8, the shift from “teacher-directed” to “student-directed” activity structures was slightly exaggerated.

**Table 5.3.**

Frequencies of Observed Activity Structure “Student Presentation/ Sharing,” by Teacher and Instructional Segment

<table>
<thead>
<tr>
<th></th>
<th>IS 1</th>
<th></th>
<th>IS 2</th>
<th></th>
<th>IS 3</th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
<td>% of All</td>
<td>Used</td>
<td>Frequency</td>
<td>% of All</td>
<td>Used</td>
</tr>
<tr>
<td>Juliana</td>
<td>4</td>
<td>16.7%</td>
<td>1</td>
<td>4.3%</td>
<td>2</td>
<td>7.7%</td>
</tr>
<tr>
<td>Maggie</td>
<td>0</td>
<td>0.0%</td>
<td>3</td>
<td>15.7%</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>Tama</td>
<td>1</td>
<td>3.8%</td>
<td>0</td>
<td>0.0%</td>
<td>2</td>
<td>9.1%</td>
</tr>
<tr>
<td>TJ</td>
<td>3</td>
<td>7.9%</td>
<td>1</td>
<td>3.6%</td>
<td>0</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

With the exception of “student presentation/sharing,” three of the four teachers’ individual activity structure frequencies reflect the majority of the general changes from Figures 5.7 and 5.8. Maggie’s classroom, however, looked much different in some ways and drove the general changes for two activity structure categories. Maggie used the
“small group work, unstructured” activity structure most often in the classes observed for the first and second instructional segments, spending half and then more than two-thirds of her time in this structure. The clearest change in her classroom structure was the steep drop-off in the use of this activity structure from instructional segment 2 to 3. The fifteen classroom segments coded as “small group work, unstructured” from the general findings are clearly driven by Maggie’s use of this structure 14 and 13 times in IS1 and IS2, respectively.

Though Maggie did increase her use of the “small group work, structured” activity structure as the other teachers did, the change did not occur until the third instructional segment. Instructional segment 3 also revealed a jump in her use of the “individual work” activity structure. While in general teachers used “interactive direct instruction” more than “non-interactive direct instruction (lecture)” as time went on, Maggie’s use of both decreased over time. When removing Maggie’s activity structure frequencies from the overall data, use of “small group work, structured” for Juliana, Tama and TJ remained stable across the three instructional segments, and use of “individual work” consistently decreased.

Interpretation of Results

According to Hufferd-Ackles, Fuson, & Sherin’s (2004) framework for a math-talk learning community, a “classroom community in which the teacher and students use discourse to support the mathematical learning of all participants,” teachers’ work to advance along a specified developmental trajectory can enact reform mathematics practices and “can affect classrooms on a large scale” (p. 82). As you move from Level 0,
in which teachers are directing the work of the classroom with little input from students, to Level 3, the teacher becomes less and less the center of the classroom, acting as a co-teacher and co-learner with his/her students (see Table 5.3). Using this framework to compare the activity structures in this research reveals that they vary among all four levels of a math-talk learning community (e.g., “non-interactive direct instruction” = level 0; “whole group discussion” = level 2/3). None of the three activity structures that increased from instructional segment 1 (interactive direct-instruction, whole group discussion, small group work, structured) exemplified level 0 math-talk, while three of the four activity structures that remained stable or declined from IS1 did (logistics-focused direct instruction, non-interactive direct instruction, individual work). In other words, generally, lower-level math-talk declined and higher-level math-talk increased.
Table 5.4.

General Levels of a Math-talk Learning Community (Hufferd-Ackles, et al., 2004), as Aligned with Directedness and Interaction

<table>
<thead>
<tr>
<th>Level 0: Traditional teacher-directed classroom with brief answer responses from students.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1: Teacher beginning to pursue student mathematical thinking. Teacher plays central role in the math-talk community.</td>
</tr>
<tr>
<td>Level 2: Teacher modeling and helping students build new roles. Some co-teaching and co-learning begins as student-to-student talk increases. Teacher physically begins to move to side or back of room.</td>
</tr>
<tr>
<td>Level 3: Teacher as co-teacher and co-learner. Teacher monitors all that occurs, still fully engaged. Teacher is ready to assist, but now in more peripheral and monitoring role (coach and assister).</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Teacher-Directed</th>
<th>No Student Interaction</th>
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<table>
<thead>
<tr>
<th>Student-Directed</th>
<th>Student Interaction</th>
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In the previous section the question was raised of what changes in classroom practice might be complementary to the changes seen in teachers’ material use and descriptions of material use over time. The increase in use of activity structures reflecting a higher-level math-talk learning community might be linked to an increase in types of materials that value students’ constructing their own meaning and engaging more with each other than with or through the teacher. These kinds of materials might include open-ended, groupworthy problems or tasks where students are asked formally to discuss ideas or share representations (e.g., Cohen, 1994).

Looking back at the changes in “in-class tasks” from the material use discussion above, teachers used more materials classified as “manipulative/resource,” “class warm-up,” and “textbook problems” in the second and third instructional segments than they had in the first. Only with the first material type, “manipulative/resource,” might students be engaging more with each other and less with the teacher due to the nature of the material, as in most cases these resources were used by students working autonomously in small groups. Thus, any relationship between the change in activity structures and the change in “in-class task” material types seems negligible.

Other changes in teachers’ material use, however, suggest that increases in the level of math-talk community would be not only likely, but necessary. Teachers used more formative assessments, wrote more formal lesson plans and adapted standards only in the second and third instructional segments. In different ways these materials may have helped the teachers have more specific understandings about what their students knew and could do mathematically, understandings that might have affected the activity structures they chose to use day to day. As one example, as Tama began writing formal
lesson plans, the activity structures in her class expanded from being heavily lecture- and individual practice-based to include groupwork, student sharing and interactive discussion. She may have begun considering the perspectives and needs of her students more directly as the year went on and accounting for them in part by changing how she engaged her students in mathematical thinking. Supporting this claim, as her use of lesson plans increased, she built in room for formative assessment in novel ways. She began using exit tickets in order to get snapshots of individuals’ understandings as they left class each day, materials she used to inform her lesson planning and that she continued to use through the third instructional segment.

One activity structure used less overall by the teachers in successive instructional segments, “student presentation/sharing,” is one that Hufferd-Ackles et al might consider level 2 or 3 math-talk. However, because individual teachers varied so much in their use of this structure, it is misleading to describe this result for the teachers as one group. Furthermore, this category of activity structure consisted of a wide variety of activities, including formal poster presentations by groups of students and instances where students organically came to the board while sharing an idea or solution. Thus, it also reflects a wide range of teacher-directedness, planning, and student participation.

The fact that teacher-directed activity structures exceeded student-directed activity structures in all instructional segments is not surprising when considering the former is the most common instructional structure in the United States (Stigler & Hiebert, 1999) and that most curricular materials are designed to fit this structure. Cooney (2009) points out that not only is the typical U.S. mathematics classroom “teacher-dominated,” but that the use of direct instruction has been “remarkably stable over the past 100 years”
Megan W. Taylor

Furthermore, Hufferd-Ackles et al developed the levels of a math-talk community specifically in response to teachers’ difficulty implementing reform-based teaching practices. However, the fact that the gap between teacher-directed and student-directed activity structure use narrowed over time suggests that the teachers valued students having more ownership over the class and autonomy within it. This could be the typical pattern in classrooms, such that as teachers and students become comfortable with each other and particular norms of interaction become engrained, teachers become more flexible with classroom structures and students’ voices are more pronounced.

* * *

In sum, the four teachers in this study were using their curriculum materials in different ways in December and March than they had in September, differences reflected in how they talked about their planning and teaching and in the activity structures they used when implementing the lessons with students. Specifically, the number of textbook materials the teachers used as-is dropped dramatically, while the number of materials they adapted increased and diversified in type. As a few salient examples of this shift, teachers introduced a greater number and variety of assessments into their practice in December and March lessons, increased their use of student-focused activity structures, and talked more specifically and consistently about what their students knew and could do mathematically in interviews. Most strikingly, the majority of the findings reported in this chapter were true regardless of teaching experience, teaching context, textbook used or content taught.

A general discussion of all data and interpretations presented so far follows this chapter. This discussion attempts to use these findings holistically to determine the best
possible explanation for the changes in these teachers’ curriculum use. It also attempts to tie the findings to the larger educational context by proposing what a general trajectory of curriculum use might look like and suggesting a conceptual framework for thinking about changes in curriculum use.
CHAPTER 6

General Discussion and Conclusions

“If...developers appreciate that teaching involves a process of design and view materials as resources to support such a process, then the errand of such materials shifts from simply transmitting instructional ideas to transforming practice by serving as a catalyst for local customization” (Brown, 2009, p. 18).

This research has described changes in four secondary mathematics teachers’ use of curriculum and the alignment of these changes with the MCAA process over the course of a school year. Overall, teachers shifted from using materials as-is (September) to adapting materials (December, March), used more “non-core,” or supplementary, materials and increased the numbers and types of assessments they gave to students. In classroom practice in March, activity structures were more reflective of higher-level mathematics talk in successive instructional segments. Teachers described viewing their textbooks more positively and they could carefully link how they assessed and adapted lessons, activities and problems from their texts to reflect specific students’ understandings drawn from classroom evidence. An increase in teachers’ engagement with the MCAA process was evident in both the changes in collected materials and changes in teachers’ descriptions of their curricula and curriculum use. Most strikingly, these findings were true for the four teachers taken together and were generally robust to individual variation.
The general discussion that follows brings these findings together to (1) evaluate the effect of the MCAA process on teachers’ curriculum use, (2) describe a “more systematic” teacher-text interaction, (3) propose a theory about a “trajectory of systematic use” for mathematics teachers’ use of curriculum over time, and (4) add to our understanding of the relationship between teachers’ beliefs, practices, and student learning of mathematics. The discussion is followed by a presentation of the implications of this research in the field and next steps.

The “Effect” of the MCAA Process on Teachers’ Curriculum Use

The fact that the observed changes in teachers’ planning and teaching were reflective of specific components of MCAA theory provides impetus to continue an investigation of the impact of the MCAA process, and of other types of “more systematic” curriculum use, on teacher practice. Because we know that changing teachers’ practices is difficult and complex work (e.g., Borko & Putnam, 1996; Richardson & Anders, 1994), it is significant that the teachers in this study sustained their engagement in the MCAA process through the school year. Furthermore, the alignment between teacher change and the MCAA process was observed for all four teachers despite variation in teaching experience, context, content, and used curricula. These findings are evidence that the changes observed in this study reflect more than “typical” shifts in curriculum use and descriptions of curriculum use.

Because the MCAA process was designed to help teachers use their curricula more flexibly and deliberately, and because teacher practice in this research was more reflective of the process over time, it can be inferred that teachers were using their
curricula with more intention as the school year progressed. That is, teachers were not just adapting their curricula more over time, they were adapting it in response to particular information about students’ needs and understandings and in content-specific ways. Furthermore, changes in the activity structures teachers used provide additional support for this interpretation.

It is reasonable to explain some of these changes with the fact that baseline data were collected at the beginning of the school year, a time when teachers know the least about their students and perhaps curricula. However, the ways teachers talked about their planning and teaching changed in ways that revealed fundamental shifts in belief systems, not just an increased familiarity with the components of their classrooms. For example, not only did teachers’ descriptions of assessment and student understanding generally change from the beginning to end of the school year, there was also a marked shift in how teachers viewed learning and understanding in their courses. Teachers were not just talking more about specific students or able to say specific things about what their students knew and understood, all four talked about assessment and understanding in broader terms, emphasizing the importance of varied types of assessment, valuing progress instead of mastery, and describing their role in providing access to content. Most importantly, teachers were also using assessment in their classrooms more frequently and in more varied ways, and using activity structures like groupwork and interactive direct instruction that allowed them more access to student thinking. These kinds of changes reflect a sustained and significant engagement with the MCAA process.

Brown (2009) might describe the MCAA course as developing teachers’ 

*pedagogical design capacity* (PDC), or the teachers’ “skill in perceiving the affordances
of the materials and making decisions about how to use them to craft instructional episodes” (p. 29). Brown emphasizes that PDC may not manifest itself in particular types of curriculum use, nor in the same ways for different teachers. As discussed previously, an important part of the design of the MCAA process and course was to help teachers approach their texts more critically and expertly, but not to prescribe if or how teachers adapt the materials. The analyses for this research were designed to provide information about how flexible teachers’ use of their materials really was. For example, the materials were categorized and coded to reflect type of adaptation and evidence of the MCAA process, but were not compared to identify qualitative similarities and differences in form or content between any two teachers’ materials. This allowed claims to be made about the teachers’ curriculum use as a group in order to assess common changes in practice associated with an engagement in the MCAA process.

**Describing a More Systematic Teacher-Text Interaction**

The conceptual framework for this research built upon Remillard’s (2009) conceptual model of teacher-curriculum interactions, initially proposing that the most effective use of mathematics curricula comes from a more systematic and flexible “teacher-text interaction.” The MCAA process, which is built on three primary processes of adaptation teachers can engage in when interacting with their curricula (see Chapter 4), was used in this research as one possible model of “systematic and flexible” curriculum use. However, it is valuable to use the results of this study to make more general claims about what this type of teacher-curriculum material relationship might entail.
Existing descriptions of this teacher-text interaction provide a jumping off point for understanding what *more systematic*, and thus *more effective*, curriculum use might look like and how it changes over time. Considering Brown’s (2002) three *types of curriculum use*, offloading (using the text as-is), improvising (creating from scratch), and adapting (modifying), alongside three types of *curriculum strategies* (Drake, 2006), reading, evaluating and adapting, we have a developing picture of what Remillard calls the “verbs” of the teacher-text interaction (2009, p. 89). Pathways naturally exist between these strategies and types (Figure 6.1); a teacher who primarily “reads” his/her text will offload planning agency onto the text, while a teacher who primarily “evaluates” the text might end up offloading, creating new materials, or adapting what has been evaluated. Engagement in these processes will result in the production or selection of the three types of materials discussed in this research: existing, created and adapted.
Figure 6.1. A pathway model of possible teacher-text interactions, linking the strategies, types and products of curriculum use. “More systematic” teacher-text interaction might start with an evaluation of the curriculum with respect to students, followed by adaptation based on this assessment.

Using the MCAA process as one example of “more systematic” curriculum use, a set of paths beginning with “evaluate” can be highlighted in this web. In this research, teachers were encouraged to approach the use of their curricula with an evaluative stance, a strategy which empowered them to think about how the existing curriculum might work or not work for their students, and then to decide if and how they would modify it to meet those students’ needs. This evaluative stance is very different from a teacher either
approaching a textbook knowing he or she will use it as written (“read” strategy) or knowing he or she will change it in some way (“adapt” strategy).

The set of paths in Figure 6.1 is not necessarily “more systematic” than others, as we know teachers do approach using their curricula with an evaluative stance when planning and teaching, and they do this with varying degrees of deliberateness. As one example from the data presented in this work, Juliana, the most veteran teacher of the group, approached lesson planning evaluatively by nature because she had taught the subject so many times. What changed was how she then made decisions about whether to offload onto the text, improvise with it, or adapt it, and that these decisions became more student-based over time. Thus, it is not the taking of an evaluative stance alone that reflects teachers’ more systematic use of their curricula, but how they evaluate their texts and what they do with the evaluations. Furthermore, while “typical” teacher-text interactions might depend on a teacher’s beliefs, context, content, textbook or any number of other factors, this research supports a claim that “more systematic” curriculum use may be more universal. That is, perhaps teachers who use their curricula systematically engage with their materials in more similar ways than do groups of teachers using materials in less-systematic ways.

The Trajectory of Systematic Use in Mathematics Teachers’ Use of Curriculum

Emerging from this data is the idea of a trajectory of systematic curriculum use, moving from using materials as-is, to creating new materials, to adapting materials. This research suggests that teachers who are working to use their curricula more deliberately and in direct response to their students’ needs may be shifting toward adaptation as their
primary type and strategy of curriculum use. Adaptation is at the end of the trajectory because it is arguably the most difficult part or product of the teacher-text interaction: it may be far easier to use a text as a script or throw it out completely than to take what is there, assess its relevance for a particular group of students, and then modify it accordingly.

One question that arises from the claim that a trajectory of systematic use exists is whether the ability to adapt curricula meaningfully develops naturally over time or must be learned. One way to evaluate this issue is to examine what we know about the relationship between teaching experience and curriculum use. Because veteran teachers tend to create and adapt far more than new teachers (e.g., Remillard & Bryans, 2004; Silver, et al., 2009), perhaps teachers do learn how to adapt just by engaging with their text over time. Because the work of all four teachers in this study was more reflective of both adaptation and the MCAA process (i.e. “more systematic” curriculum use), perhaps a trajectory of systematic curriculum use involves not only adapting curricula more, but also doing so at specific times and in specific ways. Thus, there are at least two trajectories along which teachers progress when using a curriculum over time: one we might refer to as a trajectory of typical use, and the other as a trajectory of systematic use. As teachers gain experience and expertise with their text they naturally begin to adapt it more frequently (trajectory of typical use). Teachers moving along a trajectory of systematic curriculum use, however, are not only adapting more, but adapting in more effective ways.
The Relationship Between Conceptions of Curriculum, Practices and Student Learning

Borko, Davinroy, Bliem, & Cumbo (2000), in a study of veteran teachers participating in a reform-based professional development effort, proposed factors that “contributed to and sometimes challenged” change in their participating teachers’ practices (p. 296). These included situational factors such as the structure and content of the professional development they provided, and personal factors such as when in their lives teachers were being asked to engage with the new ideas. The authors emphasized, however, that teacher change can perhaps best be explained by the “dialectical relationship between beliefs and practices, sometimes beginning with changes in practice and sometimes beginning with changes in beliefs” (p. 303), a claim supported by existing research (Borko & Putnam, 1996; Fang, 1996; Richardson & Anders, 1994; Stipek, et al., 2001). In the study described here, changes in four teachers’ material and activity structure use coincided with changes in their descriptions of their planning and teaching. Furthermore, these changes reflected an increase in engagement with the three processes of adaptation making up the MCAA process. These substantial changes in practice suggest that teachers’ conceptions about effective planning and teaching were changing in complimentary ways over time.

The fact that teachers’ understandings of the usability and effectiveness of their textbooks may have changed in March in alignment with changes in their practice and descriptions of practice supports what Fang (1996) calls the “consistency thesis” of beliefs-practice research, in which changes in one coincide with or even affect changes in the other. However, whether teachers’ conceptions of their curriculum changed
(“beliefs”), followed by their curriculum use ("practices"), or the reverse, is difficult to say. One approach to understanding this is to examine the fact that changes in practice observed in December were sustained in March. This might mean that regardless of why teachers initially began to change their practice (e.g., influence of researcher, recent end of fall course), they perceived the changes as positive and manageable enough to continue through the end of the school year. Another interpretation is that teachers’ understandings of “effective” curriculum use changed during the fall course enough to motivate and sustain changes in practice afterward, an interpretation that is plausible because all teachers who enrolled in the course were already motivated to make their planning and teaching better.

Assuming the consistency thesis is true and is applicable to this research, perhaps the concurrence in changes in teachers’ conceptions of curriculum and in their curriculum-use practices is specific to which conceptions and practices are being examined. In this research, teachers’ beliefs are defined by their articulated perceptions of the usability and effectiveness of their textbooks and their descriptions and justifications of their textbook-related planning and teaching decisions. It is not surprising that shifts in these particular conceptions would coincide with shifts in teachers’ actual use of their materials or use of activity structures to support the use of those materials. For example, when Tama began using formative assessments in her classroom mid-year, the amount of interaction between Tama and her students increased. In her March interview she explained, “I realized at one point they didn’t know some of the things I thought they did. I needed a way to get into their little heads.” In this case, an intentional shift in Tama’s
material use impacted her decisions about classroom structure and her beliefs about her role in learning about and facilitating growth in student understandings.

It may not matter how teachers’ curriculum use or understandings about curriculum use change, or how these changes are related, if the changes do not correspond with an increase in students’ success in mathematics. Though student achievement was not investigated in this study, it is clearly one crucial next step in this field of research. Figure 6.2 provides a model for the potential relationship between a teacher’s conceptions of his or her curriculum, practices and student learning in the context of this study. This model reflects the belief that teaching is a dynamic system composed of many inter-related parts, and changing one part influences all others.
Figure 6.2. Model of a potential relationship between teachers’ conceptions of curriculum, practices and their students’ learning, highlighting the complementary relationship among how teachers adapt their curricula, how they structure the implementation of the curricula, and how they take their students into consideration in doing so.
Implications

The idea that teachers can learn and implement more systematic ways to interact with their curricula is important and has implications for what common features of “more systematic” curriculum use might look like and how these features might be dependent (or not) on where a teacher is along the professional continuum. Furthermore, encouraging teachers to use curricula more flexibly and supporting them in doing so affects the roles of mathematics curriculum developers and the form and content of curriculum-based professional development. Some of these implications are elaborated on here.

Though changes in all four teachers’ curriculum use were aligned in general, there was great variation in the specific ways teachers assessed and adapted their curricula, as expected. For example, though the teachers in this study all adapted more of their assessments over time and used a wider variety of assessments, the kind, content and form of assessments used were widely different from teacher to teacher, as were the ways they adapted the materials. This flexibility was an essential piece of the design of the MCAA process to account for the assumption that the same curriculum must be evaluated and adapted in different ways to meet the needs of different groups of students, and that teachers’ knowledge, beliefs and experiences will, and should, affect this adaptation. Furthermore, if teachers should have maximal agency in mediating the given curriculum and the curriculum used in the classroom with students, more systematic use should reflect more about how teachers approach the use of their curricula instead of what that use produces.
The idea that curriculum should be evaluated and adapted by teachers, however, may be problematic from a policy standpoint because it is messy: Having one curriculum that “works” in the same way for all students, and regardless of the teacher, is easy to implement and standardize, and is cost-effective. The reality, however, is that no such curriculum will ever exist that will provide the perfect fit for every teacher and context. Instead, teachers must make decisions about curriculum use, lesson implementation, consideration of students and other practices that are both effective and sustainable.

Larson (2009) brings up the important question of how able teachers are in general to interact with their curricula in more flexible ways. He suggests that “because teachers clearly have different skills at effectively using curriculum materials, there is a need to determine and explicitly share with teachers the parameters for adapting and improvising curriculum materials” (p. 97). This research suggests that these parameters can be defined and teachers can learn them, supporting the claim that we should expect the curriculum that reaches students in the classroom to be different from what was printed in the textbook.

But what are the implications of this idea for the writers and publishers of mathematics textbooks and curriculum materials? If teachers are to be expected to systematically evaluate and change curricula for tailored use with their students, how can publishers better prepare for this use? It is reasonable to think that a curriculum designed to be used with high fidelity, arguably true of the majority of existing mathematics curricula, will look different than one designed for teachers’ flexible and selective use. In one study of the negotiations between curriculum writers and teachers in curriculum development, the authors found that the teachers’ role was important and often “placed a
reality check on authors’ intentions” (Ziebarth, et al., 2009, p. 188). Perhaps this kind of collaboration, beyond the typical role of teachers piloting provided curricula and giving one-shot feedback, could be a starting point for publishers taking adaptation more meaningfully into account in curriculum design.

The implications of this research, as of curriculum use research in general, for teacher education and professional development are great. Previous research has shown that there are clear differences in how beginning and experienced teachers use mathematics curricula, as well as differences from teacher to teacher (e.g., Drake & Sherin, 2009). This research suggests that teachers in different places along the professional continuum, serving different groups of students, teaching different content and using different texts can change their curriculum use in productive and meaningful ways when given specific types of support. Part of why teacher practice is so difficult to change is because the relationship between beliefs and practices described above is so strong (Fang, 1996). Teachers will not take up, let alone sustain, new planning or teaching practices if the practices do not align with or change teachers’ beliefs systems in significant ways, and vice versa. A crucial piece of the design of the MCAA process and course was to align the purpose and potential of more systematic curriculum use with manageable, flexible practices, to this end.

It is significant for any form of professional development to influence teacher practice, and thus it is reasonable to expect that an expansion of the MCAA course (e.g. continuation into spring semester, greater on-going support) might provide for even more striking changes in curriculum use. In terms of teacher education programs, perhaps a focus on more flexible, deliberate and student-specific uses of textbook curricula when
pre-service teachers initially explore textbooks would support new teachers in the challenging process of assessing and adapting curricula earlier in their teaching careers.

**Limitations**

The most significant limitations of this study come from the small sample of teachers and instructional segments used, the fact that the facilitator of the professional development course and the researcher were the same person, and the lack of knowledge in the field about what “typical” patterns of curriculum use might look like. Each of these factors is briefly described here.

First, a sample size of four teachers was chosen to make data collection and analysis most manageable for a single researcher. The decision was made to favor a greater depth of analysis over a larger sample size in order to gather preliminary and descriptive data about how teachers might typically engage with the MCAA process and how that engagement might affect their practice over time. This choice necessarily prevented the generalization of the findings of this research to the practice of mathematics teachers in general. Additionally, the focus teachers were teachers who volunteered for the study and had volunteered to take the MCAA course. Arguably these teachers were already interested in changing their practice and motivated to experiment in their classrooms before the study began.

The choice of three instructional segments was also based on manageable data collection and analysis. Because of this, the general timing of the instructional segments was meant to capture periods in the school year that would be highly comparable. For example, the first and last months of the school year were avoided, as were weeks during
or adjacent to holidays or testing. To accurately describe a teacher’s practice over an entire school year with a dozen visits to his or her classroom, however, is impossible, and this research recognizes that more frequent visits to the teachers’ classes would have been preferred. The variation in content from one visit to the next could explain much of the changes in curriculum use seen in these teachers, as perhaps how and when teachers use their textbooks depends on what mathematics they are preparing to teach. Finally, though the teachers were given only up to a week’s notice of when the researcher would be visiting, the teachers might have engaged in atypical planning practices to “prepare” for the observation, such as creating a lesson plan when they might not have otherwise or adapting their primary activity structures in some way.

Second, the fact that the facilitator of the professional development course was the same person who visited the classrooms of the focus teachers, collected materials from them and interviewed them, is inherently problematic. Teachers may have been especially willing to use their curriculum in certain ways because they knew their teacher would be visiting and documenting their classes. Though it is hard to believe a teacher would have the time or energy required to “fake” the kinds of adaptation, descriptions of curriculum use, or use of more student-focused activity structures seen in this study in later instructional segments, it is a legitimate and potentially substantial concern.

Finally, until we know more about what “typical” patterns of curriculum use for secondary mathematics teachers look like, we cannot make definitive claims about whether the changes in these teachers’ practices were due to their exposure to the MCAA process or not.
**Future Research**

In *Mathematics Teachers at Work*, the recent compilation of research on teachers and curriculum materials, the editors present a list of needs in the field of curriculum use research (Remillard, et al., 2009). These needs include both a development of our understanding of what is meant by “curriculum use” and a closer examination of the implications for both pre-service and in-service teacher learning. Suggestions for addressing these needs in future research are provided here.

First, contributing to our understanding of what the “teacher-text interaction” looks like generally is a key component of this research, but only in terms of a more systematic teacher-text interaction. It is clear that having a better understanding of “typical” trajectories of curriculum – e.g., how a teacher’s curriculum use typically changes over the course of a school year, repeated textbook uses, years of teaching experience -- is important in order to describe and compare them to more systematic uses. What is known about how teachers typically use curriculum is largely confined to specific sub-groups of teachers, such as pre-service teachers using a textbook for the first time, or experienced teachers in a curriculum-piloting cycle. It is essential to develop a better picture of how teachers’ curriculum use changes from pre-service to in-service teaching, with further experience, and why, in order to better support them.

In terms of professional development and teacher learning, being able to describe a trajectory of curriculum use, i.e. the “typical” pattern of use over time that could include a trajectory of systematic curriculum use, would provide teacher education programs and professional development providers starting points for better supporting teachers. As these trajectories develop in the field, it will be important to examine how
those involved in training and supporting teachers work to push teachers along them. In what other ways can *more systematic* curriculum use be defined? What does the matched professional development look like? Furthermore, as these different opportunities for learning develop, what can we learn about the best ways to help teachers develop their curriculum use? What do these forms of teacher education look like?

To the list of issues in the field requiring more examination presented by Remillard, Herbel-Eisenmann and Lloyd, the need to develop the links between a teacher’s curriculum use and student learning is added here. This piece has been largely untouched up to this point, for good reason: the nuances of teachers’ interactions with their curricula must first be better understood in order to link curriculum use to what students learn. To link *more systematic* curriculum use to changes in student achievement, for example, an important first step is to see if more systematic curriculum use can be defined, can be taught to teachers, then can be incorporated into practice meaningfully. This research suggests these goals may be achieved on some level, and calls for the final link to be made between how these particular changes in practice affect how and what students learn. Specifically, what links are there between changes in particular aspects of teachers’ curriculum use (e.g. assessment, diversity of materials used) and student achievement? Are some changes more “powerful” than others? In what ways?

This research used *more systematic* to describe one type of “more effective” curriculum use. It remains to be seen whether more systematic use, including the MCAA process, is really more effective in terms of helping students learn mathematics. This also raises the question of what other “more effective” ways there may be to use curricula –
what general curriculum use strategies are more positively correlated with student learning gains? Which pathways of possible teacher-text interactions (Figure 6.1) are related to these gains, and in what ways?

While the “teacher-proof” curriculum may continue to be the goal of many well-meaning reforms, it is more exciting to imagine a “curriculum-proof” teacher who can use any given curriculum in highly-effective ways. It is especially exciting to know that processes may exist for teachers to interact more systematically with their textbook curricula, and that these processes are learnable and sustainable. Though this concept has been explored here specifically in the field of mathematics, the idea that teachers, and not curricula, should be the experts in the design and implementation of classroom learning experiences is not subject-specific. The concept of “more systematic” curriculum use affects every classroom, and must be more seriously considered by actors in the educational, professional, and organizational decision-making processes affecting our students.
APPENDIX A: Detailed Lesson Plan for MCAA Course

(SED 874) Differentiation in Mathematics
Assessing and adapting your curriculum to provide more access to math to more of your students

LESSON PLAN - Fall 2008

Knowledge Base Theme: Preparing reflective and innovative professionals as leaders who ensure the educational development of diverse populations within dynamic educational contexts.

Goals of the Course: To explore and develop new tools and processes for planning and teaching your classes that will help you provide more access to the curriculum to more students. Specifically, to…

• ...share and discuss methods for consistently and meaningfully assessing what students know and can do mathematically.
• ...understand how to prioritize and break down standards into levels of complexity and to have done it with some sub-set of the standards for a current course.
• ...assess if/how materials you use provide access to the content to your students.
• ...leave the course with at least one tangible product that can be used in your classroom this year.
• ...feel empowered by curriculum assessment and adaptation by believing it is doable and relevant to your teaching.

Course Meeting Times:
Thursday, September 25, 2008 8:00 am - 3:00 pm
Thursday, October 9, 2008 4:00 - 7:00 pm
Thursday, October 23, 2008 4:00 - 7:00 pm
Thursday, November 13, 2008 4:00 - 7:00 pm

Course Instructors:
Megan W. Taylor – ilovemath@mac.com
Shoba Farrell – shoba.farrell@gmail.com

Session #1 Overview: Thursday, September 25 – 8:00am-3:00pm
DUE: Focus unit selection, with accompanying state/department standards; a copy of the first page of the state standards for one course you are currently teaching (www.cde.ca.gov); copy of something from your course you’d like to assess

Focus Question: What IS Math Curriculum Assessment and Adaptation (MCAA)?
• How is MCAA a form of differentiation?
- Where is the line between MCAA and normal best practices?
- How does MCAA help teachers provide more access to a curriculum?
- What does MCAA look like in practice (lessons, standards, questions, etc.)?

Materials:
- Powerpoint
- Copies of syllabus
- Copies of question/goal tracking sheets
- Copies of rubrics
- Copies of three work samples
- Copies of Problems A, B and C
- Copies of Evaluation/Feedback sheets

Activities: (approx. 330 min. of workshop time)
1. Beginning-of-course survey (30 min.)
2. Introductions and syllabus (30 min.)
   1. Expertise in the room
   2. Differentiating the course – show “graph”
   3. Question/Goal tracking sheets
3. Why differentiate? (30 min.)
4. Overview of what differentiation is and is not
   1. Sorting activity – IS/IS NOT differentiation
   2. Discussion of “lunchroom” talk (15 min.)
   3. Sharing-out (10 min.)
4. Overview of MCAA: Differentiation as More Purposeful Curriculum Use (>90 min.)
   1. From standards to assessments – a model for starting to differentiate curriculum
   2. Prioritizing and leveling standards – introduction, a model and practice
   3. Assessment of materials – using the rating scales of MCAA

LUNCH

5. Problem-Solving (40 min.) – Pile Patterns
   1. Work time (15 min.) – Problem A and B
      1. Problem A: “Given the following pattern, write a rule for finding the number of blocks in the nth term.”
      2. Problem B: “Mathlab” version of Problem A
   2. Discussion: Differentiating what kids do
      1. Small group discussions of the access points offered by each problem
      2. How are each differentiated or not?
   3. HISI Modeling – Using Problem C (like Problem A, but a new pile pattern), teachers work on it and are led through a HISI activity structure
   4. Discussion: Differentiating what you do
      1. How does HISI provide access to students?
      2. What does it mean to differentiate your “teaching?”

6. Materials Analysis, Part I – introduction to the MCAA rating scales (>60 min.)
1. Modeling using a rubric: Pile Patterns Problem B
2. Small group discussion: Given two pieces of work, groups use rubrics to categorize and assess work, keeping track of questions, comments
3. Individual work analysis: teachers use rubrics to assess work they brought and write goals for the year

7. Personal Goals for Year (10 min.) – sharing out

8. Burning questions/comments – needs for the rest of the course (10 min.)
   1. Questions I have about these ideas
   2. Things I specifically want to be addressed next session
   3. My goal(s) for this course
   4. My goal for next session

Readings for Next Time:

To-Do for Next Time:
1. For your focus unit, prioritize and level the entire set of standards that accompany it – this may just be a section of the state standards for your course, or may also include departmental standards, process standards, problem-solving or reasoning standards, etc.
2. Assess something in your class in the next three weeks using the MCAA rating scales, adapt it if necessary and bring evidence of student thinking/learning/understanding from it. This can be in the form of observations of groups, actual student work samples, comments made by students, etc.
Session #2 Overview: Thursday, October 9 – 4:00-7:00pm
DUE: Draft of leveled standards for a focus unit; Evidence of student thinking from a task/lesson you adapted in some way

Focus Question:
• How do I go from assessment to adaptation?

Materials:
- Old goal sheets with new goal sheet stapled on top
- 3 parts of Standards Analysis activity
  o problems on one sheet
  o standard revision on one side, problem revision on other
- Task card for standards analysis
- Individual reflection on assessed work

Activities:
1. Reflection on Goals (10 min.)
   1. Summarize goal sheets from last session, specifically shared goals of the group
   2. Pass back goal sheets, plus new ones
   3. Reminder to sign in
   4. Shoba introduces herself!

2. MCAA Steps 1-3 – A Cycle (75 min.) – heterogeneous groups of 3
   1. Problem-Solving: Three Rate/work/mixture problems (7-10 min.)
   2. Standard Analysis: Groups revise levels for Algebra Standard 15.0 (10 min.)
   3. Problem Assessment and Revision: Groups assess mixture problems with respect to levels they wrote/revised, and adapt them as necessary (30 min.)
   4. Debrief – each group shares out (10 min.)

3. Another Perspective of the Same Cycle – Shoba’s Reflection on her Practice (30 min.)

BREAK (10 min.)

4. Sharing/Discussion of Brought Levels (45 min.) – pairwork
   1. Pairs are formed just between people who got a chance to prioritize and level standards in some way; people who did not do this work join a pair
   2. Hand out task card and groups focus on one person at a time for 15 minutes, then switch:
      a. 5 min. – person A shares what they tried and reflects on process, where they are
      b. 7 min. – person B uses Standards/Goals rubric to talk through levels; for people who did not get to levels, partner just talks through priorities; this is think-aloud-like
c. 3 min. – both partners decide on next steps for person A

5. Individual Reflection on Assessed Work (15 min.)
   1. Individuals reflect on work they assessed
      a. What are some general reactions to/reflections on assessing a piece of work from your class? What was the most difficult part of the process? What was the most interesting/rewarding?
      b. Did you end up adapting something? If so, what? Why?
      c. What evidence of student thinking/learning did you notice/bring/see/hear from the work you assessed and used with your students? What does this tell you about how well the work allows students access to the standard(s)?
      d. How do you foresee the MCAA Rating Scales being most useful in your practice going forward, if at all?

2. Class share-out; brainstorm written up on board

5. Next Steps (10 min.)
   1. Questions I have about these ideas
   2. Things I specifically want to be addressed next session
   3. My goal for next session

Readings for Next Time:

To-Do for Next Time:
   1. Finish a DRAFT of an adapted assessment, lesson plan or activity that you will teach in your focus unit next semester. With your work, please bring the leveled standards/goals that it addresses and be ready to share how you assessed the work using the rating scales.

Note: It is NOT expected for this to be complete, perfect or ready for use in your classroom – we will peer-review in class so everyone can come back in the fourth session with revised work.
Session #3 Overview: Thursday, October 23 – 4:00-7:00pm
DUE: Draft of adapted activity/assessment/lesson/sequence and corresponding, leveled standards

Focus Questions:
• How do my adapted materials help me know what students know?
• How do I use what students know in my assessment and adaptation of curriculum?

Activities:
1. Problem-Solving: A Translation (15 min.)
   1. Part I:
      ▪ SKETCH a graph of \( y=x^2 \).
      ▪ On the same axis, sketch a graph of \( y=x^2+1 \). Justify why your graph is right.
      ▪ Find at least THREE more ways to justify your answer to part (b).
   2. Part II: What would an advanced understanding of this problem entail a student knowing, doing or explaining? What would a beginning understanding entail? Feel free to use bullets.
   3. Part III: Is this problem differentiated? If not, how could it be? If so, in what way(s)?

2. A Third Perspective on the Cycle – Megan’s adaptation of CPM at ABHS (20 min.)

BREAK (10 min.)

3. Peer review of adapted work (90 min.), in assigned trios
   1. Review goal: We each leave with specific, helpful feedback on our adapted work draft that we can use to extend/revise it for our next session.
   2. Trios are formed to engage in cycles of critique:
      ▪ 2 min. – assignment of groups, relocation in room
      ▪ 10 min. – Self-Analysis, using corresponding MCAA Materials Rating Scales
         ▪ Author specifies his/her biggest need in reviewing this work
      ▪ 5 min. – “Preparation” of work for readers
      ▪ 30 min. – Reading of and reflection on two other colleague’s work
         ▪ What is the most innovative part of the work? What do you like the best about it?
         ▪ What enduring content understanding(s) or “big ideas” does this work address?
         ▪ Do all students have access to the most basic understanding?
• Do all students have access to the most advanced understanding?
• Will feedback given on this assignment help students know where their understanding lies?
• What does this work specifically tell the teacher about students’ understandings?
• How would this work score on the appropriate MCAA Rating Scale? Why?
• Does this work require multiple types of knowledge (declarative, procedural, schematic, strategic)?
• Does this work require higher-order thinking from all students?
• What questions do you have for the author, if any?
• What two, specific suggestions for next steps can you give?

45 min. – Sharing of feedback, Next Steps (15 min./author)

4. Collaborative work time (unstructured) (30 min.)
   1. Put up on board basics of who is working on what, so if people want to collaborate with others they can

5. Wrap-up (10 min.)

Readings for Next Time:
• “Chapter 8: Grading and reporting achievement,” from Integrating Differentiated Instruction and Understanding By Design, Carol Ann Tomlinson & Jay McTighe.

• SKIM “Chapter 6: Responsive teaching with UbD in academically diverse classrooms,” from Integrating Differentiated Instruction and Understanding By Design, Carol Ann Tomlinson & Jay McTighe.
• SKIM “Chapter 7: Teaching for understanding in academically diverse classrooms,” from Integrating Differentiated Instruction and Understanding By Design, Carol Ann Tomlinson & Jay McTighe.

To-Do for Next Time:
1. Revise/expand on your adapted activity, assessment or lesson. Any time before November 13th, email your work to Megan to be added to our private, community website.
Session #4 Overview: Thursday, November 13 – 4:00-7:00pm
DUE: Second draft of adapted activity/assessment/lesson/sequence

Focus Question:
- What different kinds of adaptation exist? What are the pros and cons of each?
- How do homework and grading fit in to MCAA?

Materials:
- Grading debate worksheets
- Peer review task cards

Activities:
1. Course Reflection and Survey (20 min.)

2. Grading Reflection, Debate (45 min.)
   1. Part I: How would you describe your grading philosophy? I.e. what role does assessment play in your focus course?
   2. Part II: Decide if each statement below is true or false. If true, provide support with an example. If false, re-write it so it is true.
      i. *By incorporating the MCAA process into my practice, my grades should reflect progress more than mastery.*
      ii. *Performance levels should correspond to letter grades – an “A” corresponds with “advanced understanding,” a “B” with “proficient understanding,” etc…*
      iii. *On an assignment involving choice, you should not be able to get an A unless you show clear evidence of an “advanced” understanding.*
      iv. *Grading has to be more about communicating feedback to students and parents than to support the learning process or encourage learning success.*
      v. *Grading in differentiated classrooms reflect what the student achieved and how well the teacher provided the student access to the material.*

BREAK (10 min.)

3. Materials workshopping in small groups from last time (<25 min. – 7-8 min/person)
   1. Focus: informally take turns (about 10 min. each) talking about what you accomplished in the past three weeks in terms of making progress

4. Materials workshopping in new groups (45 min. – 15 min./person)
   1. Foci include implementation and assessment
   2. Structure of workshopping time
i. “Work tour” provide by author (5 min.)
   1. context of the class the work will be used in
   2. units that (may) precede and follow the work
   3. what adaptations to existing work have been made or what
      work was created from scratch
   4. how this work is differentiated to provide more access to
      content to more students

ii. Focused discussion (10 min.) – see discussion questions from
    session #3

iii. Open discussion (4 min.)

iv. Articulation of one goal (1 min.)

3. Provide lens questions and structure, by type of material created
   i. For prioritized and/or leveled standards and goals...
      1. What activity(ies) could be designed to address this (set of)
         standard(s)?
   ii. For an in-class assignment or task...
      1. How can this assignment be implemented? What should
         the teacher consider when implementing this activity?
      2. What grouping/ activity structures would best serve this
         task? How will all students have the opportunity to show
         what they know and can do in this structure?
      3. How will the teacher be able to gain feedback on student
         progress/ learning using this task? What will the teacher
         learn about what students know and can do?
   iii. For a lesson plan...
      1. What should the teacher consider when implementing this
         lesson plan?
      2. What grouping/ activity structures would best serve each
         task in this lesson? How will all students have the
         opportunity to show what they know and can do in each
         piece of the lesson?
      3. How will the teacher be able to gain feedback on student
         progress/ learning through or at the end of this lesson?
      4. What formative assessments are built in to this plan (ways
         to learn how student understandings are developing, what
         misconceptions they may have, etc.)?
      5. What summative assessments are built in to this plan (ways
         to learn what students have learned)?
   iv. For an assessment...
      1. What kind(s) of feedback will be given to students from the
         work on this assessment? How will it be given to them?
      2. What will the teacher learn about what students know and
         can do from this assessment, with respect to developing
         levels of understandings of the standard(s) it addresses?

4. Assign new groups
5. Next steps (readings, work, communication…) (15 min.)
   1. Final work sharing online
APPENDIX B: Sample Activity from MCAA Course

Part I: A Few Problems

These problems are from “Elementary Algebra,” published by Bittinger & Ellenbogen. This book is the beginning Algebra book used by City College of San Francisco.

1. Henri and Magda are gardeners for a new development of track housing. Henri can mow a house’s lawn in 1 hour, and Magda can mow a house’s lawn in 45 minutes.
   a. Find the minimum time it would take Henri and Magda to mow twelve lawns if they work together to complete the job.
   b. Find the maximum number of lawns Henri and Magda could mow in 4 hours if they work together to complete the job.

2. Late on June 5th, Deb rented a Dodge Caravan with a full tank of gas and 13,741 miles on the odometer. On June 8th, she returned the van with 14,014 miles on the odometer. The rental agency charged Deb $118.00 for the rental and needed 13 gallons of gas to fill up the tank.
   a. Find the van’s rate of gas consumption in miles/gallon.
   b. Find the average cost of the rental in dollars/day.
   c. Find the rate of travel in miles/day.

3. A solution containing 28% fungicide is to be mixed with a solution containing 40% fungicide to make 300L of a solution containing 36% fungicide. How much of each solution should be used?

Part II: Analysis/Revision of Performance Levels

Work alone or with others to revise the performance levels below to make sure...

- higher-order thinking is not limited to the Advanced level
- all levels meet the standard in some way
- the levels as a whole reflect a continuum of understanding of the standard
- the 4 types of knowledge are accounted for (where appropriate) – declarative (what?), procedural (how?), schematic (why?), strategic (when?)

| CA Algebra Standard 15.0: Students apply algebraic techniques to solve rate problems, work problems, and percent mixture problems. |
|---------------------------------------------------------------|---------------------------------------------------------------|-----------------------------------------------------------------|
| **Beginning Understanding** | **Proficient Understanding** | **Advanced Understanding** |
| Students can apply at least one algebraic technique to solve rate/work/mixture problems. | Students can apply more than one algebraic technique to solve rate/work/mixture problems. | Students can apply multiple algebraic techniques to solve rate/work/mixture problems and can choose the most efficient method for solving a given problem. |
| Students can identify a | Students can identify the | Students can translate a |
word problem as a rate, work or mixture problem. | key factors or variables of a rate/work/mixture word problem. | rate/work/mixture word problem into algebra.
---|---|---
Given a set of five random rate/work/mixture problems, students can solve one or two correctly. | Given a set of five random rate/work/mixture problems, students can solve three or four correctly. | Given a set of five random rate/work/mixture problems, students can solve all five correctly.

<table>
<thead>
<tr>
<th>Beginning Understanding</th>
<th>Advanced Understanding</th>
</tr>
</thead>
</table>

**Part III: A Few Problems – Revised?**

*Using your performance levels for CA Algebra I Standard 15.0, assess how well the three problems from part I allow students access to at the standard, and revise them if necessary. Be ready to share out about your decisions. Use the MCAA Rating Scale for In-Class Activities/Tasks if it is useful.*
**APPENDIX C: Descriptions of MCAA Materials Rating Levels for Each of Five Types of Collected Curriculum Documents**

*MCAA Materials Analysis: STANDARDS/GOALS DOCUMENTS (SG)*

**Checklist:**

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
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<tbody>
<tr>
<td></td>
<td>Evidence of adaptation</td>
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<tr>
<td></td>
<td>Evidence of goals</td>
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<tr>
<td></td>
<td>Evidence of inclusion of non-CST goals</td>
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<td></td>
<td>Evidence of prioritization of goals</td>
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<td></td>
<td>Evidence of determination of different levels of understanding</td>
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<td></td>
<td>Evidence of multiple types of knowledge needed</td>
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<td></td>
<td>Evidence of higher-order thinking needed</td>
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</table>

**Checklist Score:** _______/7

**Holistic Rating Levels:**

<table>
<thead>
<tr>
<th>Standards/Goals Documents</th>
<th>Clear Evidence of MCAA (5)</th>
<th>Possible/Partial Evidence of MCAA (3)</th>
<th>Minimal Evidence of MCAA (1)</th>
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<tbody>
<tr>
<td></td>
<td>• Set of standards/goals may include non-CST items and are prioritized such that the “big ideas” of the course are specified as most important.</td>
<td>• Set of standards/goals is prioritized such that some of the “big ideas” of the course are specified as most important.</td>
<td>• Set of standards/goals is prioritized clearly, but not necessarily in line with the “big ideas” of the course.</td>
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<tr>
<td></td>
<td>• All applicable standards/goals are broken down into advancing levels of understanding such that any student has a “place” along the continuum.</td>
<td>• Top-priority standards are broken down into advancing levels of understanding such that most students have a “place” along the continuum.</td>
<td>• Some standards are broken down into advancing levels of understanding, but not necessarily the top-priority standards.</td>
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<td></td>
<td>• Each level reflects different types of understandings and higher-order thinking.</td>
<td>• Each level reflects different types of understandings OR higher-order thinking.</td>
<td>• Students at one end of the continuum are ignored completely. Each level focuses primarily on one type of understanding or one order of thinking.</td>
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</table>

**EX:** A goal document for an Algebra unit on solving linear equations that specifies where the goals come from (CST, department, NCTM, etc.) and the two that are essential for students to learn by the end of the unit. The two essential standards map clearly onto the two big ideas of the unit: being able to find a value for a variable using both graphical and algebraic methods. All goals are broken down into three depths of understanding such that at all levels students are showing evidence of schematic, strategic and procedural knowledge.

**Holistic Rating:** _______/5

Megan W. Taylor
MCAA Materials Analysis: LESSON PLANNING DOCUMENTS (LP)

Checklist:

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<th>YES</th>
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Evidence of adaptation
Evidence of goals
Evidence of prioritization of goals
Evidence of determination of different levels of understanding
Evidence of goals addressed in activities/events of lesson
Evidence of connections to previous work and/or student understandings
Evidence of activities/events intended to help teacher gain new knowledge of students’ understandings

Checklist Score: _______/ 7

Holistic Rating Levels:

<table>
<thead>
<tr>
<th>Clear (5)</th>
<th>Possible/ Partial (3)</th>
<th>Minimal (1)</th>
</tr>
</thead>
</table>
| *High-priority goals of course/unit are a focus of the lesson plan such that they are specified outright, broken down into advancing levels of understanding, and specifically addressed in the activities and events of the period.
*There are clear connections to previous work/lessons, and specifically, to the teacher’s knowledge of students’ understanding.
*This knowledge is dealt with in the plan directly, and there are specific activities, procedures or materials for gaining new knowledge of what students know and can do.
*These opportunities are directly tied to the specified levels of understanding of the standard(s) the lesson is meant to address. |
| *The lesson plan has goals that are broken down into advancing levels of understanding and that are specifically addressed in the activities and events of the period.  
*There are clear connections to either previous work/lessons OR to the teacher’s knowledge of students’ understanding.  
*This knowledge is dealt with in the plan directly OR there are specific activities, procedures or materials for gaining new knowledge of what students know/can do.  
*These opportunities are directly tied to the specified levels of understanding of the standard(s) the lesson is meant to address. |
| *The lesson plan has goals that are broken down into advancing levels of understanding OR connections to previous work/lessons or to the teacher’s knowledge of students’ understanding are clear.  
*There are opportunities for teachers to gain new knowledge of what students know and can do, but that aren’t necessarily tied directly to the specified levels of understanding of the standard(s) the lesson is meant to address. |

EX: A lesson plan specifies an essential standard of the course (that students can solve a linear equation) and three advancing levels of understanding. The plan also specifies a sub-goal for students to be able to use algebra tiles to represent the equation before solving. The warm-up asks students to represent a given expression with the tiles, and notes that the exit ticket the previous day showed that many students were still struggling with this. The focus activity allows students to work in pairs to first model equations and solve them with the manipulatives, then translate the representation to paper. Pairs will work at their own pace so that everyone gets as far as they can. The teacher notes that he will take note of where students are by checking in with every pair, and that this may mean stopping to clarify or work through a particular problem as a class.

Holistic Rating: _______/ 5
**MCAA Materials Analysis: LECTURE/PRESENTATION NOTES (PN)**

Checklist:

<table>
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<th>YES</th>
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Evidence of adaptation
Evidence of goals
Evidence of prioritization of goals
Evidence of determination of different levels of understanding
Evidence of goals addressed in activities/events of lecture
Evidence of check-ins intended to help teacher gain new knowledge of students’ understandings
Evidence of opportunities for students to make sense of information on their own

**Checklist Score: _____ / 7**

**Holistic Rating Levels:**

<table>
<thead>
<tr>
<th>Lecture/ Presentation Documents</th>
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<tbody>
<tr>
<td>Clear (5)</td>
</tr>
<tr>
<td>• High-priority goals of course/unit are a focus of the presentation such that they are specified outright, broken down into advancing levels of understanding, and specifically addressed in the course of the lecture.</td>
</tr>
<tr>
<td>• There are specific and structured check-in points for teachers to gain knowledge about student understandings of the focus standard(s).</td>
</tr>
<tr>
<td>• The lecture incorporates opportunities for students to make sense of information on their own and to show what they understand and can do.</td>
</tr>
<tr>
<td>Possible/ Partial (3)</td>
</tr>
<tr>
<td>• Goals of the presentation are specified and specifically addressed in the course of the lecture.</td>
</tr>
<tr>
<td>• Either the high-priority goals of the course/unit are a focus OR the goals used are broken down into advancing levels of understanding.</td>
</tr>
<tr>
<td>• There are opportunities for teachers to gain knowledge about student understandings of the focus standard(s).</td>
</tr>
<tr>
<td>• The lecture incorporates opportunities for students to make sense of information on their own but few opportunities to show what they understand and can do.</td>
</tr>
<tr>
<td>Minimal (1)</td>
</tr>
<tr>
<td>• Goals of the presentation are specified in some way (could be indirect).</td>
</tr>
<tr>
<td>• There are no or few opportunities for teachers to gain knowledge about student understandings of the focus standard(s).</td>
</tr>
<tr>
<td>• The lecture incorporates opportunities for students to show what they understand and can do OR places for them to make sense of information on their own.</td>
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**Holistic Rating: _____ / 5**
**MCAA Materials Analysis: ASSESSMENTS (AS)**

Checklist:

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<th>YES</th>
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<th>Evidence of adaptation</th>
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<tbody>
<tr>
<td></td>
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<td>Evidence of goals</td>
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<tr>
<td></td>
<td></td>
<td>Evidence of prioritization of goals</td>
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<tr>
<td></td>
<td></td>
<td>Evidence of determination of different levels of understanding</td>
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<tr>
<td></td>
<td></td>
<td>Evidence of accessibility to all students</td>
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<tr>
<td></td>
<td></td>
<td>Evidence of multiple opportunities for students to show what they know</td>
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<td></td>
<td></td>
<td>Evidence of opportunities for teacher to gain new knowledge of students’ understandings</td>
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</table>

**Checklist Score: _______/8**

**Holistic Rating Levels:**

<table>
<thead>
<tr>
<th>Assessments</th>
<th>Clear (5)</th>
<th>Possible/Partial (3)</th>
<th>Minimal (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Assessment is based directly on high-priority goals of the course/unit that are broken down into advancing levels of understanding, and these levels are made explicit to students in some way.</td>
<td>• The assessment’s goals are broken down into advancing levels of understanding and these levels are made explicit to students in some way.</td>
<td>• The assessment’s goals are made explicit to students in some way.</td>
</tr>
<tr>
<td></td>
<td>• Assessment is accessible on some level to all students and provides multiple opportunities for students to show what they know and can do.</td>
<td>• Assessment is accessible to most students but excludes at least one particular subgroup (ex: most struggling students or most advanced students) and does not consistently provide multiple opportunities for students to show what they know and can do.</td>
<td>• Assessment is accessible to most students but excludes at least one particular subgroup (ex: most struggling students or most advanced students) and does not consistently provide multiple opportunities for students to show what they know and can do.</td>
</tr>
<tr>
<td></td>
<td>• The review/grading structure of the assessment will provide specific, qualitative feedback to students about their understandings and specific, qualitative information to the teacher about students’ progress toward meeting each standard addressed, specifically the high-priority goals of the course/unit.</td>
<td>• The review/grading structure of the assessment will provide specific, qualitative feedback to students about their understandings and specific, qualitative information to the teacher about students’ progress toward meeting each standard addressed.</td>
<td>• The review/grading structure of the assessment will provide limited feedback to students about their understandings and/or limited information to the teacher about students’ progress toward meeting each standard addressed.</td>
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**Holistic Rating: _______/5**
**MCAA Materials Analysis: IN-CLASS ACTIVITIES/ TASKS (IT)**

**Checklist:**

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- Evidence of adaptation
- Evidence of goals
- Evidence of multiple opportunities for students to show what they know
- Evidence of multiple types of knowledge needed
- Evidence of higher-order thinking needed
- Evidence of opportunities for teacher to gain new knowledge of students’ understandings

**Checklist Score: _____ / 6**

**Holistic Rating Levels:**

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<th>In-class activities/tasks</th>
<th>Clear (5)</th>
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<tbody>
<tr>
<td></td>
<td>• Task/activity is clearly designed to address the high-priority goals of the course/unit and provides multiple opportunities for all students to progress toward meeting those standard(s) on some level.</td>
</tr>
<tr>
<td></td>
<td>• The work requires multiple types of understandings (ex: schematic, strategic knowledge) and higher-order thinking (ex: synthesis, evaluation) from all students.</td>
</tr>
<tr>
<td></td>
<td>• Student work on the task will provide the teacher with specific, qualitative information about students’ progress toward meeting the lesson’s goals.</td>
</tr>
<tr>
<td>EX: A task introducing the Pythagorean property is based on two Precalculus standards, both of which are essential standards of the course and broken down into advancing levels of understanding. The task consists of five, consecutive parts; in each part students explore a different “proof” of the property, at advancing levels of complexity and difficulty. The latter parts build on discoveries from the first two parts, and thus require students to move flexibly backward and forward on their work. Students work at their own pace and are expected to get as far as they can in the allotted time. A class discussion of attempts and findings follows the activity.</td>
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<tr>
<th>Possible/Partial (3)</th>
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<tbody>
<tr>
<td>• Task/activity is clearly designed to address specific goals and provides multiple opportunities for all students to progress toward meeting those standard(s) on some level.</td>
</tr>
<tr>
<td>• The work requires either multiple types of understandings (ex: schematic, strategic knowledge) OR higher-order thinking (ex: synthesis, evaluation) from all students.</td>
</tr>
<tr>
<td>• Student work on the task will provide the teacher with specific, qualitative information about students’ understandings in general.</td>
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</table>

<table>
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<tr>
<th>Minimal (1)</th>
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<tbody>
<tr>
<td>• Task/activity is clearly designed to address specific goals but provides only singular opportunities for students to progress toward meeting those standard(s) on some level.</td>
</tr>
<tr>
<td>• The work requires more than just declarative or procedural knowledge from all students OR requires all students to engage in higher-order thinking.</td>
</tr>
<tr>
<td>• Student work on the task will provide the teacher with limited information about students’ understandings.</td>
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</tbody>
</table>

**Holistic Rating: _____ / 5**
**APPENDIX D: Classroom Observation Worksheet**

**Observation Notes**

*How are teachers using materials in the course of the lesson?*  
Date: ____/____/____

**TI-IS#: ________ - ________**  
Class: __________________________  
Period: ______

**Time Start: ____:____ am/pm**  
**Time End: ____:____ am/pm**  
**# Students: ______**

<table>
<thead>
<tr>
<th>5-Min. Segment</th>
<th>General Activity/ Teacher Commentary</th>
<th>Materials Used</th>
<th>Activity Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Start</td>
<td>End</td>
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<tr>
<td>2 Start</td>
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<td>17</td>
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**Activity Structure Codes:**

GW-I = Informal groupwork  
GW-F = Formal, structured groupwork  
IW = Individual seatwork  
P/S = Presentation/Sharing  
L = Logistics  

CD-T = Class discussion, teacher-led  
CD-S = Class discussion, student-led  
DI-I = Direct Instruction, Interactive  
DI-N = Direct Instruction, Non-Interactive
# APPENDIX E: Interview Protocols

Teacher Interview Protocol  (Abbreviated)  

| 2008-09 | Teacher Initials: _____  
| Date: ___/___/___ |

1. How do you typically go about planning your lessons?

2. In an average week, what materials do you prepare for teaching?

3. Which resources do you use in planning for an Algebra course? Which would you say are most important?

4. How do you decide which curriculum materials you’re going to use? Once you know, how do you evaluate how well these existing materials will meet your students’ needs (will “work”)?

5. Imagine you’re sitting down to plan a lesson for tomorrow. You’re moving from [topic being finished up] into [new topic]. What are you thinking about when you sit down to plan?

6. **Using book:** You’re about to start a unit on [something they haven’t taught yet]. Look at this chapter [show textbook chapter, first page] and think-aloud for me about how well it’s going to work for your students.

7. How would you describe the range of understandings students come into [your course] with at [your school]?

8. Thinking about the lesson you have planned for tomorrow, what do you expect the range of students’ understandings to be? What do you plan to do to address the range?

9. What is the main purpose of a test in your class? Quiz? [or other assessment materials…]

10. What do you do with the tests once students complete them? You’ve collected them, you’re sitting down to grade them, what are you looking for?

11. What percent of the curriculum that ends up reaching your students in some way…
   - (a) comes directly from the textbook? _____
   - (b) was adapted from the textbook in some way? _____
   - (c) was created from other materials? _____
   - (d) was created from scratch? _____
   - (e) some other origin(s)? _____

12. Suppose you look at a chapter from the text and you decide it needs changing in some way. Describe your approach to doing this. –OR-- Give me an example of something you changed from your textbook before using with your students and tell me about why you decided to change it.

13. If you met with consultants from the textbook company and learned exactly how they would want you to teach this curriculum to students, how well would it meet your students’ needs without any changing?

14. What parts of this curriculum, if any, do you think need the most adaptation or supplementation? What makes you say this?

15. Can you describe some features of an ideal Algebra textbook?
Teacher Interview Protocol (Question Bank & Links to Processes of Adaptation)

Three Processes of Adaptation:
1. Prioritization of goals and identification of expected or possible ranges of student understanding
2. Assessment of how well curriculum will meet students’ needs and maximize learning
3. Adaptation of curriculum (if necessary), including supplementation or replacement of materials

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<tr>
<th>Processes of Adaptation addressed</th>
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<tbody>
<tr>
<td>1. What would you consider a strength of your planning? What planning strategies work best for you?</td>
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<td>2. How much time would you say you spend planning for Algebra in relation to other school-related work (ex: planning for other classes, coaching, meetings, etc.)? Per day? When beginning a new unit?</td>
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<td>3. How do you typically go about planning your lessons (i.e. considerations, materials, procedures, etc.)?</td>
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<td>4. What, if any, lesson-planning documents do you typically prepare [i.e. your lesson-plans, created worksheets, etc.]? What, if any, lesson-planning materials do you use that come from existing sources [i.e. textbook lessons or problems, school-wide tests, etc.]?</td>
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<td>5. Which resources do you use in planning for an Algebra course? Which would you say are most important?</td>
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<td>7. How do you decide which curriculum materials you’re going to use? Once you know, how do you evaluate how well these existing materials will meet your students’ needs (will “work”)?</td>
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<td>8. To what extent does your planning take into account the ranges of understandings in your class?</td>
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<td>9. Can you tell me about a lesson you planned that helped you identify students’ varying understandings?</td>
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10. Imagine you’re sitting down to plan a lesson for tomorrow. You’re moving from [topic being finished up] into [new topic]. What are you thinking about when you sit down to plan? How do you deal with trying to meeting the most students’ needs?  

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11. When you plan, to what extent do you explicitly work to accommodate the range of student understandings in your class?  

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a. How closely do you use the textbook? In what ways? On a scale from 1 to 10, how much do you use the text (1=Not at all, 10=for every lesson, without editing of any kind)?  

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b. How do you figure out if a particular unit or lesson from the textbook is going to “work” for your class?  

c. You’re about to start a your unit on [unit they’ve taught before]. When you look at your textbook, what are you looking for to see if it’s going to “work” for your students? What about how it’s going to “work” for you? Your department? Your school?  

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d. You’re about to start a unit on [something they haven’t taught yet]. Look at this chapter [show textbook chapter, first page] and think-aloud for me about how well it’s going to work for your students. [Note: could bring in a novel book for this exercise, or even use a different subject’s book]  

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e. What characteristics describe the student(s) who are most successful in Algebra?  

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f. What information do you have about your students’ mathematical prior knowledge at the beginning of the year? In other words, what do you know about what they know?  

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g. How would you describe the range of understandings students come into Algebra with at Westwood? How much is it a teachers’ responsibility to find out about these ranges when teaching their Algebra course? [If yes to previous.] What are some things that you or other teachers you know of do to find out more about these understandings?  

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h. Thinking about any lesson you taught last week, what was the range of students’ understanding? Did you do anything specific to address this range?  

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i. Thinking about the lesson you have planned for tomorrow, what do you expect the range of students’ understandings to be? What do you plan to do to address the range?  

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<td></td>
<td>Question</td>
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<td>-------------------------------------------------------------------------</td>
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<td>j.</td>
<td>Take the topic of [“simple” Algebra topic]. Do you think all students are ready to learn this? Do you think all students would approach this the same way? Would you approach teaching this the same for all students?</td>
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<td>k.</td>
<td>What planning strategies have you used to address the fact that kids come into your class with hugely different abilities and understandings?</td>
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<td>l.</td>
<td>What is the most ideal, yet realistic, scenario you can think of for what the range of understandings about Algebra looks like at the end of a unit? What about at the end of a year?</td>
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<tr>
<td>m.</td>
<td>Here’s the test you plan to give next week. Tell me about how different kids will perform differently on this. Do you expect kids to perform at different levels on this test? How do you deal with that?</td>
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<tr>
<td>n.</td>
<td>What do you do with the tests once students complete them? You’ve collected them, you’re sitting down to grade them, what are you looking for? What do you do with the information you get (scores, answers, strategies, blanks, wording, etc.)?</td>
</tr>
<tr>
<td>o.</td>
<td>What is the main purpose of a test in your class? Quiz? [or other assessment materials...]</td>
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<tr>
<td>p.</td>
<td>How much do you add to the textbook (i.e. supplement it with your own work, other teachers’ or textbooks’ materials)?</td>
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<tr>
<td>q.</td>
<td>Which textbook materials (if any) do you tend to disregard entirely? Why?</td>
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<tr>
<td>r.</td>
<td>To what extent do you adapt materials from the textbook?</td>
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<tr>
<td>s.</td>
<td>Give me an example of something you changed from textbook before using with your students and tell me about why you decided to change it.</td>
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<td>t.</td>
<td>What do you consider when you open the text to the first page of a new unit you’re starting to plan for? What are you looking for?</td>
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<tr>
<td>u.</td>
<td>Suppose you look at a chapter from the text and you decide it needs changing in some way. Describe your approach to doing this.</td>
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<tr>
<td>v.</td>
<td>What does “good enough” mean in describing the suitability of a problem, lesson, etc. for the most number of students?</td>
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<td>w.</td>
<td>Imagine you are teaching a lesson tomorrow on [give an Algebra topic]. Here is a problem from the text you are thinking about using as the main activity for the period.</td>
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<tr>
<td>Question</td>
<td>Response</td>
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<td>-------------------------------------------------------------------------</td>
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<tr>
<td>What do you do to decide if it’s “good enough?”</td>
<td></td>
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<tr>
<td>x. If you're going to evaluate if something is going to work (or is “good enough”) for students, what do you consider?</td>
<td>X</td>
</tr>
<tr>
<td>y. What percent of the curriculum that ends up reaching your students in some way (a) comes directly from the textbook? (b) was adapted from the textbook in some way? (c) was created from other materials? (d) was created from scratch? (e) some other origin(s)?</td>
<td>X</td>
</tr>
<tr>
<td>12. If you met with consultants from the textbook company and learned exactly how they would want you to teach this Algebra curriculum to students (i.e. provided you a script and timeline, clarified goals, sequence, etc.), how well would it meet your students’ needs without any changing?</td>
<td></td>
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<tr>
<td>13. What parts of this curriculum, if any, do you think need the most adaptation or supplementation? What makes you say this?</td>
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<tr>
<td>14. What parts of this curriculum, if any, do you think need to be replaced? What makes you say this?</td>
<td></td>
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<tr>
<td>15. Can you describe some features of an ideal Algebra textbook?</td>
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<tr>
<td>16. How satisfied overall would you say you are with your textbook?</td>
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<td>17. Describe the best textbook or curriculum materials you have ever used. Why do you see them as better than others?</td>
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<td>18. Imagine you are teaching five sections of [a non-Algebra high school math course they have never taught before] next year. Tell me about beginning to plan your course.</td>
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<td>19. Give me an example of any change you have made to your planning since you began teaching that has had positive repercussions on student learning. Is there any change you’ve made that particularly sticks out in your mind in this respect?</td>
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Lesson Overview (Pre-lesson)

What will be happening in the lesson(s)?

Date: ____/____/____

TI-IS#: ________ - ________

Class: __________________________

Period: ______

Time Start: ____:____ am/pm

Time End: ____:____ am/pm

# Students: ______

Observation #_____/_____

Basic Timeline of Lesson:

Notes/Role of Teacher:

__________________________________________________________________

________________________________________________________________________

________________________________________________________________________

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Lesson Material(s):

<table>
<thead>
<tr>
<th>Existing, Adapted or Created</th>
<th>Teacher/Student Use</th>
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Other Notes:
Post-Observation Clarification

*How are teachers using materials in the course of the lesson?*  
Date: ____/____/____

<table>
<thead>
<tr>
<th>Questions</th>
<th>Teacher’s Answers</th>
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</table>

TI-IS#: _______ - _______  
Class: _________________________  
Period: ______

Time Start: ____:____ am/pm  
Time End: ____:____ am/pm  
# Students: ______

General Teacher Comments:
Post-Instructional Segment Debrief/Reflection

How do teachers reflect on their use of materials over the course of the lessons?

Lesson Dates: ____/____/____ to ____/____/____

Class:________________________  Period:____

1. Tell me about your decisions to adapt or replace existing materials in/for these lessons. If no materials were changed in the course of the lessons, please leave the table below blank.

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<thead>
<tr>
<th>Artifact(s)</th>
<th>Commentary</th>
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</thead>
</table>

2. Overall, if you could go back in time and teach these lessons again to the same students, how would you use your materials differently, if at all?
REFERENCES:


Ziebarth, S. W., Hart, E. W., Marcus, R., Ritsema, B., Schoen, H. L., & Walker, R. (2009). High school teachers as negotiators between curriculum intentions and
enactment. In J. T. Remillard, B. A. Herbel-Eisenmann & G. M. Lloyd (Eds.), 

*Mathematics Teachers at Work: Connecting Curriculum Materials and 
