Curricular Decision-Making in Community College Mathematics Courses for Elementary Teachers

by

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Abstract

Although the mathematical preparation of future teachers is of particular concern within the field of mathematics education right now, little research has taken into account the increasing role of community colleges in offering mathematics courses for elementary teachers. The purpose of this study was to investigate the curricular decisions of community college instructors who teach these courses as an initial step towards understanding the types of mathematical opportunities that might be available to students in these settings. The study addresses the following research questions: How is written curriculum adopted for community college mathematics courses for elementary teachers? What factors influence instructors' decisions in implementing mathematics curriculum for elementary teachers in these courses?

Interview data was collected from 21 department chairs and instructors of mathematics courses for elementary teachers at four community colleges in the United States. Analysis of the data revealed four themes that described variations in influences on curricular decision-making between colleges: department autonomy in course design, course consistency and sharing of resources, use of the textbook and other curricular resources, and instructional practices. From those themes, models of curricular decision-making for each college were developed, demonstrating that curricular decisions were made at different levels depending on the structure and organization of the department around this course. Drawing upon these models, as well as Lattuca & Stark's Academic Plan (2009), an expansion of Remillard's (1999) framework of arenas of curricular decision-making is presented which incorporates curricular decisions that are made outside the level of the individual instructor. Three external influences particular to community college mathematics courses for elementary teachers—transfer, the textbook, and organization of the department around the course—are identified and described, and implications for both research and practice are presented.

Chapter One

Introduction

The focus of my research is the decisions that community college instructors make around curriculum for mathematics classes for elementary teachers. This research focus reflects several choices, which were inspired partly by my own experiences teaching mathematics and mathematics for teachers at both two-year and four-year colleges. First, of all mathematics courses taught by college instructors, I chose to focus on courses specifically designed for prospective elementary teachers. Not only is the mathematical understanding of future teachers of particular interest to the field of mathematics education, but these classes also have a very different subject matter and purpose than other mathematics courses that are typically offered at the postsecondary level. This makes them an interesting site for studying college mathematics instruction. Second, I chose to study these classes from the perspective of the decisions that instructors make around curriculum. My concern for the mathematics that is being taught and learned in this class could conceivably lead to other paths of research than curricular decision-making, such as observation of classroom practices, department-wide decision-making, or textbook analysis, and therefore my particular research focus will require justification that I provide below. And third, I chose to study courses and instructors at two-year rather than four-year degree granting institutions. As I will discuss, two-year colleges play a significant role in the mathematical preparation of teachers, and important differences exist between two-year and four-year institutions, which likely have an impact on the experiences of both instructors and students in this course. In the following section I will address the rationale behind each of these three decisions and the specific research questions I am posing.

Choice of Course: Mathematics for Elementary Teachers

First, I chose to turn my attention to mathematics courses for elementary teachers, rather than courses in the standard mathematics sequence (developmental math, algebra, trigonometry, calculus, etc., Steen, 1998) or mathematics courses for other professions (math for nursing, calculus for engineers, etc.). In a general sense, mathematics courses for elementary teachers are fundamentally different from these two other types of mathematics courses. The content of courses in the standard mathematics sequence consists of topics that build on topics taught in prior classes and that prepare students for higher levels of mathematics. Courses designed for specific professions develop particular concepts and calculations that are believed to be useful to professional practice. In contrast to both of these, mathematics courses for elementary teachers are typically centered on readdressing basic mathematical concepts, with the expectation that students in these classes will be teaching, rather than using, these concepts. In my personal experience with instructors, concepts taught in this course are perceived as not really new, and possibly easy to teach and learn, which can lead to widely varying interpretations of what it means to teach this course. These interpretations range from a focus on pedagogy, in which the instructor may model methods of teaching basic concepts, to an attempt to teach these basic concepts “at a college level” by introducing higher-level mathematics. Because of this difference in the nature of the course when compared to other courses commonly taught, it makes a particularly interesting site for studying the decisions made by college mathematics instructors.

Furthermore, and importantly, in recent years, there has been a great deal of interest in the mathematical education of elementary teachers, both pre-service and practicing. Research has demonstrated that teachers' mathematical knowledge does have an impact on student achievement (Hill, Rowan, & Ball, 2005), while simultaneously raising the concern that many U.S. elementary teachers have weak mathematical backgrounds (Ma, 1999; Seaman & Szydlik, 2007). However, while there have been calls for an improved undergraduate mathematical experience for prospective teachers (e.g., Wu, 1997), thus far there has been very little research on the opportunities prospective teachers actually have during their undergraduate experience to learn the mathematics that will be the foundation for their future teaching.

The mathematics content course that is the subject of this study is often the only time in teachers' careers when they can give focused attention to the actual mathematics that they will be teaching, as opposed to pedagogy. There has been some research on the mathematical understanding that future elementary teachers bring to their pre-service education, and on how that understanding changes or does not change over the course of their content and methods classes (e.g., Ball, 1990; Eisenhart, et al., 1993). But few studies have examined the course content and the instruction that is taking place in the mathematics content courses where teachers are expected to gain a mathematical foundation. Nor have there been many studies on how college mathematics and mathematics education instructors make decisions about the content and pedagogy appropriate for this class: what mathematics is necessary for future elementary teachers to learn and how to teach these future teachers. As the mathematics education community learns more about the mathematical knowledge that contributes to good teaching, we also need a better understanding of the mathematical experiences prospective elementary teachers have, and how college instructors can be better helped to create learning experiences that will provide teachers with a solid foundation for their future teaching.

Choice of Lens: Instructors' Decisions around Curriculum

These types of questions lead naturally into my second choice, about how to examine the role that mathematics instructors play in creating learning opportunities for future elementary teachers. I chose to center my research on the decisions mathematics instructors make around curriculum when they teach courses for elementary teachers. At a basic level, a study of written curriculum materials can provide insight into the mathematics that students have opportunities to learn, and which teachers draw upon when teaching. But studies of mathematics curriculum at the K-12 level have, over time, increasingly emphasized the role of the teacher in enacting the curriculum, and how teachers' beliefs and choices can lead to very different classroom outcomes (Stodolsky, 1989; Remillard, 2005). There is little research on mathematics curriculum adoption and enactment at postsecondary levels, but the same basic principle is doubtless the same. The choices that an instructor makes in selecting, adapting, and enacting curriculum materials will affect the mathematics that students have an opportunity to learn and how they learn it, regardless of the particular curriculum or textbook being used. There are many different textbooks commercially available for mathematics classes for elementary teachers, and many additional resources developed commercially and independently. But understanding what prospective teachers have the opportunity to learn in this class requires going beyond the textbooks to the instructor who has responsibility for selecting, adapting, and enacting curriculum materials.

Choice of Setting: Community Colleges

Finally, my particular interest lies in mathematics courses for elementary teachers that are taught in community colleges, instead of four-year institutions. Community colleges are increasingly making elementary mathematics courses available for students who plan to teach, and many students are taking advantage of this opportunity. In 2005, there were approximately 72,000 students enrolled in a mathematics course for elementary teachers at a four-year institution, compared to about 29,000 students enrolled in a similar course at a two-year college (Lutzer, Maxwell, & Rodi, 2005). This means that more than a quarter of students who are taking this course at all are choosing to take it at a community college, making the community college an important site for the mathematical education of elementary teachers.

Community colleges, however, have virtually no representation in the little research that does exist on the mathematical education of prospective teachers. Yet there are significant differences between two-year and four-year institutions that could potentially affect the way these courses are taught and how instructors think about teaching them. For one, community colleges are open-access institutions, accepting students with a wide variety of backgrounds and mathematical histories. Community colleges tend to have higher faculty teaching loads and faculty with differing educational backgrounds than at four-year institutions. Additionally, most students enrolled at community colleges in mathematics courses for elementary teachers expect to transfer to other institutions to complete their teaching degree, and therefore decisions about what to teach and how must also take into account the requirements of education programs that the students could conceivably transfer into. At the same time, unlike four-year colleges where most students enrolled in this course will expect to complete their teaching credentials, at least a few students enrolled at the community college are taking the class to fulfill requirements for paraprofessional credentials, and other students will never transfer credits to another institution after completing their associate's degree. This creates a diversity in student experiences and professional intentions that is not encountered in most four-year settings. Because there are factors unique to community colleges that would not be captured by looking at four-year institutions, and because I am a community college instructor myself and have a personal interest in that setting, I have chosen to focus my attention on mathematics content courses at two-year rather than four-year institutions.

My research questions then are as follows:

- How is written curriculum adopted for community college mathematics courses for elementary teachers?
- What factors influence instructors' decisions in implementing mathematics curriculum for elementary teachers?

The dissertation is organized as follows. Here in Chapter One I have laid out the motivations for my study and introduced my research questions. In Chapter Two, I review research literature relevant to this study. This includes a review of research on mathematics content courses for elementary teachers, a discussion of relevant characteristics of community colleges and a review of literature conceptualizing curriculum at the K-12 and postsecondary levels for their potential contribution to conceptualizing curriculum in this particular course and setting. In Chapter Three I describe the research methods. The study consists of interviews of instructors at four different community colleges, and I present a rationale for the research method, the choice of participants, a description of the procedures, and a discussion of the analysis of the data. In Chapter Four I present the findings, organized as a description of each of the four colleges in my sample around four central themes that emerged in the analysis. In Chapter Five I discuss patterns across colleges within each of these themes, as well as how these patterns uniquely characterize curriculum use in the mathematics course for elementary teachers at each of the four colleges. Finally, in Chapter Six I discuss the implications of this study, and suggest paths for future research.

Chapter Two

Literature Review

There is a significant amount of research in the mathematics education literature on curriculum and teachers' use of curriculum. However, most of this research has centered on elementary teachers, and some secondary teachers.[1] Research on mathematics curriculum materials and curriculum use at the postsecondary level is sparse, with a few studies on how students use textbooks (Lithner, 2003; Benesh, et al., 2006), or on the content and structure of the textbooks themselves (Raman, 2004; Mesa, 2007); research on the use of the textbook in postsecondary *instruction* is almost nonexistent. Furthermore, although there has been a great deal of interest in the mathematical preparation of teachers, and there is a wide variety of commercially published mathematics textbooks for future teachers, very little research has focused specifically on the curriculum for these courses, or on the role that the available curriculum plays in classroom instruction.

I organized this literature review into three sections. I first review some of the literature on the mathematical preparation of teachers and what is known about the instruction of this course. I then discuss the community college, with a particular emphasis on how the community college setting differs from the university setting, and how these differences may be reflected in the mathematics course for elementary teachers. Finally I discuss research on curriculum use, including research on mathematics

[1] Because my research involves teachers of teachers, and students who themselves will be working with students in the future, throughout this paper I will use the term *instructor* to refer to those who teach future teachers at the college level, *teacher* to refer to elementary teachers. The term *student* will refer to prospective teachers enrolled in mathematics courses for elementary teachers, unless otherwise stated.

curriculum use and higher education conceptualizations of curriculum, and what aspects of this research may be relevant to the context of teaching mathematics for elementary teachers at the community college level.

The Mathematical Preparation of Teachers

Over the last several decades, there has been a surge in the attention explicitly paid to the content knowledge of teachers, as opposed to pedagogical knowledge. Conceptualizations of the knowledge necessary to effectively teach mathematics have evolved from Shulman's (1986) definition of pedagogical content knowledge (PCK) as a distinct, content-specific knowledge possessed by teachers, to Ball and colleagues' emerging theory of mathematical knowledge for teaching (MKT), which has been correspondingly linked to student achievement in the classroom (Hill, Rowan, & Ball, 2005). While researchers continue to identify the specific nature of the mathematical understanding teachers do or ought to possess, there is little dispute that effective teachers of even elementary-level mathematics must themselves have a robust understanding of the mathematics that they are teaching.

There is also consensus that elementary teachers in the United States, who generally teach across the general curriculum rather than within a particular disciplinary specialty, rarely enter the profession with this robust understanding of mathematics (Ball, 1990; Ma, 1999; Simon, 1993; Tirosh & Graeber, 1989). While there is evidence that practicing teachers' mathematical knowledge for teaching can increase through experience and professional development (e.g., Hill & Ball, 2004), the mathematical preparation of prospective teachers is an equally important task for teacher educators. Mathematics courses designed specifically for prospective elementary teachers are an important site in the work of equipping teachers with mathematical skills and understanding that will be useful in their teaching and in their ability to continue to develop mathematically throughout their career. These courses are often the first time that prospective teachers will encounter mathematical thinking in a context explicitly tied to their work as teachers, and possibly the only time that they will be able to give extended time and attention to mathematics without the pressures of simultaneously dealing with pedagogical concerns, as is likely to happen in their methods courses and student teaching.

But in spite of the distinctive and crucial role that these courses can play in the mathematical development of future teachers, research on these courses is still sparse. Some research on prospective teachers' mathematical knowledge and the factors and conditions that affect (or fail to affect) their knowledge picks up at their methods courses (e.g., Eisenhart, et al, 1993). This may be partly a matter of accessibility to education researchers, as methods courses and student teaching are more likely to be within the domain of education departments, whereas content courses are frequently the domain of mathematics departments. It may also simply be that mathematics teacher education research has typically focused its efforts on situations where teachers and prospective teachers are engaged in the work of teaching, and a content-specific course is peripheral to that work. However, as has already been discussed, the role of content-specific courses in teacher preparation is unique and important, and they have been the focus of some research on prospective elementary teachers, as will be described below.

Research on the mathematical preparation of elementary teachers in their content courses can be divided into small-scale and large-scale studies, which have very different methodologies and purposes. The smmaller-scale studies that I will discuss first, studies that are focused on one or several classrooms, tend to highlight possibility: Can a mathematics content course positively influence the knowledge and beliefs about mathematics that prospective teachers hold? And under what circumstances?

There is, in these types of studies, an undercurrent of optimism. The researchers conducting the studies believe in the potential of these courses, and actively seek evidence that student knowledge changes as a result of particular methodologies. Peretz (2006) built upon prior research and theory to construct a constructivist approach for teaching mathematics to elementary teachers, intended to enhance not just their mathematical knowledge but their reasoning ability. Although the tenability of her approach relies on its theoretical rather than empirical foundations, and her reports of its successes are only anecdotal, her development of this method of teaching exemplifies this optimistic approach to the mathematical preparation of teachers in that she assumes the possibility of building worthwhile mathematical knowledge through the course for elementary teachers and works to create conditions that will produce the kind of mathematical knowledge assumed to be worthwhile.

Speiser, Walter, and Sullivan (2007) take a different approach, focusing less on method and instead zeroing in on individual students as learners and doers of mathematics, who invented their own task and explored the mathematics in their own way. The factors that may have made this mathematical work possible is subordinated to the mathematical work and capabilities they observed in their students. Where Peretz's work centers almost entirely on the instructional design and uses student engagement with the design to illustrate the design's features, Speiser, et al. relegate instructional design to the background and center their analysis on individual learners. Their study, then, exemplifies an optimistic approach from a different perspective: Peretz attempts to show what instructional design might be capable of in preparing students, and Speiser and colleagues attempt to show what students themselves might be capable of.

However, a second undercurrent to smaller-scale studies on mathematics courses for elementary teachers, and one that is better substantiated by empirical evidence, is that change is difficult. More studies document change in mathematical attitudes (Phillip & Christou, 1998; Szydlik, Szydlik, & Benson, 2003; Philipp, et al., 2007) than document change in mathematical knowledge. Students' prior experiences with doing mathematics are powerful, and trying to change students' approaches to mathematics is difficult. Zevenbergen (2005) found that many students enrolled in a mathematics content course for elementary teachers that were intended to develop conceptual understanding were resistant to change, in large part because of prior successes with "lockstep mathematics." Students had met with success in past courses when teachers showed them step-by-step methods of completing the problems, and they relied heavily on this same strategy even in a course emphasizing conceptual development. Eisenhart and colleagues' (1993) and Foss and Kleinsasser (1996) found similar phenomena, albeit in mathematical methods courses rather than content courses.

Philipp, Ambrose, Lamb, Sowder, Shappelle, Sowder, Thanheiser, and Chauvot (2007) have conducted what is possibly the most comprehensive experimental study of mathematics courses for elementary teachers, in which prospective teachers enrolled in a mathematics course were given extensive exposure to student thinking through video, guided tutoring sessions, or classroom visits, in the hopes that connecting mathematics to prospective teachers' motivations for teaching would enhance their motivation for mathematical learning. While they found noteworthy changes in students' attitudes, they found the affect on students' mathematical learning to be disappointingly low. The authors suggest that this finding highlights "a need to examine more closely what such courses do accomplish and to compare results within the community" (p. 469). *Because* change in mathematical knowledge is difficult both to achieve and to document, more focused research attention to the mathematics course for elementary teachers is an important gap to fill in current research on mathematics teacher preparation.

In opposition to the focus of smaller-scale studies on the possibility of mathematical learning in courses for elementary teachers, the focus of the handful of larger-scale studies that exist, which look across classrooms and colleges, are more descriptive in nature: What mathematical preparation do prospective teachers actually receive? Below I describe three studies that attempt to survey the undergraduate mathematical preparation of teachers in general in order to draw conclusions about the opportunities for learning mathematics afforded to teachers.

Adler and Davis (2006) used data from a large research project in South Africa to shed light on the kinds of mathematical knowledge made available to teachers in teacher preparation programs. They collected formal evaluative events (such as tests) from mathematics-related courses in a variety of teacher preparation programs across the country and analyzed these evaluations according to the type of mathematical work they required of prospective teachers. Although the mathematics education community supports the idea that teachers need to understand how to "unpack" mathematical ideas, Adler and Davis found that the majority of evaluative events instead required students to compress or abbreviate mathematics. While the context of post-Apartheid South Africa is in many ways quite different from the context of United States teacher preparation, their findings still reveal ways that beliefs about the types of mathematics that teachers should learn might not be reflected in what the curriculum actually requires of the students.

Raven McCrory and her colleagues (McCrory, 2006, Kim & McCrory, 2007) have begun a large-scale investigation of the opportunities to learn mathematics offered to prospective teachers at 4-year institutions with teacher education programs in Michigan, South Carolina, and New York City. Their data include interviews and surveys given to mathematics department heads and instructors, tests on content knowledge administered to students enrolled in mathematics courses for elementary teachers, and textbooks published for use in mathematics courses for elementary teachers. Many of their initial findings describe in concrete terms aspects of the context in which students take these courses that have typically been taken for granted. For example, students are generally required to take one to three mathematics courses, which are offered through the mathematics department and designed specifically for future teachers, and contrary to popular belief, most mathematics departments express positive opinions about these classes, and usually do not have difficulty finding faculty to teach them. Textbooks for the courses tend to be encyclopedic in nature, covering a large number of common topics in piecemeal fashion rather than telling a coherent “story” of mathematics (McCrory, 2006). And students who enroll in these courses do evidence growth in measures of mathematical knowledge for teaching over the course of the semester in which they take the course (Kim & McCrory, 2007). These findings show that there is some consistency across the institutional contexts of mathematics courses, at least in 4-year institutions, although the large-grained analysis says little about the actual nature of the curriculum and instruction of these courses.

Finally, a recent report by the National Council on Teacher Quality (NCTQ) surveyed the program requirements, course syllabi, and textbooks for mathematics content and methods courses in 77 U.S. schools offering teacher certification programs with the intent of documenting the adequacy of mathematical preparation of teachers in the United States (Greenberg & Walsh, 2008). Programs were found to have widely varying mathematics requirements for prospective teachers, and under the guidelines developed by a committee of mathematicians and mathematics educators, teachers' mathematical preparation was found to be insufficient in the majority of institutions surveyed, particularly in the area of algebra. The committee subsequently issued a series of recommendations for improving the university-level mathematical preparation of teachers.

Taken together, these studies help to paint larger pictures of the types of mathematical opportunities available to prospective teachers. All three in some way examine the curriculum of content courses, whether through the formal evaluations that students encounter in their studies, or through the textbooks and syllabi that are used in mathematics content courses. The focus of all of the studies is less on what students are actually learning and more on what they have the opportunity to learn, although the breadth of the data available to answer this question is limited by the size of the samples. Students' classroom experiences and *how* the curriculum is implemented in the classroom are not within the scope of these studies. It is not necessarily clear to what extent textbooks, for instance, accurately reflect the mathematics students actually have the opportunity to learn.

Also noticeably absent are two-year colleges. The sampling methods detailed in the studies above involved choosing colleges with teacher certification programs. Such a sampling procedure makes sense because it is institutions with teacher certification programs that undertake the formal undergraduate preparation of elementary teachers. However, many students at these four-year institutions can legitimately transfer relevant credits from two-year institutions. Because two-year institutions are left out of the sample, little is known about whether there are significant differences between opportunities available to students at two-year and four-year institutions, or whether important characteristics of the students, such as mathematical background, motivation, career goals, and other variables, differ from institution to institution. These are factors that could potentially have a great impact on the classroom instruction and curriculum use in courses for elementary teachers at different types of institutions.

The report on undergraduate mathematics by the Conference Board of the Mathematical Sciences [CBMS] (Lutzer, et al., 2005) is one of the few sources of information on mathematics courses for elementary teachers at community colleges. The report also gives additional insight into the context of the mathematics course for elementary education majors at all institutions (two- and four-year), as well as the teaching practices of instructors for this course. Because CBMS surveys both four-year and two-year institutions, there is substantial data in the report on the teaching of the mathematics course for elementary teachers at the community college—in fact, more data than is available for the teaching of this course at the university. This is partly because enrollment in this course at the community college increased significantly during the five years between the 2000 CBMS survey and the 2005 survey; in fact, at the enrollment increased 61% over that four year period (to 11,000 students), the largest percent increase in enrollment in transferable, college-level mathematics courses. Ten percent of these enrollments in the course for elementary teachers are distance enrollments, among the largest percentage of distance enrollments in community college math classes. Fifty-nine percent of community colleges offer this course, an increase of 10 percentage points since 2000. In terms of instruction, the CBMS survey includes questions about particular instructional practices. Practices that were used in math courses for elementary education majors at community colleges included standard lecture (48%), writing assignments (52%), group projects (48%) and computer assignments (13%).

Of course, such data is still quite limited. Instructional practices are restricted to what appeared on the survey, and are self-reported. Each of the instructional methods above could look very different from one class to the next, and could vary in effectiveness depending on how the instructional method was implemented in the classroom. In addition, the data on the mathematics course for elementary teachers that was collected at two-year colleges differed from the data collected at four-year colleges, making it impossible to make comparisons between, for example, teaching methods, or the composition of faculty teaching the courses.

In short, research on mathematics content courses for elementary teachers is still somewhat scattered and sparse. Both small-scale and large-scale studies, as well as various policy documents, make recommendations for the mathematical preparation of elementary teachers, but implementation of recommendations, and possibly their effectiveness, may be affected by contextual factors. The community college is taking on an increasing role in the mathematical preparation of teachers, but there are crucial differences between community colleges and four-year institutions that might impact the capacity of instructors who teach the course and the learning opportunities of students. The impact is not necessarily negative, but is important to understand. In the following section of my literature review I will discuss the role of the community college and some of the differences between two-year and four-year institutions that might bear upon mathematics courses for elementary teachers.

The Community College

As stated in the introduction, the mathematical preparation of teachers at the community college should be of particular interest to the field of mathematics teacher education given that increasing numbers of students are completing their mathematics content course requirements at the community college. All of the research on mathematics courses for elementary teachers included in the above section, however, takes place in the context of university courses. Large-scale studies are more likely to sample institutions with teacher certification programs. Smaller scale studies may focus on four-year institutions because scholars who research the mathematics content course are likely to do so at their own research institution. Community colleges are known for their teaching focus, and may even discourage faculty from publishing research, either explicitly or through institutional structure (Grubb, 1999). The community college, therefore, constitutes a blind spot in research on the mathematical preparation of teachers. But although my research questions imply the need to focus on the institutional context in which community college students are enrolling in their mathematics course, this focus is also relevant to the study of mathematical preparation of teachers in general, which as shown in the preceding section has thus far focused on student learning largely at the individual level with little regard to context beyond that which is personal or programmatic. In this section I will attempt to describe some of the contextual aspects of community colleges that might play a role in the work and experiences of the instructors who teach the mathematics course for elementary teachers.

The community college, originally called the junior college, evolved around the turn of the century in order to increase access to higher education without burdening existing institutions. Originally serving a transfer function, the community college role later broadened to include vocational preparation and community education, and an open-access policy and low tuition have made community colleges a viable option for students who might otherwise not have access to higher education (Kane & Rouse, 1999). The community college is often touted as a democratic institution for providing access to higher education for underserved students, and as a teaching institution for its faculty's focus on teaching over research, and on the one hand, research has documented successes in the role of the community college in opening opportunities for students (Bailey & Morest, 2006). Hilmer (1997), for example, showed that students who first attended community colleges, particularly students who came from poor families or performed poorly in high school, attended higher quality universities than those who did not. But on the other hand, the institutional context of community colleges often works counter to its democratic and student-centered aspirations. Clark (1960), writing during a period of historical growth in community colleges, discussed the "cooling out" function of community colleges, in which the open-door policy led to some successes, but for many students to failure that was “inevitable and structured.” More recently, Grubb and associates (1999) interviewed and observed community college instructors across departments throughout the United States and found that the teaching emphasis of community colleges often created a work load that limited opportunities for preparing for and improving instruction. Full-time community college mathematics faculty teach an average of 15.2 contact hours per week, in addition to non-teaching responsibilities and time spent with students outside of class, and the teaching load is increasing over time (Lutzer, et al., 2007). Furthermore, few structures (in terms of hiring practices and professional development) are in place in community colleges to improve instruction, meaning that teaching is often developed through trial and error rather than systematically (Grubb, 1999).

Characteristics of faculty at community colleges also differ from four-year institutions. Eighty-two percent of full-time mathematics faculty hold a master’s degree as their terminal degree, 16% hold a doctorate. However, 68% of community college mathematics instructors are part-time faculty, and they are less likely than faculty at four-year institutions to hold a doctorate, and slightly less likely to hold a master’s degree as well. Although part-time faculty have smaller teaching loads, a significant proportion of mathematics classes are taught by part-time instructors. Part-time faculty are similar to full-time faculty in many of their instructional practices, but have less contact with students outside of class, fewer interactions with other colleagues, and are less likely to particular instructional practices that have been shown to be effective for students, such as using technology and collaborative work (Shuetz, 2002). Part-time faculty who have participated in professional development are more likely to use innovative teaching methods (Keim & Biletsky, 1999), but there are few professional development opportunities for part-time faculty. Concerns have been raised that part-time faculty are less effective as teachers, but there is inconclusive evidence to support this claim, and very little research comparing the actual classroom instruction of part-time and full-time community college faculty (Banachowski, 1996).

Research on teaching practices in community college mathematics courses and student success is limited, and almost entirely focused on developmental (remedial) mathematics courses (King & Crouse, 1997; Umoh, 1994; Waycaster, 2001), with some reference to the use of technology in classrooms (Adams, 1997). In addition, measures of student success in mathematics at community colleges are rarely tied to actual learning (Mesa, 2008). Community college mathematics faculty are concerned with issues of articulation and transfer; courses are designed to prepare students to succeed in future math classes, even if the course is terminal for most students (see Burn, 2006), and measures of success often focus on persistence and retention (Umoh, 1994; Castles, 2004; Bahr, 2008).

Two points are worth noting about the data and research described above. First, differences in the teaching conditions and faculty composition of community colleges in general differ markedly from the courses described above in the smaller-scale research on pre-service teachers learning mathematics in four-year institutions. Instructors of such courses generally held doctorates and had strong ties to education departments. The courses themselves were often carefully designed by faculty members with a vested interest in promoting not just mathematical learning, but constructivist attitudes towards mathematical learning. While such courses can give us insight into the conditions in which pre-service teachers might successfully learn mathematics (as well as impediments that exist within these conditions), it is not clear that such conditions are the norm even in four-year institutions (as documented by the larger-scale studies described in the previous section), and given the data above it seems doubtful that similar conditions exist in community colleges. Understanding the conditions that exist in typical classes in community colleges and the backgrounds of typical instructors may be more useful for providing support to the teachers who teach this class in this context.

Second, very little research exists about the instructional practices and concerns of community college mathematics faculty, and what little there is focuses on courses that are part of a standard sequence of mathematics. Notions of articulation and transfer, as well as purpose and even the role of the academic discipline, would likely take on very different meanings to faculty who are teaching a course such as mathematics for elementary teachers, which, unlike developmental mathematics or college algebra, is a terminal course in the mathematics sequence and designed explicitly for relevance to a particular non-mathematics career path. In addition, the textbooks available and commonly used for mathematics for elementary teachers are very different in content, and sometimes format, than the textbooks used for mathematics classes in the standard sequence.

Mathematics Curriculum Use at the K-12 Level

In a study of learning opportunities that are available to students at any level in any subject or course, curriculum is a natural starting point, and is thus the focus of my research on mathematics courses for elementary teachers in community colleges. I approach my study from a mathematics education perspective, and so conceptualization of curriculum that drives my study originates from conceptualizations of curriculum in mathematics education research. However, because I am studying a course that is offered at the community college level, a higher education perspective is both relevant and important. But attempting to discuss curriculum from both a higher education and a mathematics education perspective is problematic because both fields frame curriculum very differently. Adding to the difficulty, within each respective field alone the term “curriculum” is used in a variety of ways that can cloud understanding about curriculum and its impact on students (Lattuca & Stark, 2009; Remillard, 2005). Even in everyday language, the term curriculum is used in a variety of ways; a web search on curriculum returns definitions ranging from a program of courses required for a degree, a series of experiences and assessments, and an instructional plan taught in the classroom. I begin this section, then, with a discussion of how curriculum is conceptualized within research settings relevant to my study and a clarification of how I conceptualize curriculum for the purpose of my research. I then refer to specific frameworks that inform my thinking about curriculum in the context of my research questions.

Conceptualizing curriculum.

One aspect of curriculum that is common to both higher education and mathematics education is that the term itself is neither clear-cut nor consistently used. At the college level, the term curriculum is particularly broad. It “can refer to the educational plan of an institution, school, college, or department, or to a program or course” (Ratcliff, 1997, p. 7). The term can also be used ambiguously, so that it is not clear whether curriculum refers to particular courses, choices made my students, the experiences students take away from the courses, the teaching strategies chosen by professors, etc.

(Lattuca & Stark, 2009). Lattuca and Stark, arguing that definitions of curriculum are often too general to be helpful, defined curriculum as an “academic plan” incorporating decisions around purposes, content, sequence, learners, instructional processes, instructional resources, evaluation, and adjustment, thus providing a definition and framework that can be applied at any level, be it institution, department, program or course (Lattuca & Stark, 2009, pp. 4-5).

The academic plan model helps consolidate and formalize definitions of curriculum in higher education literature, but it also emphasizes the breadth of the higher education conceptualization of curriculum. To speak of curriculum at the level of a single course, as in this study of community college mathematics courses for elementary teachers, would include a discussion of content and sequencing of content, as well as overarching purposes, resources, instructional methods, types of assessment and evaluation, and so on. Additionally, this model emphasizes the myriad influences that contribute to a students’ actual classroom learning experience, and to a faculty members’ course construction.

This broad conceptualization of curriculum differs noticeably from how curriculum is conceived in mathematics education research. A major difference between curriculum broadly conceived in higher education (and, for that matter, in education in general), and curriculum as typically discussed in the field of mathematics education is the role of formal written materials. Textbooks and other written curriculum materials are generally central to discussions of curriculum in mathematics courses, whereas they are only peripheral (if they are even present) in discussions of curriculum at the college level.

This is largely because the teaching of mathematics, more than other subjects, is strongly tied to the content and sequencing of textbooks, as described by Remillard (2005):

> [M]athematics is a subject that has long been associated with textbooks and curriculum materials. Other school subjects, such as literacy-based subjects, have enjoyed brief periods where teachers were encouraged to draw on literature or trade books to shape their curriculum, but mathematics has a long history of being driven by the textbook. The reasons for this trend include, among others, societal views of the nature of the content and how it is learned, and the level of comfort that many teachers have with the subject. (p. 212)

While Remillard's description of the textbook-driven nature of school mathematics refers mainly to K-12 mathematics courses, college mathematics courses, or at least lower division courses, are also likely to be textbook driven. For one, "societal views of the nature of the content and how it is learned" do not necessarily change in the transition from high school mathematics to introductory college mathematics. And curricular decisions by faculty in introductory college mathematics courses have been shown to be more heavily influenced by textbooks than in other college subjects (Stark, et al., 1988).

Because of this, mathematics education research on curriculum has largely focused on curriculum *materials*, including textbooks, activity manuals, teachers' editions of textbooks, or even written outlines of topics and sequences mandated by states or districts (Ball & Feimen-Nemser, 1988; Freeman & Porter, 1989; Drake & Sherin, 2006). In my study, I refer to such materials as curricular resources. Research on curriculum in mathematics education has increasingly shown that these written materials (curricular resources) are transformed through teachers' decisions and students' reactions, and that the resulting transformations have great bearing upon how students experience the curriculum. It is these transformations that introduce ambiguity to the term "curriculum" in mathematics education research. Curriculum can refer to printed or published resources, but it can also refer to goals and activities outlined by school policies, a teachers' intentions for a given class, or what actually takes place in the classroom, what is often called the "enacted curriculum" (Travers, K. J. & Westbury, I., 1989; Remillard, 2005).

These differences in definitions or conceptions of curriculum reflect the common concerns of research on curriculum in mathematics education. Written curriculum materials have been a primary means of promoting reform in the mathematics classroom, and as a result there has been a great deal of research on the impact and use of reform-oriented curriculum materials (Remillard, 1999). Originally such research pursued the question of *whether* different curriculum materials had an impact on student learning, but findings about the complex nature of the relationship between written curriculum and learning led to new questions about how the written curriculum was enacted. Stein, Remillard, and Smith (2007) organize their review of research on the relationship between mathematics curriculum and student learning around the transformations curriculum undergoes from written, to intended, to enacted, and the myriad influences on those transformations. They claim that understanding the impact of curriculum on student learning "would not be possible without reviewing what is known about how the curriculum is mediated before and in the process of making its way to students," and that there is "vast conceptual territory that lies between the curriculum as a designed object and student learning" (p. 362). Remillard's (2005) review of research on mathematics curriculum also shows how focus has shifted from whether curriculum has an impact, to how curriculum is enacted in the classroom.

Conceptualizing curriculum as inclusive of both curricular resources and the process whereby those curricular resources are transformed as they are implemented in the classroom has two benefits. First, it explicitly acknowledges the role and influence of curricular resources, including textbooks. This is a role that might not be as central or important in other subject areas, but is central to most mathematics courses, including mathematics courses for elementary teachers. It is important to note that what little large-scale research exists on the learning opportunities in these courses includes surveys of textbooks, as well as findings that most courses are not built from the ground up but use published texts (Kim & McCrory, 2007; Greenberg & Walsh, 2008), and that many widely-published textbooks exist specifically for such classes (McCrory, 2006). And where textbooks are central to a given course, their potential influence on instruction cannot be ignored. Take for example a study by Herbel-Eisenmann, Lubienski, and Id-Deen (2006) of an 8th-grade mathematics teacher as she simultaneously taught two versions of the same class using two different textbooks, one traditional and one reform. Her teaching practices varied greatly between the two courses, and the teacher herself openly recognized that the textbook influenced, and in some ways constrained, her pedagogical practices.

Second, this conceptualization of curriculum also acknowledges the influence of the instructor and other factors on how the written curriculum is experienced by students in the classroom. This particular influence is well-documented in K-12 mathematics classes. Ball and Cohen (1996) emphasized that teachers' adaptation of curriculum materials for and in the midst of instruction is a central and inseparable part of curriculum use. Research on how teachers use curriculum materials in the classroom has identified patterns and influences in the ways that teachers make adaptations to curriculum. For example, Drake and Sherin (2006) based their research on Ball and Cohen's assertion of the inseparability of curriculum adaptation to curriculum use and explored how such adaptation happens. They looked at two teachers using a reform-oriented curriculum, and at how and when they made adaptations to the curriculum. Each of the two teachers had a distinctive way of adapting curriculum, and their adaptations were tied to their narrative identities as teachers, including their past experiences with mathematics, and experiences within their own families.

Davis, Beyer, Forbes, and Stevens (2007) also addressed the adaptation of curriculum materials, describing how two teachers made changes to science curriculum, and how constructing narratives of their adaptations affected the way they thought about adapting. Creating these narratives around adaptation of curriculum served in this case as a professional development tool, and Davis, et al., discussed what could be learned about what teachers need to know in order to make productive changes to the curriculum. They posit that better understanding the purposes of curriculum materials could help lead to teaching that is better aligned with those purposes.

In this study of mathematics courses for elementary teachers, then, I use a conceptualization of curriculum based largely on mathematics education research. That is, I consider written curriculum materials, or curricular resources, as the starting point for thinking about what students have the opportunity to learn in mathematics courses for elementary teachers, and include instructors' decision-making around these curricular resources as an essential component of curriculum because of the impact of these decisions on what reaches students. I choose this perspective based on the assumption that a mathematics content course for elementary teachers will likely be similar to other mathematics courses in that content and sequencing are structured by textbooks and other curricular resources, but also that the use of these curricular resources will be strongly mediated by the decisions instructors make in implementing these resources in the classroom. I therefore address both of these aspects in my research questions, the first of which refers to how written curriculum is adopted in this setting, and the second of which addresses the factors that influence instructors' decision-making in implementing the adopted written curriculum.

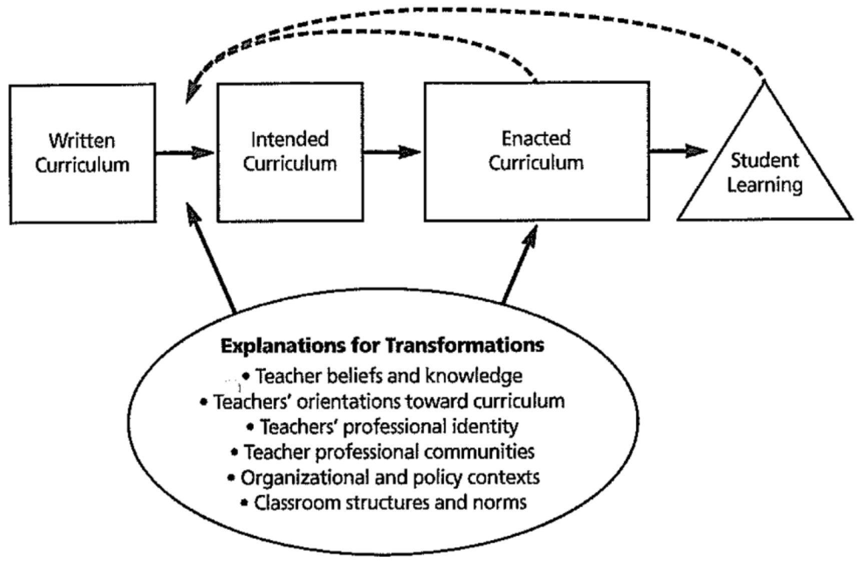
However, I also acknowledge higher education conceptualizations of curriculum in that the influences that impact what a student experiences in the classroom are broader than the day-to-day decisions an instructor makes about how to convey textbook material. Mathematics curriculum studies take place almost exclusively in K-12 mathematics classrooms, often with the assumption that textbooks are being used to implement change and reform. Teachers in this context are usually making decisions around a text that is assigned by a school or district, with the expectation that students will master a given curriculum before proceeding to the next class or grade level. In a college-level mathematics course for elementary teachers, instructors likely have more control over the textbook that is used and, because the course lies outside the standard mathematics sequence, there are not specific content expectations for students to proceed to the next level of mathematics; the goal of the course is to prepare students with mathematics specific to their future teaching rather than with mathematics preparatory to future mathematics classes. This affects the areas where instructors might potentially make curricular decisions that impact students' learning opportunities, and my research design takes into account broader levels of decision-making and factors that might affect these decisions.

Frameworks for curricular decision-making.

Here I describe two different frameworks for curricular decision-making from the mathematics education literature that informed the design and analysis of my study. I briefly describe the frameworks themselves, and then discuss how the context of my study differs from the contexts in which these frameworks were developed, and how this difference may impact the usefulness of the frameworks in conceptualizing curriculum for the purpose of this study.

First, in their review of how curriculum influences learning in mathematics, Stein, Remillard, and Smith (2007) illustrate a model in which the written curriculum goes through a series of transformations, to intended, and then enacted curriculum, before impacting student learning (Figure 2.1). These transformations, in turn, are influenced by teachers' beliefs and knowledge, orientations towards curriculum, and professional identity; professional communities; organizational and policy contexts; and classroom structures and norms (p. 322).

Figure 2.1: Transformation of Written Curriculum (Source: Stein, Remillard, & Smith, 2007, p. 322)



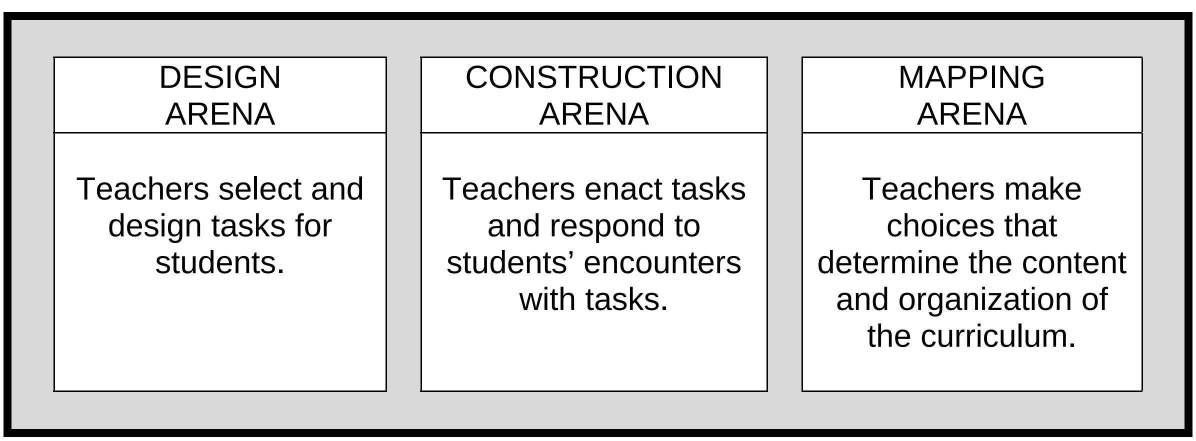
This model illustrates the various components of the definition of curriculum that I have adopted for this study. Curriculum as a whole consists not just of written curriculum, but of the modifications to the curriculum that occur as instructors interpret the curriculum and implement it in the classroom. The model also acknowledges the non-static nature of curriculum, that the instructor's intentions and interpretations are affected by each experience in enacting the curriculum and observing students' reactions and learning. Finally, the model details some of the factors that research has shown to affect the transformations.

Although this framework was developed from research on curriculum use in K-12 mathematics courses, many aspects of the framework can likely be extended to curriculum in mathematics classes for elementary teachers. Even considering differences in the mathematics being taught, the institutional context, and teacher backgrounds, it seems reasonable to expect that the nature of the relationship of curriculum to learning will be similar in a community college setting, because students' experience with written curriculum materials is still mediated in some way by the instructor. However, because little research on mathematics curriculum use at community colleges, or in classes for elementary teachers, exists, the nature of the instructor's role in the curriculum-learning relationship remains an open question and is worth investigating.

Furthermore, there are some contextual differences that are likely to influence how curriculum is used. The studies through which Stein, Remillard, and Smith's model was developed were almost exclusively focused on teachers using "reform curriculum." That is, as stated above, a primary concern of much curriculum research is how to help teachers effectively work with curriculum that reflects a presumably unfamiliar approach. The teachers who were the subjects of the studies were generally using a curriculum that had been chosen at a school-wide or district-wide level, and learning to use that curriculum either on their own, or with additional professional development. At the community college level, and particularly in mathematics courses for elementary teachers, the relationship of the instructor to the curriculum is likely to be quite different. It is likely (though not certain) that teachers have more of a say in the choice of curriculum materials, for example, and the resources they have access to and choose to draw on may also be very different from the resources available to and used by elementary mathematics teachers. The purposes of the course are also different, meaning that adaptations of the curriculum may also include bringing in pedagogical or philosophical ideas that are not a part of a more standard mathematics curriculum. And finally, community college instructors, who typically carry a load of 15 credits or more, are likely to be teaching other courses from very different textbooks, an additional teaching experience that may or may not impact their use of and beliefs about curriculum in the mathematics course for elementary teachers. My research seeks to uncover the influences on the transformation of written curriculum to enacted curriculum that are specific to mathematics courses for elementary teachers in community college settings, which may differ from those influences identified in Stein, Remillard, and Smith's model.

The second model I draw upon is Remillard's (1999) description of the arenas in which teachers make decisions about curriculum (Figure 2.2). Remillard integrated prior research on teachers' curriculum use to develop a framework of how teachers engage in curriculum development, and identifies three arenas in which teachers make decisions when engaging with the curriculum. In the *design* arena, teachers select and design tasks for students. In the *construction* arena, teachers enact the tasks and respond to students' encounters with them. And in the *mapping* arena, teachers make choices that determine the content and organization of the curriculum.

Figure 2.2: Arenas of Curricular Decision-Making (adapted from Remillard, 1999)



Whereas Stein, Remillard, and Smith’s model of transformation of curriculum is useful for defining the scope and nature of what I mean by curriculum, Remillard’s model is useful for thinking about the types of decisions that instructors might make around the curriculum. However, as I discussed above, instructors at the community college level are likely to have more opportunities to make decisions about the written curriculum itself than are K-12 teachers. In anticipation of this possibility, I have extended Remillard’s model of curriculum use to include decisions made at the level of curriculum adoption for the purpose of being able to identify instructors’ roles in such decisions. To this end, I adapted Remillard’s model to include two levels of curricular decision-making—the level of curriculum use included in the original model, and a level of curriculum choice and course design. Below I describe the types of choices encompassed by each arena at the level of curriculum use in the original model, and the analog that I perceived at the level of curriculum choice and course design. These are summarized in Figure 2.3.

Figure 2.3: Arenas of Curricular Decision-Making at Two Levels

	DESIGN ARENA (Resources)	CONSTRUCTION ARENA (Enactment)	MAPPING ARENA (Goals)
Level 1: Curriculum Adoption	Instructors determine the textbook and other curriculum materials to be used in the course.	Instructors decide how the class will be structured, how students will be evaluated, etc.	Instructors determine the knowledge, skills, and dispositions that students should learn.
Level 2: Curriculum Use	Instructors select/design specific activities, examples, tasks, etc. to use to present a topic.	Instructors respond to students’ encounters with the activities, examples, tasks, etc.	Instructors map specific topics to the broader goals of the course.

The first arena of decision-making in Remillard's framework is the *design* arena. At the level of curriculum use, decisions made in this arena are essentially those made around the resources that are to be used in the classroom. Instructors adapt, create, and give purpose to activities that they will use with their students. They are choosing *from* the curriculum and other resources that are available to them, according to what they believe the students should learn about a particular topic. At the broader level of curriculum adoption, instructors (or departments) must make decisions around resources as well, but this time choosing the textbook of record, and possibly other curricular materials (activity books, online textbook components, etc.), according to what they believe the students should be learning in the class as a whole.

The second arena of decision-making is the *construction* arena. At the level of curriculum use, these are decisions made in the enactment of the curriculum and activities that were designed in the first arena. The construction arena is the arena in which instructors make decisions in direct response to their students' reactions to the implementation. At a broader level of curriculum adoption, the construction arena would also involve making decisions in the course of practical implementation of the adopted curriculum, initially in preparation for the implementation and subsequently with feedback from prior experience with students. These decisions are laid out at the beginning of the course, but may change over the course of the semester, or from one semester to the next. How will students' learning of the curriculum be evaluated? What will a standard class session look like? What structures will be in place to support students' work outside of class? While these decisions take place in a longer span of time than construction decisions at the level of curriculum use, they are still decisions that are made in response to the practical application of the general curricular planning.

The third arena of decision-making is the *mapping* arena. At the level of curriculum use, these are decisions made around goals, and fitting classroom work to those goals. This is the arena in which instructors make decisions about fitting specific topics to the broader goals of the course, and so at the broader level of curriculum adoption, the decisions involve determining the knowledge, skills, and dispositions that students should learn from the class itself, and how the curriculum will meet these goals.

In addition, all of these decisions are made within a particular context. Some aspects of this context that might affect the decision-making that occurs in each of these arenas include instructors' backgrounds, students' characteristics as learners, students' life circumstances and their purposes in taking the course, the position and organization of the course within the department, and transfer requirements if students are to take the course to other institutions for credit, among other possible factors.

By separating out different aspects of decision-making around curriculum, and possible influences on decision-making, this model helps to guide the data collection of this study. Analysis of data will then help determine the relevance of this framework to the way curricular decisions are made in community college mathematics courses for elementary teachers.

Summary

My research questions center on how community college instructors make decisions around curriculum in mathematics courses for elementary teachers—specifically, how curriculum is both adopted and implemented in these courses. In the review above, I have discussed the mathematics content course for prospective elementary teachers, the community college setting, and research on curriculum use, the areas of research most directly relevant to my particular research questions. My research questions stem from an interest in the mathematical opportunities available to future teachers who enroll in community colleges, but as this overview of other relevant research shows, the questions also have potential to contribute to broader questions. Mathematics curriculum use is a well-developed area of mathematics education research, but has not been applied to postsecondary settings, and there are many open questions about the college instructor's role in using curriculum in instruction, and how what we know about curriculum use at the K-12 level may or may not apply to a college (and particularly community college) setting, or to a specialized course such as mathematics for elementary teachers. Moreover, instruction at the college level, and at the community college level in particular, is an understudied topic; research on how instructors think about and use mathematics curriculum for elementary teachers in a community college setting will help shed light on at least one aspect of community college instruction. Finally, as important as the mathematical education of teachers is within the field of mathematics education research, there is still a great deal to be known about the classes that are designed to help prospective teachers develop the mathematical foundations they will need. This research will contribute to this understanding by focusing on a significant and growing subset of these classes that, so far, have received little attention.

Chapter Three

Research Methods

This is a qualitative interview study, with data comprising semi-structured interviews of community college instructors from four institutions in the United States to address the following research questions:

- How is written curriculum adopted for community college mathematics courses for elementary teachers?
- What factors influence instructors' decisions in implementing mathematics curriculum for elementary teachers in these courses?

In this chapter I explain my choice of using interviews to address these research questions. I then describe the sample used, the interview protocols, and the analytical techniques used. Lastly I address matters of validity before proceeding with my findings.

Rationale for an Interview Study

In determining the type of data that would be most useful for my research purposes, I considered several options. There have been many studies of mathematics curriculum use at the elementary and secondary levels, and such studies typically involve case studies of one or several teachers derived from classroom observations, interviews, and other data sources (Remillard, 2005). Although it seems natural to consider the possibility of using similar methods by drawing upon long-term observational data, classroom documents, and instructor interviews, I decided not to take this approach. The in-depth research undertaken at the elementary and secondary levels was preceded by a substantial body of research and theory on curriculum use at those levels, but a similar body of research does not exist for either college-level mathematics classes, or mathematics courses for elementary teachers. Without clear guiding principles on what factors to observe, such an in-depth approach would not be useful in addressing my research questions on how curriculum is adopted and used in community college mathematics courses for elementary teachers. In designing my study, I decided to take a more wide-range approach in order to identify and narrow down characteristics or features of curriculum use in this setting that would be more suitable for a more intensive in-depth analysis at a later point in time.

This meant that my study needed to encompass a broader range of instructors and settings than could be taken in by a single case study. A similarly, but wider-ranging and less intensive option would have been to rely on observational data alone in determining how teachers design courses and use curriculum materials. However, this would restrict my ability to learn about curriculum choice and broader questions of curriculum adoption, which do not play directly into the day-to-day decisions of an instructor. Furthermore, relying only on observations, though they may be a rich source of data, conflicts with my broader research goals. Thinking about how to create rich mathematical learning opportunities for pre-service teachers by working with the instructor and curriculum at the community college entails understanding the background, experience, and thought-processes of the instructor—the circumstances in which the instructor teaches and the meaning the instructor gives to these circumstances and experiences. Although I am interested in *what* the instructors do, the information is less useful without having some way to gain insight into *why* they do what they do, or how they think about what they do. I also believe that the backgrounds of the instructors and the backgrounds of the course itself are crucial to understand in order to provide support for instructors either through the curriculum or through other means.

Finally, a third option would have been to conduct a large-scale survey. This would achieve my purposes of gathering a wide range of data. However, just as a very small-scale study is limited by the lack of a body of research on issues of curriculum adoption and implementation in this group of instructors because of a lack of clearly defined constructs, a very large-scale study is limited by the same lack of a body of research. Because the information acquired by means of survey instruments is necessarily restricted, it is important to design the survey with a sense of which questions are important questions to ask in the first place. A more open-ended form of data collection could therefore be a first step in paving the way for a larger-scale survey study.

Ultimately, then, I wanted to find a balance between the richness of smaller-scale methods and the breadth of larger-scale methods. I therefore determined that interviews would be the best means for gathering data pertinent to my research questions. The purpose of an in-depth interview study "is an interest in understanding the lived experience of other people and the meaning they make of that experience" (Seidman, 2006, p. 9). Interviewing allows us to learn "about people's interior experiences… what people perceived and how they interpreted their perceptions… how events affected their thoughts and feelings" (Weiss, 1994, p. 1). A study relying on interview data, then, is one in which the purpose is to uncover or describe participants' perspectives (Marshall & Rossman, 2006). An interview study allows me not only to reach a wider array of instructors, in different regions of the country, different types of colleges, and different teaching positions, but also to gain insight into their background, experience, and thought processes. Such a study in turn can pave the way for other studies, both large-scale and small-scale, such as those described in the preceding paragraphs.

Sample

In order to select possible participants for the study, I created a database of information on all community colleges with over 5,000 students in the United States, gathered from the National Center for Education Statistics (NCES) website. I chose to gather information only on colleges with over 5,000 students for two reasons. First, based on some of my experience looking at community colleges, it seemed that colleges with fewer than 5,000 students were less likely to offer specialized mathematics courses for teachers. Second, even those small colleges that do offer mathematics for elementary teachers will tend reach a much smaller population of students than larger colleges. For example, in the state of Michigan, while only 13 of the 32 community colleges have more than 5,000 students, those 13 represent over 80% of the community college student population in the state. By sampling only from colleges of 5,000 students or more, I will be choosing a sample that is more likely to reach a larger number of students.

I organized the database first by region, and then by state, and for each college I input information for the following:

- College name
- College website
- Location (name of city or town)
- Setting (urban, suburb, rural, etc.)
- Percent of students with financial aid
- Number of students

- Ratio of students 25 and older to students younger than 25
- Ratio of part-time to full-time students
- Ratio of male to female students
- Ethnicity comprising the majority of the student population
- Other ethnicities comprising 2% or more of the student population
- Graduation and transfer rates
- Existence of a specific elementary education major
- Existence of a mathematics class specifically for education students

The database for the state of Michigan is included as Appendix A.

The purpose of this database was to choose a sample of community colleges that would, on the one hand, be as representative as possible of the majority of community colleges in the United States, and on the other hand represent the variation in region, size, location, socio-economic status, etc. that exists around the country. By creating a database, I was able to easily compare colleges along particular characteristics, and to organize by particular characteristics for the purpose of choosing a sample.

The final sample included four colleges, which I chose both by region and by size/structure of the college. This allowed for a diversity of setting, while at the same time restricting my sample size to four colleges allowed me to speak with several instructors, both part-time and full-time, within the college. I will refer to the four colleges as Northeast Community College, Midwest Community College, West Coast Community College, and Southern State Community College, according to the region of the United States in which they are located. Northeast Community College is a small community college (less than 10,000 students) located in the suburbs of a large metropolitan area in the eastern United States. Midwest Community College is a midsize community college (more than 10,000 students) located in a college town in a rural part of a Midwestern state. West Coast Community College is a large (more than 20,000 students) single-campus community college located in the greater Los Angeles area. And Southern State Community College is a large (over 30,000 students) multi-campus community college located in a small city in the southern region of the United States. Basic demographic data is included below in Table 3.2, and a more detailed description of the colleges will be given in the following chapter.

Table 3.1: Community College Sample

	Northeast	Midwest	West Coast	Southern State
Setting	Large Suburb	Rural	Large Suburb	Large City
Percent Financial Aid	47%	72%	38%	40%
Number of Students	8,500	11,200	27,000	35,800
Percent students 25+ years	28%	34%	35%	38%
Percent Part Time	49%	59%	69%	72%
Ratio Male/Female	44/56	47/53	46/54	42/57
Majority Ethnicity	White (71%)	White (79%)	Hispanic (32%)	White (59%)
Other ethnicities greater than 2%	Black (10%) Hispanic (8%) Asian (2%)	Black (11%) Hispanic (3%) Asian (2%)	White (20%) Black (18%) Asian (16%)	Hispanic (24%) Black (8%) Asian (5%)
Graduation Rate	21%	10%	22%	3%
Elementary Ed Major?	Yes	Yes	No	No
Mathematics class for Education?	Yes	Yes	Yes	Yes

Instruments

I designed an interview protocol to comprise two separate interviews. Although both research questions target community college instructors' relationship with curriculum materials for mathematics classes for elementary teachers, each question addresses a different aspect of this relationship. The first question focuses on how curriculum is adopted, which includes decisions about the textbook and supplementary materials, the content of the course as a whole, and the general structure and organization of the curriculum. The second question focuses on the day-to-day decisions that instructors make in actually implementing these curriculum materials. In the course of conducting my pilot interviews, it became apparent that neither of these foci could be addressed sufficiently without giving extended and focused attention to each one. I therefore rewrote the interview protocol as two separate protocols addressing each individual research question, giving careful attention to how each interview question aligned with my research questions. The first of the two interviews focuses on how curriculum is adopted, including choice of curriculum materials and instructors' decisions regarding course design at a general level. In the second interview, I planned to ask the participant for a detailed description of the most recent class session and to focus on their decision making process around curriculum use in this particular class session. Where possible, I sought to observe an instructor's class in order to corroborate the interview data with observational data. While this source of information was not analyzed, it was used to triangulate data from other sources.

Pilot study.

In order to test the methods of data collection and the potential of using interviews to address my research question, I conducted a small pilot study with four instructors. I used the database of community colleges (described above) in order to identify colleges of different sizes and locations within the United States, and contacted several instructors of mathematics courses for elementary teachers. In my pilot sample I included three of these instructors who expressed a willingness to participate in a telephone interview. I also included one instructor with whom I was personally acquainted in order to test a face-to-face interview, and to receive feedback on the interview process.

The sample for the pilot included four instructors: an adjunct instructor at a suburban college in the northeast, an instructor at a suburban college in the southwest, an instructor at a small, rural satellite campus of a larger community college in the south, and an instructor at a suburban community college in the Midwest. For the first three participants, I conducted 30-minute long interviews by phone, taking detailed notes of their responses. The fourth interview was slightly longer (about 45 minutes) and conducted in person. I used the same interview protocol for all four interviews, but modified or eliminated questions from each interview based on the length or nature of participants' responses. The experience of conducting these interviews and an initial analysis of the data informed my plans for the structure of the interviews for the actual study, and the interview protocol itself.

Restructuring the interviews.

The pilot study resulted in three major adaptations to the research design. First, having conducted the pilot interviews and seen the early evidence of patterns and differences in instructors' experiences and approaches to the course, I restructured the interviews to focus on the details that were most relevant to the research questions. In the pilot interviews I had found that, although I had chosen the interview questions carefully, the interviews lacked a sufficient structure to adequately address different aspects of curriculum adoption and use. Additionally, I chose to conduct this study at community colleges under the hypothesis that characteristics of the community college setting (such as the student population, the need to meet transfer requirements, and the role of part-time faculty) would have an influence on curricular decision-making. Therefore, the data collection and analysis needed also to help me identify ways in which these characteristics play a role in curricular at both levels.

I therefore turned to Remillard's (1999) framework and to my adaptation to the framework (p. 33) in order to account for curricular decision-making at the level of curriculum adoption and design. Drawing upon the interview protocols that I had used in the pilot study, I rewrote, removed, and added questions, restructuring the interview using the adapted framework. The structure of new interview protocols, included in Appendix B, are given in Table 3.2.

Table 3.2: Structure of Instructor Interviews

	Interview 1 Curriculum Choice and Course Design	**Interview 2 Curriculum Implementation**
Background	Structure of the course, professional background of the instructor, etc.	Instructors describe the most recent class session. This will serve as grounding for the remaining interview questions.
Mapping (Goals)	Questions about the overarching goals of the class: the knowledge, skills, and dispositions that students are to learn.	Questions about how this class fit into the broader goals of the class [to be asked at the end of the interview].
Design (Resources)	Questions about how the textbook and other resources are chosen for use in the course.	Questions about planning the lesson, how the instructor chose activities, examples, etc., and how the textbook and other resources were used in the planning phase.
Construction (Enactment)	Questions about how the course is structured, what a typical class session looks like, how students are evaluated, etc.	Questions about how the lesson was actually carried out, what went well, what didn't go well, what changes the instructor made and why, and what the instructor might do differently.

The second adaptation prompted by the analysis of the pilot interviews suggested that it would be beneficial to speak with several instructors from the same department, rather than with a single instructor. This would allow me to distinguish between characteristics of the department and characteristics of an instructor's individual approach to curriculum adoption and implementation. Instructors in the pilot study all alluded to other instructors in their department who would have had similar resources available to them, but may have had very different roles and approaches to the course. By speaking to multiple instructors in the same department, I would be able to identify whether particular factors and influences were relevant at an individual or departmental level. In addition, I adapted the first interview protocol for department chairs. By doing so, I would be able to learn information about the structure of the department that might not be readily available to instructors. An interview with the department chair would also help me learn about how textbooks were chosen and courses constructed in general within the mathematics department and how curriculum adoption and use for the mathematics course for elementary teachers might conform to or differ from department procedures and standards. The department chair interview is included with the other interview protocols in Appendix B.

The third adaptation resulted in an addendum to the second interview for the purpose of seeing how instructors might react to textbook extracts that were very different from the textbook that was used at their college. A discussion of other textbooks would provide another context for the instructor's discussion of his or her own textbook use. Thus at the conclusion of the interview I planned to show each instructor three photocopied textbook selections. Each textbook selection came from a mathematics textbook for elementary teachers, and the three were chosen to include the textbooks used by the instructors in the sample, and also to represent the range of texts that are widely available for use in mathematics courses for elementary teachers. The three textbooks were *Mathematics for Elementary Teachers* (Bassarear, 2008), *Mathematics for Elementary Teachers: A Contemporary Approach* (Musser, Berger, & Peterson, 2006), and *Elementary Mathematics for Teachers* (Parker & Baldridge, 2004). I chose sections of each textbook that covered the subtraction algorithm for three reasons. First, it is an important topic that would be certain to be covered in any sequence of mathematics courses for teachers, second, it was common to all three textbooks, and third, in each book it encompassed a manageable portion of the text that could be read within the setting of the interview. I designed a portion of the interview to elicit instructors' specific thinking about textbooks and how they might use or adapt the text by presenting them with both a specific and familiar example, and with a specific but unfamiliar example. The questions I asked in the interview are also given in Appendix B. These questions focus on the specific aspects of the textbook passages that instructors like or dislike, comparisons of the different textbook passages, and their perception of the relative ease or difficulty of the passage for students to use as a resource for learning.

Survey on instruction.

In addition to the telephone and in person interviews, I submitted a series of short response questions to instructors in the form of an email survey. The purpose of the survey was to obtain additional detail on the instructors' instructional practices within the classroom. Instructors had been asked in the interview to describe a typical class session. The survey questions were designed to elicit responses about specific classroom practices so that I would have information about the relative frequency of both more commonly used instructional activities and less commonly used activities that instructors may not have mentioned in their interview response. Additionally, the survey allowed me to better compare the nature of instruction that students in different colleges were experiencing by describing instruction across a common set of activities and purposes.

I wanted for the survey study to reflect practices that had been shown by other research to have an impact on student learning. McCrory, Zhang, Francis, and Young (2009) had used the results of a survey of instructors of mathematics courses for elementary teachers at 4-year colleges to show a correlation between student-centered and teacher-centered teaching practices, and student growth in mathematical knowledge for teaching, and so I patterned the survey for this study on two questions taken from McCrory's survey; one addressing classroom practices, and one addressing the amount of time spent on particular types of activity in a typical class session. I modified the content of these questions slightly based on my experience interviewing instructors. I also wrote a third question on goals that instructors actively sought to address in their classes based on goals that instructors had discussed in the interviews. The resulting survey is included in Appendix C.

Procedure

I recruited participants by first contacting the mathematics department chairs of these colleges. From the department chairs, I obtained the names of faculty members involved in the mathematics course for elementary teachers. I then contacted these faculty members with a description of my study and what their participation would entail. The final selection of instructors was based on willingness to participate and availability. In each case I was able to recruit enough faculty members to proceed with the study, with the exception of my first choice of community college in the western United States. West Coast Community College was contacted after I failed to find enough instructors willing and able to participate in interviews at my first choice. By finding a different college, I was able to obtain the number of interviews I felt was needed for my study to be successful.

I interviewed 3 department chairs; the chair at Southern State Community College was unavailable to participate in an interview, but one of the instructors at that college had formerly served as department chair and was able to answer the questions in the department chair survey that differed from the questions in the instructor survey. I was able to schedule interviews with all current instructors of the course at both Midwest and Northeast Community Colleges, 5 of 7 current instructors at Southern State Community College, and 3 of 4 current instructors at West Coast Community College for a total of 18 instructors across the four colleges. Of these instructors, 7 were part-time or adjunct faculty, and 11 were full-time faculty.

I conducted interviews over the phone and, when possible, in person. In most cases I conducted the first interview by telephone and the second interview in person during a visit to the campus. In some cases time constraints required me to combine both interviews in one and to conduct a single interview instead of two separate interviews. In each of these cases I had already spoken with several members of the faculty of that particular school and was able to streamline the interview because I had already obtained information about the general structure of the courses. These combined interviews, provided all the information I anticipated collecting.

The exception to this general interview structure was Northeast Community College. Although the two full time instructors for the course agreed early on to participate in the study, it was difficult to arrange a campus visit at times when the instructors would be available, so I conducted a single, combined interview over the phone with each instructor. This allowed me to gather data from all four instructors (part time and full time) of the course at Northeast Community College. The participants and data collected from each participant are listed below in Table 3.3.

Table 3.3: Data Collected

College	Name	Title	Interview 1	Interview 2	Chair Interview	Combined Interview	Textbook Exercise	Class Observation	Instruction Survey
Midwest Community College	Andrew	Department Chair			X				
	Beth	Instructor	X	X*					X
	Christine	Adjunct Instructor				X*	X		X
	Dana	Instructor	X*	X*			X		X
	Ellen	Instructor	X	X*					X
	Francine	Instructor	X*	X*			X		X
West Coast Community College	Greg	Department Dean			X				
	Henry	Instructor	X	X*			X	X	X
	Irene	Instructor				X*	X	X	X
	Jennifer	Instructor	X	X*			X	X	X
	Karl	Adjunct Instructor	X						
Southern State Community College	Lisa	Instructor and Course Coordinator	X	X*			X		X
	Monica	Adjunct Instructor	X	X*			X	X	X
	Nina	Adjunct Instructor	X	X*			X		X
	Olivia	Adjunct instructor	X	X*			X		X
	Patricia	Instructor and Former Department Chair	X		X				X
Northeast Community College	Rachel	Instructor				X			X
	Suzanne	Instructor				X			X
	Tracy	Adjunct Instructor				X			X
	Valerie	Adjunct Instructor				X			X
	William	Department Chair			X				X

* Starred interviews were conducted in person.

Analysis

In order to analyze the interviews with respect to how instructors within each department adopted and used curriculum, and the factors that affected these choices, I developed a system of codes to draw out relevant information from which I could seek out themes and patterns. The final coding system that I used to identify themes on adoption and use of curriculum materials was the result of a four-phase process of developing codes, applying them to data, revising codes, and checking the codes for alignment with my research purposes. I also explain how I analyzed the survey questions that the instructors responded to via email.

Phase 1: Transcription and blocking of text.

I audio recorded and then transcribed each interview. I transcribed the interviews word for word. I left out most speech disfluencies (fillers such as “um,” short pauses, stuttering or repetitions, etc.) as they interfered with the flow of a particular thought, but included long pauses, laughter, sighs, etc., that might signify thoughtfulness or a particular attitude.

I also worked to subdivide the interviews into manageable blocks of text for ease of coding. Line-by-line coding proved to be too fine-grained an analysis, as many of the instructors’ utterances were more meaningful in a larger context, but coding lengthy blocks of text did not allow a sufficiently focused analysis. As I worked with the interviews and creating a coding scheme, I found it best to work with blocks of text approximately three to eight lines long. This meant that in many cases, a response to a single interview question could comprise one block of text, but in those cases where responses were lengthy I subdivided the text at points where the instructor appeared to move to a new line of thought. For example, in the following portion of an interview response, I would subdivide the response at the indicated point because the instructor moves from talking about the structure of the course at her college to her involvement with a mentor when she began teaching the course.

> … different courses at Southern State have their own committee and they have their own course leaders and there's not a big group of teachers, like I said, that teach this course, **[begin new block of text]** but Patricia is the one who, the first time I was going to teach this class I worked with her… (Monica 1, 40-41)[2]

Transcribing and blocking the text, while primarily for the purpose of preparing the text for coding, also served as an initial phase of analysis in that I was able to familiarize myself with the interviews and to begin to see potential patterns within and across the four colleges.

Phase 2: Development of initial codes.

Having read through the interviews, I developed codes based on the study's research questions, on the curricular decision-making framework I discussed above, and on the patterns I had begun to see in the data. The research questions address how curriculum is adopted and implemented, and what factors influence instructors' decisions around curriculum, and I wanted the codes to reflect that so that they could help me identify statements within the interviews that would help me to make sense of the research questions within the context of the data.

Table 3.4 contains the initial set of codes. Some codes that I used were obvious. For example, I wanted to have a way to identify statements that speak directly about how curriculum materials are chosen within a particular department or by instructors for use in the class, therefore the code *Choice*. I wanted to know how the class itself was structured, because I cannot know about factors impacting the implementation of curriculum without understanding the design of the course itself, therefore I used the code *Structure*. Other

[2] Whenever I include excerpts from interviews, I reference the pseudonym of the instructor, the number of the interview in cases where I conducted two interviews with the instructor, and the number identifying the block of text from which the excerpt is taken. For instance, (Monica 1.40-41) means the reference comes from Monica's first interview, from the 40th and 41st blocks of text within the interview.

codes came from my own experiences with the data and my own hypotheses about potential influences on curriculum adoption and curriculum use. For example, I included the code *Transfer* in order to track issues related to students transferring their course credit to other institutions, because I believed these issues might bear on course adoption and curriculum choice. I included the code *Goals* because I wanted to track references to goals of the course as I believed there might be interplay between curricular decision-making and what the instructors perceived to be the goals for the course.

I also identified instances of very particular ways in which the official textbook for the course was used. Brown and Edelson (2003) discuss different ways of using texts, which they term *offloading*, *adapting*, and *improvising.* As I read through the interviews, it appeared that some of the differences between how particular departments utilized the official textbook aligned with these three categories (although ultimately I decided that these trends were more visible at a broader level of analysis, and discarded these codes). These codes are included under “Use of Curriculum” in Table 3.4.

Table 3.4: Initial Codes

Broad Issues	Textbooks	References to the textbook (in any way)
	Students	References to students
	Resources	References to resources other than the textbook
	Transfer	Issues of transfer from the community college to a four year school
The Course Itself	Goals	Goals of the course for elementary teachers
	Choice	How textbooks are chosen
	Structure	The general structure of the class (grading policies, what a general class session looks like, etc.
	Design	How the instructor makes choices to prepare for a specific class session
	Enactment	What happens in a specific class session
Use of Curriculum	Offloading	Instances where the instructor relies solely on the textbook
	Adapting	Instances where the instructor adapts material from the curriculum
	Improvising	Instances where the instructor creates their own curriculum material
Interaction with others around the course	Independence	The instructor makes decisions on their own
	Collaboration	The instructor collaborates with other instructors
	Dependence	The instructor is tied to decisions and policies outside their influence
	Guidance	The instructor has guidance from people/organizations other than themselves

After developing this initial coding scheme, I applied it to interviews from four of the eighteen instructors in order to refine and revise the coding system. These interviews were chosen to represent some of the variations that existed in the interview data, and included a first interview from an instructor at Southern State, a second interview from a different instructor at Southern State, a combined interview from an instructor at West Coast, and a first interview from an instructor at Midwest who was not currently teaching the course, but had in the past. In applying the codes to these interviews, I realized that some of the codes and categories were problematic, which resulted in revised codes and categories.

For example, during the coding it became apparent that the definition of the interaction codes was problematic because there was some overlap and ambiguity between codes. For example, when one instructor talked about creating her syllabus, she spoke of working closely with two other instructors. Statements such as “She gave me all of her materials to show me,” and “I have my own grading schema that’s based on hers because I like the way she does grades” were difficult to categorize—was the instructor collaborating with others (*Collaboration*), following guidelines (*Guidance*), or making independent decisions (*Independence*)?

The Course categories were also problematic. The code *Structure* was hard to interpret, and indeed seemed to be too broad a category as I was applying it. In some cases *Structure* and *Goals* were difficult to differentiate, and in other cases *Structure* and *Design* were difficult to differentiate. Also, Brown and Edelson’s categories were particularly hard to code, as explained above, and I determined that the categories were less useful than I had anticipated, so I decided to put the codes aside.

Below in Table 3.5 is the revised set of codes and categories after this initial coding. Codes are organized into six broader categories. *Curriculum Materials* encompasses codes involving the textbook or other written curriculum materials and instructors’ and students’ interactions with the materials. *Interaction* encompasses codes involving instructors’ interactions (or lack of interactions) with each other or with school/state policies and guidelines. *Course* encompasses codes that in some way describe goals, structures, and day-to-day workings of the course itself. *Students* encompasses codes that refer to instructors’ statements about students. *Instruction* encompasses codes referencing the nature of instruction that takes place in the course. And *Context* encompasses codes about the broader institutional context.

Table 3.5: Revised Codes

Category	Sub-code	Description of Sub-code
Curriculum (materials)	Choice	Choosing textbooks/curriculum materials
	Description	Descriptive or evaluative statements about textbook/curriculum materials
	Students	Students' *use* of the textbook/curriculum materials
	Attitude	Students' *attitude* or reaction toward text/curriculum materials
	Teacher	Teacher's use of textbook/curriculum materials
	Resources	Journal articles, manipulatives, computers, etc.
	Intent	Statements about the author's purpose/intent
Interaction	Independent	Choice/action is taken independently
	Collaboration	Any interaction with other instructors around the course
	Policy	Policies or guidelines exist or are made available
	None	Any reference to lack of interaction/isolation
Course	Enactment	Anything that happened at a given point in time
	Goals	Goals and purposes of the course for teachers.
	Topics	Mathematical content that is covered
	Structure	Grading, policies, how things are done in general
	Comparison	Comparisons to other courses
Students (may refer to some or to all)	Characteristics	Characteristics and backgrounds of students
	Reactions	Student reactions (to topics, policies, etc.)
	Expectations	What is expected of the students (they will/should do…)
	Teaching	Students' roles as future teachers
Instruction	Affect	Affective statements about teaching the course (hard, fun, etc.)
	Class	Instructional work during class time
	Preparation	Instructional work to prepare for a particular class session
	Design	Instructional work towards course design
	Limitations	Limitations and constraints on instruction
	Revision	Changes that have been made, at a specific moment or over time
	Other	This may include grading, assigning groups—things that do not take place in class necessarily and don't fall into other codes

Table 3.5: Revised Codes (Cont.)

Category	Sub-code	Description of Sub-code
Context	Staffing	Staffing the course (easy, hard, qualifications, etc.)
	Transfer	Issues of transfer to 4-year institutions
	Institution	References to particular characteristics of the community college (role, population, etc.)
	Certification	Teacher certification requirements (institution, state, etc.)
	Background	Instructor's background, qualifications, etc.

Phase 3: Reliability of codes.

The next step in developing the coding system was to test the reliability of applying this coding scheme to the data. I prepared several documents to send to another mathematics education doctoral student in order to check for reliability in the coding scheme. I chose at random 10 sequential blocks of text from each of the four interviews that I had initially coded. This represented approximately 15% of the data that I had coded myself (40 of 270 total blocks of text). I prepared a description of the coding process and the coding scheme for the independent coder, who coded these 40 blocks of text. I then compared the codification and counted instances of a) agreement (we both recorded the same code for a block of text), b) disagreement with the independent coder's codes (the independent coder recorded a code that I had not recorded), and c) disagreement with my codes (I recorded a code that the independent coder did not). The counts of these instances are summarized below in Table 3.6. The percentage recorded in the table is a percent of the total number of distinct codes that were recorded by the independent coder and myself. (That is, a code recorded by both the independent coder and myself counts as once instance, as does any code recorded by just one of us.) The final line removes instances of two codes that I had in the meantime determined were ambiguous and not useful for my analysis.

Table 3.6: Coding Agreement for First Reliability Test

	Agreement	Independent Coder	Researcher
Interview 1	15	6	18
Interview 2	9	7	21
Interview 3	9	4	10
Interview 4	10	4	17
TOTAL	43	21	66
Percentages	33%	16%	51%
w/o two codes removed	41 (33%)	17 (14%)	60 (51%)

I then went back through the 40 blocks of text and looked carefully at the two sets of codes. In many instances I found that I agreed with the independent coder's decisions, or agreed that one of the codes I had recorded was not actually accurate to the block of text. I adjusted my own codes accordingly, and made note of some of my observations about the codes, then created the Table 3.7 to summarize the inter-rater agreement with the revised coding.

Table 3.7: Coding Agreement for First Reliability Test After Revision

	Agreement	Independent Coder	Researcher
Interview 1	18	3	8
Interview 2	11	4	15
Interview 3	11	3	5
Interview 4	12	2	14
TOTAL	52	12	42
Percentages	49%	11%	40%

Agreement was still low (just under 50% of the codes), but was higher than with the original coding. I also noted that most instances of disagreement involved my recording codes that the independent coder did not record, rather than vice versa. That is, I was coding more broadly than the independent coder had, likely because I had developed the coding scheme myself and was familiar with the context of the interviews, the research questions, and the development of the coding scheme.

I made the following observations about the coding scheme based on disagreement with the independent coder, in order to revise the codes for a second round of reliability testing:

- The *Instruction* category was problematic. The independent coder only coded 5 instances of that category for a total of 5 codes, while I coded 14 instances of the category, for a total of 22 codes. Of these we were only in agreement on 3. I determined that the category was not clearly defined, or was misnamed. That is, the name “Instruction” did not call to mind the aspects that I wished to capture within that category for the coder.
- Negative statements were also problematic. For example, I would code a block of text that talked about what students were *not* to do as belonging in *Student Expectations*, but the independent coder did not, and similar problems occurred with other codes.
- The codes for *Course Design* and *Instructors’ Decisions Around Design* overlapped—sometimes one of us would choose one and the other would choose the other for the same block of text. However, I did think there was an important distinction between the two and made note for a revision of the codes and descriptions of the codes.

Table 3.8 contains the final version of the coding scheme developed based on this test. The codes are no longer listed in categories because coding first by category and then by sub-code had created too much room for error. I also realized that several of the codes were not useful to me, or were captured within other codes, and so I removed categories, combined several codes, and simplified the coding scheme.

Table 3.8: Final Set of Codes

Identification of Curriculum Materials	The block of text identifies (for the first time) specific curricular resources that are used in the course.
Curriculum Choice or Development	The block of text addresses *how* or *why* particular curriculum materials were chosen or developed for use in the course.
Descriptive/Evaluative Statements about Curriculum Materials	Any description of curriculum materials beyond simply naming them, or evaluative statements (positive and negative aspects of particular curriculum materials)
Student Interaction with Curriculum Materials	The block of text refers to students interacting (or failing to interact) with curriculum materials, student attitudes or reactions to materials, or expectations of how students should interact with curriculum materials.
Instructor Interaction with Curriculum Materials	The block of text refers to how the instructor uses curriculum materials. These statements may be general, or they may be specific instances of use.
Collegial Interaction	The instructor refers to interacting with colleagues in conjunction with this course, *or* to lack of interaction with colleagues around the course.
Course Goals	The block of text refers to goals and purposes of the course for teachers.
Course Structure	The block of text gives insight into how or why things are done *in general* in the course.
Lecture/Discussion	The passage refers (directly or indirectly) to the instructor giving a lecture or leading a discussion
Activity/Student Work	The passage refers (directly or indirectly) to students working in class on individual or group work.
Comparison to other Math Classes	The instructor refers to how things are done in other math classes, in terms of how they are either similar to or different from this class.
Student Characteristics	The instructor describes the characteristics or backgrounds of some or all students in the course for elementary teachers.
Students as Teachers	The instructor alludes in some way the fact that students will someday be teachers.
Affective Statements about the Course	The block of text refers to the course being easy, fun, hard work, etc. from the perspective of *either* the teacher or the students.
Changes	The block of text gives evidence of a change that was made, either in a specific moment, or gradually over time.
Staffing	The block of text contains any statements about staffing the course.
Transfer	The block of text refers to any issues regarding transferring of credits to a 4-year institution.
Teacher Certification	The instructor refers to teacher certification requirements for future teachers.
Institutional Issues	The instructor refers to particular characteristics or policies of community colleges or their particular college.
Instructor Background	The instructor discusses his or her background, qualifications, past teaching experience, or personal experiences that bear on teaching.

I submitted this new coding scheme to the same independent coder for a second round of reliability testing. For this round, I gave the independent coder a 5-block portion of one of the sequential blocks of text that had been used in the first round of coding, and added 18 additional, non-sequential blocks of text chosen from three interviews that had not been used in the first round of reliability testing. This meant that both the independent coder and myself were coding these 18 blocks for the first time. These blocks were chosen first at random, and then I made some revisions to the choices to better reflect a diversity of codes. Table 3.9 summarizes the results of this second test. Once again, percentages are calculated as a percent of the total number of distinct codes recorded by both the independent coder and myself.

Table 3.9: Coding Agreement for Second Reliability Test.

	Agreement	Independent Coder	Researcher
Interview 1	10	0	1
Interview 5	9	2	4
Interview 6	6	1	3
Interview 7	7	2	6
TOTAL	32	5	14
Percentages	63%	10%	27%

The inter-rater agreement of this test was much higher and, once again, the majority of the disagreement resulted from under-coding by the independent coder. Some of this can be explained by the lack of context. Because the blocks of text were non-sequential this time, there were many codes in which I was familiar with the context and knew that, for instance, the interviewee was referring to a change she has made in the course over time, which was not clear from reading the block by itself. In addition, two of the instances where the independent coder coded for something that I did not involved a misunderstanding of language for the code Comparison to Other Math Classes. When I referred to Comparison to Other Math Classes, I meant between different mathematics courses (e.g., college algebra) and not, as the independent coder did, to sections of math for elementary teachers taught in different semesters. Were we to reach consensus on this code with a clarified definition, the percentage of agreement would be 65% instead of 63%.

Phase 4: Final coding of interviews.

Given the complexity of the coding process, taking into account the role of context, and including more clarification about the meaning and use of the codes, I determined that the agreement was high enough to proceed with coding the remainder of the interviews. I coded each block of text in the interviews for each of the 18 instructors for a total of 1,885 blocks. After each interview, I consolidated each coded statement from the entire interview into a single location so that I could both see trends for that particular instructor, and so I could easily compare individual instructor's responses for a particular code to those of other instructors'. Throughout this process I recorded my observations and hypotheses, and began writing analytical memos in which I described patterns and trends that I was seeing.

Although I had originally intended to analyze the addendum to the interview in which I asked instructors to examine textbook materials, I found that the detail in instructors' responses to the questions about the texts varied so widely as to be less useful to me than I had hoped. Because of this, I decided not to conduct a separate analysis of instructors' reactions to different textbooks and instead coded their responses to this portion of the interview with the same coding scheme that I used for the rest of the interview. This allowed me to use instructors' statements about the curriculum materials that were relevant to my ongoing analysis, some of which proved useful in understanding how curricular decision-making occurred differently across instructors and colleges.

Analysis of survey questions.

Although the survey questions were an extension of the interviews, the form of the data was quite different and required a different form of analysis. I was interested in how the patterns and trends across colleges might affect the learning experiences and opportunities of students in the different colleges, and so I organized the data by college, rather than by individuals. For both the first and third question (on instructional activities and learning goals) I calculated simple averages for each college for each item. Within colleges, I looked at which instructional activities and learning goals were given most and least value. Across colleges, I looked for instances where differences between colleges appeared particularly narrow or wide. For example, instructors at all schools reported that students were frequently engaged in explaining the reasoning behind an idea, suggesting that this was an important goal across the cases. On the other hand, "Listen to you explain computational procedures or methods" had a much wider range of responses, with students at Northeast Community College spending a great deal of time listening to instructor explanations and students at Southern State spending very little time.

For the second question, on how instructors use their class time, I was most interested in how much of the time is spent on instructor-centered instruction and how much of the time is spent on student-centered instruction. I classified Homework Review, Lecture-Style Presentation, Instructor-Guided Student Practice, and Re-Teaching or Clarification as Instructor-Centered, and I classified Work in Small Groups and Independent Student Practice as Student-Centered. For each instructor, I calculated the ratio of reported Teacher-Centered instruction to reported Student-Centered instruction, and then found the average ratio for each college.

There are some caveats to this calculation. First, not all instructors' totals added up to exactly the number of minutes spent in class. In some cases, instructors may have been overlapping categories—Instructor-Guided Student Practice, for example, might be interpreted as helping students as they work in groups or independently. Second, some instructors reported ranges. In these cases I simply averaged the range of time reported. Finally, my categorization of activities as Teacher-Centered and Student-Centered may not be strictly accurate. In her interview, Suzanne described her homework reviews as highly student-centered, with students helping other students figure out problems and Suzanne taking a minimal role. However, as a rough approximation of how instructors report their class time being spent, the calculations are adequate for seeing differences across colleges.

Validity

In a qualitative interview study, researcher's identity is relevant to the selection of the topic, the data collection, and the analysis of the data; such identity and how it situates the researcher within the context she is studying is not to be seen as a negative source of bias, but a position to be acknowledged (Taylor, 2001). I recognize that my personal involvement with the setting that I am studying has influenced my questions and my design, and that it is impossible for me to enter a study completely free of biases, beliefs, and assumptions (Strauss & Corbin, 1998). In conducting my research I attempted to acknowledge my position but to take measures so that my position would not overly constrain my data collection or my interpretation of the findings.

As a master's student in mathematics education, I had the opportunity to teach a mathematics content course for elementary teachers for three consecutive semesters. Graduate student instructors of this course were given a great deal of freedom in adapting a particular set of curriculum materials and designing the course. There were three very different written curricula commonly used within the department, and as instructors access to each of these, and were allowed to modify, add to, or combine materials as we saw fit. This allowed me to confront questions for myself about what was important for my students to learn, and how best to help them learn it.

As a doctoral student, I took on a part-time position as an instructor at a local community college, where I requested and was assigned to teach mathematics for elementary teachers because of my prior experience teaching the course. My teaching experience in this setting was quite different. I had an assigned textbook, and a list of chapters to be covered from that textbook, and found that I did not always agree with the textbook's presentation of particular topics. I also had a very different group of students. Instead of primarily full-time, traditional-aged students, I had students from a variety of backgrounds, many with jobs or family obligations outside of school, and encompassing a wide range of mathematical proficiency. I found that I was confronting the same questions of what my students needed to learn and how to learn it, but that I was forced to think about these questions in new ways that were tied to this new setting and my role within that setting.

My research questions coalesced as I came to appreciate the role of community colleges in the mathematical education of future teachers, and the differences between two-year and four-year institutions. I wondered if other instructors who worked at community colleges, either full-time or part-time, had experiences similar to mine and, more importantly, how this might bear on the opportunities students who took these courses at community colleges had to learn the mathematics they needed to learn for their future work in the classroom. My experiences also made me eager to listen to other instructors' voices regarding their decision making process around designing instruction and using curriculum. My own experience in making decisions around curriculum and instruction in a variety of circumstances equipped me with the sensibilities to capture the process in other instructors and settings.

Many of the questions with which I approached my study of community college instructors, therefore, were influenced by my personal experiences. As I designed my interview, I included questions that would specifically address issues that my experience had led me to believe might be important or influential. For example, the textbook used at the community college where I teach is the same textbook used at a local university where many students transfer or are concurrently enrolled. I was interested in knowing if transfer played a role in curriculum adoption and use at other institutions, and if so, what sort of role it played. I therefore included a question about how instructors thought about transfer issues in my interview. In this sense, my background was a strength in that it informed me of potentially important factors. However, I also recognize that my experience is limited, and I did not want to inadvertently constrain interview responses by the particular factors I had experienced myself, or to the way I experienced those factors. I therefore carefully worded my questions to be open-ended, and to allow for new ideas that I may not have considered. While I certainly cannot claim to have identified all factors that might influence curriculum choice and use in this population, many of the instructors I interviewed identified circumstances and ways of thinking that did not necessarily reflect my own experience.

In conducting the interviews, I recognize that my position as a community college teacher myself may have influenced the responses of participants. In some ways, my shared experience proved advantageous for gaining access to the instructors. I expected that instructors would see me as someone who was genuinely interested in the work they were doing rather than as a dispassionate researcher who would cast judgment on their teaching practices. At the same time, I tried to approach the interviews themselves as an outsider, and to interject little of my own experience; by doing this, I wanted the instructors to be recognized as the experts in their situation, and I wanted them to be confident in sharing their expertise with me, as a less informed apprentice. Most of the instructors had been teaching the course, or teaching at community colleges, for several years, and my position as a part-time instructor and a novice helped me to position myself as an outsider interested in learning their perspectives. In most cases, the instructors were confident in their descriptions of their practice and opinions, and eager to share their observations and experiences. Only in one case did an instructor, in her first semester of teaching the course, seem reticent, and worried about giving the “right answers.” In this case, I tried to assure her that there were no right answers, and that her own thoughts and experiences were what would be most valuable to my research.

Maxwell (1992) addresses five types of validity commonly addressed in qualitative research. *Descriptive validity* refers to the factual accuracy of an account. I have taken care to audio record and accurately transcribe the interviews, and information on the colleges that I include beyond the words of the participants has come from reliable sources such as the National Center for Educational Statistics or the college's catalog and websites. *Interpretive validity* refers to the accuracy of the report of the perspective of individuals in the study. According to Maxwell, "Accounts of participants' meanings are never a matter of direct access, but are always constructed by the researcher(s) on the basis of participants' accounts and other evidence" (p. 290). A qualitative interview study by nature seeks to uncover the meaning attributed by participants' to their experiences, so I have designed questions that will elicit this meaning and made sure I use the participants' words to aid in my understanding and interpretation of their experiences.

Theoretical validity refers to an account's function as not just a description or interpretation, but as an explanation. When in my findings I describe the constructs I developed to understand the accounts that I am studying, I include the evidence I drew upon to arrive at these constructs and explanations so that the reader may judge the theoretical validity of the findings. *Generalizability* refers to the extent to which the findings of a qualitative study can be extended to different populations, settings, and so forth. While the findings in this study are specific to the four colleges, I believe that they highlight factors and circumstances that might be found in other community college mathematics courses for elementary teachers. I address this possibility when I discuss the significance of the study. Finally, *evaluative validity* refers to assigning value to objects of study (such as stating that particular actions are right or wrong, or legitimate or illegitimate). "Evaluative validity is not as central to qualitative research as descriptive, interpretive, or theoretical validity" (Maxwell, 1992, p. 295), and I do not ascribe particular value to the actions or beliefs of instructors in my study within the contexts in which they are working, but rather look at the circumstances that motivate particular actions.

Chapter Four

Findings

I began this research with questions about the factors that influence, on one level, matters relating to curriculum adoption in the mathematics courses for elementary teachers at the colleges in the sample, and on another level the factors that influence decisions instructors make about actually implementing curriculum. I interviewed individual instructors, but chose a sample to include groups of instructors who taught the same course at each of four different institutions. In the analysis, then, while I considered the perspectives of instructors as individuals, the patterns and trends that emerged through my analysis highlighted characteristics that differentiated groups of instructors teaching the course at the four different colleges and how those characteristics affected decision-making at both the level of the individual and the collective level of the group of instructors in the college. Differences existed among instructors, but it was the similarities within departments that proved most interesting. Four general themes emerged as characterizing and differentiating the mathematics course for elementary teachers at each of the four colleges, and the instructors' roles in curriculum choice and curriculum use as they varied from one department to the next. In this chapter I will first describe each of these four themes, and then I will present descriptions of the group of faculty teaching this course at each of the four colleges in relation to these themes. In Chapter Five I will discuss the differences and similarities between the four groups of instructors, as well as the potential implications of the differences among the groups of instructors and how these differences may reflect or impact the mathematical opportunities of students enrolled in these courses.

Discussion of Themes

I discuss the following four themes according to their proximity to the actual classroom experiences of the students. I first discuss broader institutional and departmental influences on curriculum adoption, including issues of transfer and the work of instructors to structure and design the course at their college. I then proceed to the interactions between instructors around the enactment of the curriculum, then to the use of particular resources in this enactment, and finally to the actual instructional practices of the instructors.

Theme 1: Department autonomy in course design.

This first theme grew out of the hypothesis that the curriculum adopted for mathematics courses for teachers would be impacted by the necessity of making the course transferable to other institutions. Unlike four year colleges and universities where students enrolled in a mathematics course for teachers will likely complete their certification at that particular institution, students enrolled in a similar course at a community college must, with only rare exceptions, transfer to a four year institution in order to earn their teaching certificate. Because community colleges are not only internally accountable for the courses that they offer, but also externally accountable to other institutions, instructors' agency in adopting curriculum and choosing particular curriculum materials to be used in the course may be restricted by the requirements of local or state universities.

My description of this theme for each of the colleges relates both to the relationship that the individual colleges have with one or more transfer institutions, and the corresponding level of autonomy that instructors exhibited in adopting formal curriculum for the course and making decisions about how that curriculum would be carried to the students. The ties between the community colleges and their transfer institution range from close ties to a single institution where most students are expected to transfer, to weaker ties to several potential regional transfer institutions. There is variation in the level of perceived autonomy as well, from instructors who express a strong sense of ownership for the course at their own institution, to instructors who speak of the course as being handed down to them from someone else.

Theme 2: Course consistency and sharing of resources.

The second theme relates to the interactions of instructors with other instructors within the same department around the mathematics course for elementary teachers. There are two dimensions to this theme. The first is the extent to which instructors make an effort to keep their section of the course for elementary teachers consistent with other sections of the same course that are taught at their institutions. The second is the extent to which instructors interact with each other and share resources and information.

In discussing course consistency I refer to the effort of instructors to keep everything in their respective classes the same as what students might experience in other sections of the same course at the same institution. At one extreme, a group of instructors would attempt to create exactly the same learning experience for all students who enroll in a mathematics course for elementary teachers at their college. At the other extreme, instructors would act largely independently within their own classrooms, and there would exist both greater freedom and greater variety in how the class is taught across sections.

In discussing sharing of resources I refer not just to material resources (activities, formal evaluations, etc.), but also to ideas and information. On one end of the spectrum, instructors might share very little. They would use their own resources and seldom talk with other instructors about what they are doing in their respective classrooms. On the other end of the spectrum, instructors share everything. Lesson plans, activities, evaluations, etc. would rarely be used without consulting other instructors of the course.

Theme 3: Use of textbook and other curricular resources.

The third theme involves the written curricular resources that instructors draw upon in designing actual instruction, and how they make use of those resources. In discussing curricular resources I refer not just to the textbook, but to any written materials that instructors use in planning or enacting instruction. However, because the textbook has a unique role in classroom instruction, I consider the use of the textbook and the use of other resources separately, which allows me to see relationships between how instructors made use of these two different types of curriculum materials.

In each of the four colleges that I sampled, students purchase a textbook for use in the course.[3] But while the use of a single specific textbook across all sections of the course is common to each of the four colleges, the role of that textbook varies, from being the primary text for preparing and teaching and guiding course content, to being supplemental to instruction. In addition to the textbook, most instructors draw in varying

[3] The one exception is the geometry course at Midwest Community College, which uses several books from the middle school level *Connected Math* curriculum as its primary printed text.

degrees upon other resources including, for example, other textbooks, elementary school-level activity books, activities from conferences, and computer programs.

Theme 4: Instructional Practices.

Finally, the fourth theme relates to the type of instruction that actually takes place within the classroom. Instructors use a variety of teaching methods, and use these methods to varying degrees. I used information both from instructors' responses to questions about what happens in a typical class session, and from instructors' responses to email questions about the extent to which their students engage in particular activities in class. I looked especially at the class time instructors reported that their students spent engaged in student-centered activity (in which the students are doing most of the mathematical work) and teacher-centered activity (in which the instructor is doing most of the mathematical work).

I present my findings on instructional practices in two parts for each college. First, I discuss the goals that instructors spoke of for their instruction. Although instructors across colleges consistently reported that understanding the "whys" of elementary mathematics was an important goal for the course, other goals for the course varied across the groups of instructors and uniquely characterized each group. Second, I discuss the types of activities that the instructors reported that their students typically engage in at each of the individual colleges, with a particular focus on teacher-centered and student-centered activity.

Midwest Community College (MWCC)

Midwest Community College (MWCC) is a midsize college (approximately 11,000 students) located in a rural community in the Midwestern United States. The main campus is located at the outskirts of town, and there is a small satellite campus downtown. The students at MWCC are primarily white (79%), with smaller populations of Black (11%), Hispanic (3%), and Asian (2%) students. The mathematics department consists of 19 full time faculty members and about 25 part time faculty members. Faculty members are not otherwise ranked by education or experience and all share the title of Instructor.

Mathematics courses for elementary teachers have been offered at MWCC since the college opened in 1968. Currently the mathematics department at MWCC offers a sequence of three courses for elementary teachers. It has been offering these three courses for over 20 years, and as long as any of the instructors I interviewed had been teaching at the college. The courses and content are as follows:

> **Number Concepts for Elementary/Middle School Teachers**
> (4 credit hours)
> Structure of arithmetic and introduction to algebra, problem solving, and number theory. Sets, numeration systems, operations on whole numbers and signed integers, fractions, decimals, percents, estimation and mathematical sentences.

> **Geometry for Elementary/Middle School Teachers**
> (4 credit hours)
> Exploration and analysis of planar and spatial geometry. Analysis of common plane and space figures, measurement with the customary and metric systems, triangle congruence and similarity, coordinate geometry, compass and straightedge constructions, transformations and symmetry, computer activities using Geometer’s Sketchpad and Logo, and Geoboard activities using the TI-73 calculator.

Probability and Statistics for Elementary/Middle School Teachers
(4 credit hours)
Concepts of elementary probability and statistics. Analysis of graphical and tabular displays of data, organizing and interpreting data, measures of center, measures of variability, theoretical and experimental probability, simulation techniques, and analytic methods of probability.

I interviewed six faculty members at Midwest Community College, including the department chair.

- Andrew, the department chair, had served as chair for 8 months at the time of our interview. He is also a full time instructor in the mathematics department, where he has been teaching for 21 years, and he had taught high school for 11 years prior to his work at the community college. Although not currently involved in the mathematics courses for elementary teachers, Andrew had taught the geometry course in the past because of his experience teaching high school geometry, and expressed a willingness to teach it again if the need were to arise.
- Beth is a full time instructor and is currently the only instructor for the Geometry course for elementary teachers. This is the only course for elementary teachers that she has taught at MWCC, although she also has had experience teaching Number Concepts at the local university. She had been a full time instructor for five years at the time of our interview, and had taught at the local university during the five years prior to that, including her time as a graduate student. Beth has a bachelor's degree in Psychology and a master's degree in Mathematics Education.
- Christine is a part time instructor, and the only part time instructor involved in the mathematics courses for elementary teachers at MWCC. She has been a part time

instructor at MWCC for twenty years and her primary teaching duty for all twenty years has been the number concepts course. Christine has a bachelor's degree in secondary education with a math and engineering emphasis, and a master's degree in K-5 Mathematics Education. She has also had significant teaching experience, both in middle school level mathematics and reading, and in K-8 computer education.

- Dana is a full time instructor who has been teaching at MWCC for sixteen years. She has been involved with the number concepts course consistently for the past four years, and taught the class several times in the 1990s. At the time that I interviewed her, she was not currently teaching a section of the course, though she was scheduled to teach again the following semester. Dana has a bachelor's degree in mathematics education with a computer minor, and a master's degree in secondary mathematics education.
- Ellen is a full time instructor who has been teaching at MWCC for 28 years. She is a regular instructor of the number concepts class and has been teaching this class for most of the time that she has been an instructor at MWCC. She has a bachelor's degree in mathematics, a master's degree in secondary mathematics teaching, and 60 or more additional graduate credits in education that she has earned over the years outside of formal degree programs. She also taught middle school mathematics for three years early in her career.
- Francine is a full time instructor who has been teaching at MWCC for 5 years. Francine is the only instructor for the Probability and Statistics course for elementary teachers, and also teaches non-education statistics courses. She has

taught the geometry course in the past when enrollment was higher. Francine has a bachelor's degree in mathematics with a minor in history, a master's degree in mathematics, and a second master's degree in computer science education. At the time of the interview she was in her second year of a doctoral program in mathematics education. Although she has only taught at MWCC full time for five years, she had taught part time for many years prior to that, run the mathematics tutoring center, tutored privately, and taught high school.

Theme 1: Department autonomy in course design at MWCC.

Midwest Community College is located in a college town that is home to a large state university, and MWCC's ties to the university are strong. The department chair estimated that about 95% of the MWCC students who transfer will transfer to this university (Andrew, 1.10)[4], and he and all five teachers interviewed completed their undergraduate or graduate degrees, or both, at the local university. Beth, Christine, and Francine have all taught math for elementary teachers at the university at some point in their careers, either as graduate students or adjunct faculty.

Instructors had a general awareness of the nature of the mathematics course for elementary teachers at the local state university. Beth taught the geometry course there as a graduate student, and when she was hired full time at MWCC she and Francine collaborated around implementing the curriculum that had been used at the state university (Francine 1.35). They brought over curriculum materials (primarily selections from the middle grades mathematics curriculum *Connected Mathematics* (Lappan, et al.,

[4] As explained in Chapter Three, references to interviews consist of the pseudonym of the instructor, the number of the interview (1 or 2), and the number identifying the block of text from which the excerpt is taken. For instance, here Andrew 1.10 means the reference comes from Andrew's first interview, from the 10th block of text within the interview.

2006)) and technology (Geometer's Sketchpad, Logo, etc.) (Beth 1.15). Beth spoke of her efforts to make the course comparable to what students would get were they to take it at the university instead:

> I used to teach it at [the university] and so one of my goals when I came to MWCC is to have the course in alignment with the course at Western, so that they would be getting the same, like, difficulty level, you know? … I want it to be so that it's comparable to what they would have gotten if they take it at [the university] versus if they take it at MWCC. (Beth 1.48)

Similarly, Francine had worked previously on the statistics course for elementary teachers at the university, and uses a textbook that was created by the university faculty (Francine 2.27). She is personally acquainted with the faculty who have written the book, and knows about the changes and updates to the text that they are in process of making.

In neither Statistics nor Geometry, however, do Beth and Francine seem to feel obligated to use the same text as the university or to structure the course in the same way. Rather, implementing the curricula was a conscious choice, and replaced a prior curriculum that was not directly aligned with the curriculum for the course at the university. This change took place at the time that they were both hired as full time faculty members at Midwest Community College (Francine 1.4). Both instructors spoke of changes and adjustments that they had made to the course independent of the university's influence. For example, Francine adds to and supplements topics based on her experience teaching non-education statistics classes (Francine 2.28-38). And Beth at the time of the interview was wondering whether to continue using *Connected Mathematics*, and whether to integrate even more technology into the course (Beth 1.12).

The number concepts course is taught by a different group of instructors. Dana explained that twenty years ago the curriculum for the course was probably closely aligned with the local university, but that these days instructors at MWCC design the course around the needs of the community and what they see happening at a broader level:

> We've worked with [the local university] for many, many years, and over twenty years ago, we probably had a set curriculum between the two schools, and so they approved it to make sure [it was aligned]. But more recently we keep in touch with what's going on in the community as opposed to necessarily just what's going on at [the university]. So we attend a lot of conferences, we find out what other community colleges are doing, what other universities are doing, and just make sure that we're in line with those. (Dana 1.39)

Ellen describes the choice of the current textbook as having occurred when the university re-did their curriculum in a way that community college students were unprepared to handle (Ellen 1.33), although Christine attributes the use of discovery and cooperative learning at MWCC to her experience teaching at the university using similar methods (Christine 1.38). All of the Number Concepts instructors alluded to influences from the local university, but the instructors choose to align with or deviate from the university curriculum according to what they perceive to be the needs of their students.

In short, the three courses for elementary teachers at MWCC are designed by the instructors who teach them with an awareness of what is happening at the transfer university, rather than an obligation to fully align the curriculum with the university. Decisions based on multiple factors have led in the case of the Statistics and Geometry courses to alignment with the university, and in the case of Number Concepts to a deviation from the university's curriculum, but in both cases to a general sense of freedom to design the course as they see fit without worry that it will transfer to the transfer institution.

Theme 2: Course consistency and sharing of resources at MWCC.

Midwest Community College has a high degree of collaboration around the mathematics courses for elementary teachers, and a high level of consistency between sections of the same course where they exist. Although the number concepts course is taught by one group of faculty and the geometry and statistics courses are taught by another group of faculty, with no overlap between these two groups, both groups maintain a similar culture of collaboration with each other. Here I describe this culture of collaboration, and how it both reflects an intent to maintain consistency, and an openness to sharing resources and information.

Beth and Francine, who were hired at the same time and share an office space, teach the geometry and statistics classes. Currently Beth teaches geometry while Francine teaches statistics,[5] but when enrollment was higher they both taught a section of the geometry course and they worked together on structuring the course. "At that time," said Beth, "there were two sections offered and we each taught one section, so we did a lot of planning together and assessment writing together, and a lot of collaboration" (Beth 1.19). And Francine stated that "the only thing we change [on the syllabus] is our names and our office hours, but we do everything together" (Francine 1.51). Now, even though they no longer teach the course at the same time, Francine still discusses the course with Beth (Francine 1.45), and is very involved in the course, particularly in creating assessments:

> We even, when we assess our exams, will discuss the student solutions because we sort of do a rubric grading…. Even though I haven't been teaching [the

[5] Francine is currently the only instructor teaching statistics, and since she began no one else has taught the course. Therefore, I will exclude the statistics course from this discussion of collaboration and consistency as there is neither opportunity nor need for consistency across sections.

> geometry course] I've had a lot of influence. I'm writing exams, changing the order of questions, which has made a real difference in how [students] respond. (Francine 1.51)

Christine, Dana and Ellen teach the number concepts course, and their collaboration is similar. "We try to do things almost exactly [the same]," said Dana. "We try to make the curriculum very consistent, and when one has a good idea we share it and try to improve upon it as we go through" (Dana 1.28). The differences between instructors' courses were largely surface differences amid structural similarities: "Usually the homework problems are the same, the activities are the same. [It's] pretty consistent. What you *say* might be different, the parts that you emphasize might be different, how much time you let [students] play might be different, that kind of stuff could be different" (Dana 1.34-35).

The consistency between classes is maintained by both communication during the semester and a consistent meeting schedule during the summertime to revisit lessons and course structure. All three of the instructors spoke unprompted about their collaboration:

> We meet a lot in the summer… and even during the regular part of the semester we talk about what's going on and what happened, what worked and what didn't work. (Dana 1.29)

> Every summer we meet to go over what changes or corrections need to be made or something needs to be pulled out because we really aren't finding it useful anymore or it's just too old or we've found something new that we want to replace it with…. And we try to make note of [things that need to be changed] as we're going through the semester so that we can correct them for next time. (Christine 1.21)

> The three of us work really well together as a team, we can bounce ideas off each other. Someone will start with something, and someone [else] will say, "well wait a minute, if you think about it this way…" So we work really well together, the three of us. (Ellen 1.38)

Even when an instructor deviates from what the others are doing, she will let them know, and then follow up on how the changes go. If things work well, the other instructors will incorporate that change into their own class (Christine 1.23, Christine 1.26, Dana 1.28).

Theme 3: Use of textbook and other curricular resources at MWCC.

The three mathematics courses for elementary teachers offered at Midwest Community College each require students to purchase a standard text, although the textbook required for the statistics course differs from that required for the number concepts and geometry courses. However, instructors for all three courses draw extensively on outside resources in order to teach the class. As a consequence, the course content is more instructor-driven than textbook-driven. Instructors, collectively, determined the content that will be taught, and then draw on the textbook as one of many resources to teach that content.

This tendency towards instructor-driven curriculum among the elementary math instructors at MWCC was most evident with Beth, the current instructor of the geometry course. The textbook for the geometry course is officially the same as the textbook that students use in the numbers concepts course, *Mathematics for Elementary School Teachers* (Bassarear, 2007). But when asked about how the textbook is used in her geometry class, Beth's response indicated that the class is only loosely based around the textbook.

> The activities that we do are kind of in a line with the way the chapters run…so we just kind of structure the activities that we're doing in that sequence so that they can read up on it…. So most of it is just a place to go after we do the investigatory discovery activities in class, it's like, okay, this is where you can find more information in the section in your book. (Beth 1.25, 28)

Beth considered the core of the course to be the activities that were done on a daily basis, and these activities came from a wide variety of resources. Many were drawn from geometry portions of the middle school *Connected Mathematics* series (Beth 1.11), but she also used activities based around technology, such as *Geometer's Sketchpad* (Jackiw, 1995) and *Microworlds EX* (Beth 1.12), and drew on or modified ideas from conferences she had attended or from the Bassarear explorations manual (Beth 2.7). She would assign homework problems from the Bassarear textbook (Beth 1.28), but would also choose extension problems from the *Connected Mathematics* books or create her own assignments (Beth 1.29).

Francine, the instructor of the statistics course, seemed to adhere more closely to the textbook, but also drew extensively on other resources in planning and designing instruction. Although Francine used a textbook that had been developed at the local university, she stated that the class "is mostly still the textbook, but every semester I add more of my own" (Francine 2.71). Throughout the interview she referred to resources that she used, including the NCTM *Navigations* series (Francine 2.26), articles from teaching magazines that she gave as critical reading assignments to her students (Francine 1.17), and activities she had acquired from elementary textbooks and from practicing teachers (Francine 1.34, 2.34).

The instructors of the number concepts course, Christine, Dana, and Ellen, also spoke of freely drawing on resources, and, like Beth, used the textbook more as a supplement for their students than as a primary text. Christine put it most directly when she said, "I pretty much use the textbook to supplement what needs to be taught" (Christine 1.71). Dana explained that in preparing to teach she relies more on the coursepack of additional resources that she and the other instructors have put together than on the textbook itself.

> The order of things that we do is still the same as in the textbook, we don't necessarily jump from chapter to chapter and come back. And we do use the problems in the book for homework, for practice, but we try to make better problems within the class, more experiential kind of things going on in the classroom. When we first got the textbook, I read it cover to cover many times. But probably now I may not as much. Like I'm going to be teaching next semester, in January, and we have the coursepack, and so that's going to probably be my focus. (Dana 2.9-10)

The coursepack that Dana refers to is the accumulation of the resources that the three instructors have used in the years they have taught the class. In a sense, it is their way of giving consistency and organization to the practice of drawing on many and varied resources, a practice that could become messy and disjointed when multiple instructors are involved. Dana was the one who first brought all the resources that were being used into one place, for the purpose of greater consistency (Dana 1.31), and Christine describes the process:

> I used to be known as the copy queen because I used to give all those handouts out separately to students throughout the semester, and just for one class [period] I probably overdid what a number of other classes did all combined together. Just because as I found activities that were good and got across the point that I wanted to get across to the students for whatever area we were working in, I added [things] in. And then we finally said, you know, instead of putting all of these out separately, why don't we just join it all together into a packet? So that's really all that it is, is taking all of our handouts and putting them in a packet. (Christine 1.20)

All the instructors were consistent in their description of the packet as a conglomeration of resources, and in some cases they were no longer even certain where the activities had come from in the first place. The course pack contained activities, worksheets, practice quizzes, and study guides. "We pulled from all over the place," said

Christine, “made up our own activities, changed some enough to call them our own” (Christine 1.17). Dana described the course pack as mostly made up of “things that we’ve seen in the past and we’ve just adjusted them a little bit” (Dana 1.17). And Ellen said that the course pack was made up of some things that had been “stolen” or modified from other textbooks and conferences, and some things that were original (Ellen 1.45, 2.10, 2.61). Formalizing the resources into a course pack did not inhibit their ability to continue to seek out and use new resources because, Christine explained, “Every summer we meet to go over what changes or corrections need to be made, what needs to be pulled out because we aren’t finding it useful anymore, or if we’ve found something new we want to replace it with” (Christine 1.21).

Theme 4: Instructional practices at MWCC.

Instructors at Midwest Community College stated that their goal for the course was for students not just to understand how to do elementary mathematics, but for them to understand the “whys,” or to be able to explain the mathematics, whether in the number concepts, geometry and measurement, or statistics course. However, instructors also consistently referred to goals related to their students’ future roles as teachers. Instructors told me that “we’re not there to teach [students] how to teach [the math]” (Beth 1.7), but it was apparent that instructors intended students’ classroom experiences to impact their ideas of themselves as future teachers.

> But because they are all going into education, you know, that definitely comes into play with a lot of what we do, we relate it to as teachers what, as future, as possible future teachers, what might they do with it? (Christine 1.9)

> So I want them to be the kind of teacher that they, if they could create the ideal teacher in their mind who they would have loved to have had as a, say a fourth

> grader or a fifth grader, what would that teacher have looked like? I want them to start thinking about that so they can start aspiring to create those behaviors in themselves. (Ellen 1.14)

> Many of our students haven't been to school in a long time and they may not have the opportunity to visit an elementary classroom, so we want to…make some connections [between] what we're doing [and] different grade levels. (Dana 1.22)

As stated above, instructors in both the Number Concepts and the Geometry courses used activities from the middle school level *Connected Mathematics* textbooks with their prospective teachers to teach certain topics. To this end, several of the instructors spoke of a dual purpose in using the middle school curriculum: to teach the mathematical ideas, and to expose prospective teachers to the types of activities they would experience in their own future classrooms.

> I guess [the purpose of using *Connected Mathematics* in this course is] both to learn the mathematics *themselves* if they don't already know it, understand the hows and whys behind how these algorithms and how everything fits together, and then also kind of experience some of the exact same type of problems and situations and curriculums that their students are going to. (Dana 1.12)

> I like [the *Connected Math* books] because it gives them a sense of how they're going to be teaching when they get into the classroom…and get that hands-on sense of how the curriculum is structured, how to engage students, and I hope that through using, you know, some of these *Connected Math* activities that they will pick up teaching ideas just through [my] modeling. (Beth 1.21-22)

Each of the instructors reported using in-class discovery to both teach and to model what they expect the prospective teachers to do in their own future classrooms. In fact, all courses for elementary teachers at MWCC are taught in a room specifically designated for these courses, in which desks are arranged in "pods" of four so that students can more easily work together on group work and investigations. Although class sessions might vary somewhat from day to day depending on the nature of the topic being taught, group work was a central part of every instructor's description of a typical class session. Christine gave a lengthy description of how her introduction to whole number arithmetic algorithms involves students working together to solve problems in nontraditional ways, presenting solutions, learning different algorithms with their groups, and teaching each other the algorithms they have learned (Christine 1.54-67). Other instructors' descriptions of class sessions also involved extensive group work.

> It's a lot of cooperative learning, group work, whether through the [*Connected Mathematics*] activities or whether we're booking days in the computer lab and working on activities through Geometer's Sketchpad… I don't ever have just, like, lecture days… Every class period they're working on something in their groups. (Beth 1.30-31)

> Usually there's an activity where we just give them the directions and they have to read it, follow directions, talk about it, come up with something…Sometimes I'll walk around and they just share amongst themselves. And then we try to come back as a whole group and kind of debrief what were the main ideas, what did you bring from this lesson, maybe what you already knew, what did you already know. (Dana 1.36)

> Well, we do some small group work, they're actually in pods of four…I might do a little lecture, a little intro, give them some things to work on, roam around the room, ask questions, if I see somebody get off course I might ask them to articulate what they're thinking about. Then we usually come back together and debrief. (Ellen 1.25-28)

> Students, you know, are assigned groups and … it will start out with an activity where they, like in geometry one of the first things they do is they have shapes that they have to classify and we leave it real open-ended. And they work on that for awhile and then we have them, share how they grouped things and why, you know. And then we discuss and at the end of that lesson we decide what we consider to be a quadrilateral and why…. That would be a typical activity. (Francine 1.53-55)

In general, the instructional methods used in this course for teachers at MWCC revolve around group work, mixed with homework review, class discussion, and lecture. Although instructors spoke of group work as comprising the bulk of their instructional time, their descriptions of the group work were intermingled with references to homework review, short lectures to introduce content for group work, and debriefing after group work to discuss what students learned, had trouble with, or should take away from the lesson.

Instructors' responses to the interview questionnaire also reflected this structure of high levels of group work combined with other instructional practices. MWCC instructors reported a low ratio of teacher-centered instruction to student-centered instruction at 0.96, meaning on average the mathematical work of the classrooms is student-directed about as often as it is teacher-directed (Table 4.1). Beth and Francine, who teach the Geometry and Statistics courses respectively, reported lower ratios (0.1 and 0.63), and the instructors who teach number concepts, Christine, Dana, and Ellen, reported slightly higher ratios (1.5, 1.25. and 1.33).

Table 4.1: Teacher-Centered and Student-Centered Instruction at MWCC

Respondent	Minutes Spent on Teacher-Centered Instruction	Minutes Spent on Student-Centered Instruction	Ratio of Teacher-Centered to Student-Centered Instruction
Beth	10	100	0.1[6]
Christine	60	40	1.5
Dana	50	40	1.25
Ellen	40	30	1.33
Francine	30-45	65-80	0.63
Average			**0.96**

Instructors' reports of the activities that their students engage in during class sessions from the questionnaire are also consistent with the descriptions they gave in their interviews. Table 4.2 below shows the activities reported at the highest and lowest levels

[6] The ratios presented in the table are the minutes spent on teacher-centered instruction divided by the minute spent on student-centered instruction. A ratio of one means that equal amounts of time were spent on teacher-centered and student-centered instruction, while ratios lower and higher than one mean greater amounts of time were spent on student-centered and teacher-centered instruction, respectively.

(on a scale of 1 to 4). Instructors' reported students spending the most time working in groups, explaining the reasoning behind ideas, and discussing different ways to solve problems, and reported little time spent listening to instructor explanations.

Table 4.2: Student Activity at Midwest Community College

High (>3.0)	
Work in small groups on investigations that take part or all of the class period	3.4
Explain the reasoning behind an idea	3.4
Work in small groups on sets of problems	3.0
Discuss different ways that they solve particular problems	3.0
Low (<2.5)	
Make conjectures and explore possible methods to solve a mathematics problem	2.4
Analyze similarities and differences among several representations, solutions, or methods	2.4
Listen to you explain terms, definitions, or mathematical ideas	2.4
Use manipulatives such as base ten blocks or fraction bars	2.2
Work individually on mathematics problems	2.2
Use graphing calculators to solve exercises or problems	2.0
Practice computational skills	2.0
Write equations to represent relationships	2.0
Do problems that have more than one correct solution	1.8
Prove that a solution is valid or that a method works for all similar cases	1.8
Listen to you explain computational procedures or methods	1.8
Use computers to solve exercises or problems	1.4

Instructors rated each activity using the following scale: 1 – Never or almost never, 2 – Some lessons, 3 – Most lessons, 4 – Every lesson. Numbers given in this table are the average of the scores across the 5 instructors.

Summary of findings for MWCC.

While Midwest Community College has a close relationship with a single local transfer institution, the faculty who teach mathematics courses for elementary teachers have a strong sense of ownership over the course as it exists at their own institution. Instructors are aware of the nature of the course at the transfer institution, but independently make decisions about the structure and nature of their own course based on their beliefs about the purposes of the course and the needs of their students. Instructors work together closely in designing the course. They share resources and ideas, and actively strive for consistency across sections. Instructors make decisions in consultation with other instructors of the same course.

Students are required to purchase a textbook, but the textbook serves largely as an outline for ordering the material to be taught. Instructors rely far more on instructional materials that they have collected and modified as a group over the course of many semesters from a variety of sources, including other textbooks, conferences, and teaching magazines.

While the most common goal across instructors for the course is that students learn the whys of elementary level mathematics, instructors also uniformly expressed an interest in their students' future teaching careers. Instructors deliberately use interactive teaching methods that they hope their students will take to their own classrooms. Group work is a central part of typical class sessions, and a high proportion of class time is spent on student-centered activity.

West Coast Community College (WCCC)

West Coast Community College (WCCC) is a large college (approximately 27,000 students) located in a large suburb in California. There is also a smaller urban campus associated with West Coast Community College, but the two campuses operate largely independently, and the mathematics course for teachers is only offered at the larger suburban campus. WCCC is the most ethnically diverse of the community colleges in my sample. The largest percentage of students is Hispanic (32%), with substantial percentages as well of white (20%), Black (18%), and Asian (16%) students.

Mathematics at WCCC is part of the Division of Mathematical Sciences, which includes mathematics, computer science, and engineering.

Mathematics courses for elementary teachers have been offered at WCCC for over 20 years, as long as any of the faculty I spoke with, including the dean of the Mathematical Sciences Division, has been at the school. Currently the mathematics department at WCCC offers a sequence of three courses for elementary teachers, although they have only recently (within the last few years) transitioned away from a two-course sequence. The current courses and content are as follows:

> **Mathematics for Elementary School Teachers – The Real Number System**
> (3 credit hours)
> This course is designed for preservice elementary school teachers. The course will examine six content areas: Numeration (historical development of numeration systems); Set Theory (descriptions of sets, operations of sets, Venn Diagrams); Number Theory (divisibility, primes and composites, greatest common factor, least common multiple); Patterns (number and geometric patterns); Properties of Numbers (whole numbers, integers, rational numbers, and models for teaching binary operations); and Problem Solving (strategies and models to solve problems).

> **Probability and Statistics for Prospective Elementary School Teachers**
> (4 credit hours)
> This course is designed for students who plan to become elementary school teachers and will emphasize group and hands-on activities, the use of computer software, and graphing calculators in the exploration of statistics and probability. Topics include creating and interpreting graphs, random variables and sampling, measures of central tendency and dispersion, analysis of experiments including hypothesis testing, design of experiments, and data gathering. In addition, basic laws of probability, logic and set theory including dependent, independent, and mutually exclusive events, odds, and expected values will be explored.

> **Geometry and Measurement for Prospective Elementary School Teachers**
> (4 credit hours)
> This course is designed for preservice elementary school teachers and emphasizes problem solving with particular focus on constructing tables and recognizing patterns. Topics include informal geometry, congruence similarity, constructions, transformations, tessellations, and measurement involving both English and

metric unites in one, two, and three dimensions. Problem solving will include the use of computer software and hands-on activities.

I interviewed four faculty members at West Coast Community College and the dean of the Mathematical Sciences Division.

- Greg is the dean of the Mathematical Sciences Division. The position of dean is not a faculty position and so Greg is involved in administrative duties, and not teaching duties. He has been the dean for six years, and prior to that was an administrator and mathematics professor at another college.
- Henry is a full time instructor who has been teaching at WCCC for five years. He has been teaching the Real Number System course for about three years, and is unusual in the sample of instructors in that he himself took a similar course as a college student. Before teaching at WCCC, Henry taught mathematics full time at another nearby college. Henry has bachelor’s and master’s degrees in science and mathematics, and is currently working on a doctorate in education.
- Irene is a full time instructor who has been teaching at WCCC for over twenty years. She has been teaching the mathematics courses for elementary teachers since she first began her career at WCCC, and until Jennifer was hired Irene was the only instructor who taught what was then a two-course sequence. Now she is the sole instructor of the Probability and Statistics course, although she still occasionally teaches the Real Number System course when the need arises. She is actively involved in several programs at WCCC for future science and mathematics students, and is also involved in funded outreach programs that provide her opportunities to work with teachers in public schools. Irene has

bachelor's and master's degrees in mathematics, and a doctoral degree in education. Prior to teaching at WCCC she taught middle- and high-school mathematics.

- Jennifer is a full time instructor who has been teaching at WCCC for ten years. She is currently the sole instructor of the Geometry and Measurement course for elementary teachers, and also teaches the Real Number System course regularly, although she was not teaching this course during the semester in which I interviewed her. Jennifer has a bachelor's degree in science and mathematics, a single subject credential in mathematics (the California state requirement for teacher certification), and a master's degree in mathematics. Prior to teaching at WCCC she taught high school mathematics for ten years.
- Karl is a part time instructor who has been teaching mathematics at several community colleges since earning a masters degree in mathematics. He had taught the Real Number System course at WCCC in the summer. Although this was his first time teaching the course at WCCC, he has taught a similar course twice before, at two different colleges. He was not teaching mathematics for elementary teachers at the time I interviewed him.

Theme 1: Department autonomy in course design at WCCC.

Instructors at West Coast Community College spoke of two state universities where the majority of students transfer, both located within a large state university system. Neither is located within the same city as West Coast Community College, though one is nearby. Instructors did not seem to concern themselves with transfer, or with the nature of the course at other institutions. They were aware of the need to ensure that the course transferred to other institutions, but Irene, Henry, and Jennifer each informed me that issues of transfer are handled by an office at the college, which also approves course outlines. They knew that the process occurred, but were not able to provide great detail about the process itself.

> These [courses for elementary teachers] are all articulated through the college articulation process. We have an articulation officer that, so there's no problem…. These [courses] follow a fairly acceptable series of courses that you see a lot. There's nothing outlandish about them. And so they easily will transfer and meet the requirements. (Irene 1.47)

> We work closely with our counseling office, we do definitely ensure that these courses will transfer, because as other courses, not every course will be accepted by every single university, but we try to focus on universities that our students will most likely attend. (Henry 1.58)

> We have a course outline, that when you teach a class here, through the curriculum committee at school, a course outline has been developed. First it develops at the department level, then it gets pushed up to the curriculum level, and they'll approve it…. That's not really done at our own specific level, that's done through the curriculum committee. (Jennifer 1.30, 40)

WCCC seems to have freedom to design courses according to the needs of their particular student population. In fact, Irene described a major change that had occurred within the last several years in which she and Jennifer had decided that they would better serve their students by offering three 4-unit courses instead of the two 3-unit courses that they then offered. Irene's description below details both their reasoning in changing their course offerings, and some of the opposition that they ran into internally within the college.

> We put together sort of a document that lines with the stuff that we do in our courses with the CSET [California Subject Examination for Teachers]…. We looked at the math component of that CSET and we took the topics that are in the CSET and we matched those to our courses and at that time we had just a two-course sequence. And many of the other colleges and universities were moving toward more math, changing that one 3-unit course to two 4-unit courses which is

> significantly more math. And what we did was we matched up the topics in [our] two-course sequence and [a] three-course sequence and … really felt that those [three] courses are going to better prepare them to teach math. And to, short-term, pass the CSET because that's a hurdle.
>
> Not everybody here agreed with us, because some of our teacher education folks want to get [students] out as fast as possible, transfer. And two courses are faster than three courses, you know.… So we gave the college plenty of time and we said, okay, we're going to phase out that other three unit course and we're not going to offer it as of spring 2008, about a year, year and a half ago…. And if our enrollment goes down, oh well. Because they can take that course at the transfer institution if they have it, but we feel we are serving our students the best by giving them more math. (Irene 1.26-29)

As can be seen above, the department does take the structure and content of other institutions into account, but that the structure of their courses is not dictated by other institutions. Trends at other colleges were one of several factors that the instructors as a group considered when changing their courses, but these factors also included state certification requirements and their own beliefs about the mathematical needs of their students. In the end, the decision to change the course offering was a department-level decision.

Theme 2: Course consistency and sharing of resources at WCCC.

In West Coast Community College interaction and collaboration around the course for elementary teachers is strongest when new instructors are being mentored into the course.[7] There is a substantial amount of interaction and sharing of materials in general, but also, among the experienced instructors, less effort to try to make the course the same across sections.

[7] In this section, I will refer only to the Real Number System course because both Geometry and Measurement, and Probability and Statistics are taught by a single faculty member at West Coast Community College and have been for years, leaving little room or need for collaboration.

The Real Number Systems course is taught by two full-time instructors, Henry and Jennifer. Frequently there will be sections taught by part time instructors as well, though neither of the part-time instructors who had taught within the past year had taught the course before. I was able to interview one of the instructors, Karl, and also to get a sense of how part time faculty are mentored into the course from Henry, Jennifer, and Irene (who currently teaches statistics for elementary teachers, but has taught the Real Number System course in the past). All four instructors spoke of mentoring in new instructors, whether part time or full time. “We very carefully help people who are brand new at teaching it,” said Jennifer (Jennifer 1.33). She explained that while new instructors are given freedom to set up their syllabus and organize the sequence of topics, they are given access to all of the notes and activities of the more experienced lead instructor. In addition, Jennifer sat in on Irene’s classes almost every day during her first semester of teaching the course, and Henry sat in on Jennifer’s classes (Jennifer 1.30-32).

Part-time instructors, possibly because they are only committed to one semester of teaching, do not typically sit in on the lead instructor’s courses. Karl, the part-time instructor who taught the course in the summertime, described how he relied on Jennifer as he taught the course:

> I’m a beginning teacher, so what I used was a lot of the stuff that Jennifer gave me…. The only thing[s] that I made up myself were some of the test portions and then the final. But most of the other stuff I tried to base it on how she taught the class because she’s gotten good results in the past, so I just wanted to make sure my students got an experience that was similar to the one that she would give them. (Karl 1.18-19)

Because the focus of collaboration is at the level of mentorship, the collaboration at WCCC seems to be relatively “top down.” That is, Jennifer learned first from Irene, but once she began teaching the course regularly she developed many of her own materials (Henry 1.46, Jennifer 2.38-39). Jennifer now shares these materials with new instructors: “Usually the people who teach the [Real Number System] course I share this information with them. They have all the activities, so you can pick and choose” (Jennifer 2.39). Now Henry is the lead instructor for the Real Number System course, and he spoke of using Jennifer’s materials, but also developing his own activities (Henry 1.46). In the semester that he was interviewed he was mentoring a part-time faculty member who was new to teaching the course, just as Jennifer had done the previous summer. Sharing between more experienced and less experienced instructors did not seem as common in the other direction. In fact, Irene stated that when she did teach the course, Jennifer told her, “You can do whatever you want” (Irene 1.33).

Thus while there is a great deal of sharing of resources there is less of a sense of cohesion across different sections of the course. The instructors of the course value open communication, but also value individual autonomy. Although instructors spoke of sharing resources, and seemed aware of what other instructors were doing, they also spoke of their freedom to make modifications. Jennifer provided activities so that new instructors could “pick and choose” among them (Jennifer 2.39). Henry received Jennifer’s exams when he first began teaching but “was given the freedom to adopt her exam or modify it” (Henry 1.51). Henry said, “we kind of want to provide students the uniformity in terms of our expectations, so we typically have the same number of exams, and number of quizzes” (Henry 1.51), but uniformity in structural similarities contrasted with significant autonomy in teaching the class on a day-to-day basis.

Theme 3: Use of textbook and other curricular resources at WCCC.

West Coast Community College instructors of the Real Number System course for elementary teachers[8] strongly aligned the content of the course with the content of the textbook. The textbook provides an outline for the material to be taught, that all instructors follow. Jennifer, who also teaches the Geometry and Measurement course but follows the textbook much more loosely than she does in the Real Number System course, provided a rationale for the close alignment with the textbook saying that it is because of “the size of the class, and the fact that I’m not the only one teaching it, and so we try to keep in line with each other” (Jennifer 1.34). Structuring the course closely around textbook topics helps to keep consistency across multiple sections and instructors.

Although instructors align the content of their course with the textbook, they also draw significantly upon supplemental materials The use of supplemental materials reflects the collaboration among instructors discussed in the preceding section. In a typical class at WCCC, students will spend a portion of the period working on worksheets, and it is these worksheets that constitute, and depend upon, supplemental material. The three instructors teaching the Real Number System course (Henry, Jennifer, and Karl) used these worksheets; Jennifer had written most of them and shared them with Henry and with part-time instructors such as Karl. When I spoke with Jennifer, she showed me a file cabinet organized by topic. She explained to me that she acquired ideas and activities at conferences and on the Internet, and also created activities herself (Jennifer 1.28-29). Then, when it came time to teach a particular topic, she would pull out

[8] In this section I will again refer to the Real Number System course, but not the Geometry and Measurement or the Probability and Statistics courses, simply because geometry and statistics by virtue of each being taught and organized by a single instructor, reflected very different relationships with the textbook than in situations in which multiple instructors taught the same course.

the file and look at the resources that were in that file. “You just start gathering,” she said, “and then you just kind of put it together into your own type of activities” (Jennifer 2.20). She showed me a stack of handouts that included all the modified versions of a single activity that she had been using throughout the years, and added that she felt it was about time for the activities to be “re-looked at and revamped and fixed up” (Jennifer 2.50), a project she would begin undertaking when she taught the course the following semester.

Henry had access to all of Jennifer’s resources and used them, but also made up his own (Henry 1.46). In fact, when I observed his classroom he was reviewing linear functions with his students, and distributed a worksheet that he had developed previously for use in an algebra class. In both interviews, he mentioned that he looked at other textbooks, and when I visited him in his office he showed me a stack of textbooks for elementary teachers that he frequently looked through and pulled from. Karl, a part-time instructor who had taught the course in the spring, told me that he did not really draw on outside resources, but added that it was largely because he was new to teaching this course and he “didn’t get a chance” to look outside the textbook. Instead, because he worked closely with Jennifer, he used the worksheets that she gave him, which ranged from explorations to more mechanical practice.

Theme 4: Instructional Practices at WCCC.

At West Coast Community College, the primary stated goal of the courses for elementary teachers is for students to understand why mathematics works the way it does. The three instructors for the number concepts course (Henry, Jennifer, and Karl) spoke in detail about this goal:

> We cover [the four basic operations] from a different perspective. We want to build on, on how, on why the operations work the way they do, for instance when you're combining fractions, say through any one of those operations, if you choose addition and subtraction, the question is why do we need a common denominator, okay, what is meant by a common denominator? … The idea in this course is for students to understand how things work, why they work out the way they do, not just doing the process, the memorization. (Henry 1.12-13)

> In the first course it's, I think of it as the four operations and then I think about, you know, looking through the hows and whys.… My hope I think is that when they leave those courses they can start thinking about not only procedural understanding but also conceptual understanding. (Jennifer 1.7-9)

> They shouldn't be learning how to do math, that should be something that they already should know how to do. I think they should be learning, they should be given different methods corresponding how to be, they should be more interested in explanation instead of just how to do it. (Karl 1.6-7)

Although instructors spoke of other goals, such as students developing confidence and overcoming their fear of mathematics (Jennifer 1.10), or developing critical thinking skills (Henry 1.16, 2.13), none of these goals stood out as prevalent across the department. The primary shared focus of the course is to develop a deep understanding of basic mathematical concepts.

In the classroom, instruction involves a mix of activities, some teacher-centered and some student-centered. Instructors' descriptions of typical class sessions involved developing particular mathematical ideas through instructor lecture, whole-class discussion, group work, and student presentations. Karl, the only adjunct instructor interviewed at WCCC, gave the most structured description of a typical class session:

> I would present the material, and I would give more of a broad overview, it wouldn't be in great detail because, you know, find the greatest common factor and the least common multiple is something that they should already know… Once we went over things like that I would generally give them a worksheet for the day and they would work in groups and I would go around and help them and give them ideas about how to think about certain things. [The worksheets consisted of] problems. You know, some of them were more explorations…or it

> could be more mechanical…. It varied depending on which section we were in. (Karl 1.22-24)

Both Henry and Jennifer also talked about introducing a topic and then exploring the topic through group activities.

> And we do use some manipulatives in some of these topics and there's always an ongoing class discussion and there's group, or like activities, so it's not only I that's presenting information, but everybody in the classroom is learning, including myself. (Henry 1.22)

> Usually [I] very briefly give a look at the new topic. And then turn them loose on group activities. So then they're working in groups and explaining and discussing and I'm circulating the room kind of trying to listen to them, hear their explanations, things like that. [The group work] can be all sorts of stuff. It can be explorations if it's something I'll want them to figure out on their own, it can be practice problems, it can be extensions of practice problems…. In most cases it definitely involves doing some problems and then also some sort of reflection about the process. (Jennifer 1.35-38)

Instructors spoke of group work as an important part of the class time, but the group work was embedded within a variety of types of activities, including discussion, student presentations, and lecture. The ratio of teacher-centered and student-centered instruction at WCCC is 1.76 (Table 4.3). Both Henry and Jennifer, who teach the Number Concepts course, had ratios of 2 or higher (2.9 and 2 respectively), meaning students experience about twice as much teacher-centered instruction as student-centered mathematical work.

Table 4.3: Teacher-Centered and Student-Centered Instruction at WCCC

Respondent	Minutes Spent on Teacher-Centered Instruction	Minutes Spent on Student-Centered Instruction	Ratio of Teacher-Centered to Student-Centered Instruction
Henry	80	35	2.29
Irene	80	40	2
Jennifer	40	40	1
Average			**1.76**

Table 4.4 below shows the activities that instructors at WCCC reported students engaging in both most and least. Many of the activities reported with the highest frequency involve important mathematical work. Work on mathematical communication and representation was quite frequent at WCCC, and other frequent activities include explaining reasoning, discussing different solution methods, and generalizing solution methods.

Table 4.4: Student Activity at West Coast Community College

High (>3.0)	
Work on mathematical communication and/or representation	3.7
Discuss different ways that they solve particular problems	3.3
Listen to you explain terms, definitions, or mathematical ideas	3.3
Explain the reasoning behind an idea	3.3
Work in small groups on investigations that take part or all of the class period	3.0
Prove that a solution is valid or that a method works for all similar cases	3.0
Analyze similarities and differences among several representations, solutions, or methods	3.0
Practice computational skills	3.0
Low (<2.5)	
Work on group investigations that extend for several days	2.3
Make conjectures and explore possible methods to solve a mathematics problem	2.3
Use manipulatives such as base ten blocks or fraction bars	2.3
Do problems that have more than one correct solution	2.0
Write equations to represent relationships	2.0
Use computers to solve exercises or problems	1.7
Use graphing calculators to solve exercises or problems	1.0

Instructors rated each activity using the following scale: 1 – Never or almost never, 2 – Some lessons, 3 – Most lessons, 4 – Every lesson. Numbers given in this table are the average of the scores across the 3 instructors who responded to the survey (Henry, Irene, and Jennifer).

Teacher-centered activities had a high frequency as well, however. Neither of the activities on the questionnaire that involved listening to the instructors was ranked among the lowest activities, and one, listening to the instructor explain terms, definitions, or ideas, was ranked among the highest. Practicing computation skills was also given a high value by instructors at WWCC.

In short, students in the math course for elementary teachers experience variety in instructional activities, including group work and important mathematical activity, but also experience a high level of teacher-directed instruction.

Summary of findings for WCCC.

Instructors personally are largely unconcerned with matters of transfer, which are handled by a central office at the community college, and have no well-formed relationship with a particular transfer institution. The instructors are aware of trends in the mathematical preparation of teachers, and exhibit a sense of freedom in designing a sequence of courses consistent with these trends that will meet the needs of their particular students. Instructors share resources and ideas, though most of the sharing is “top-down” in that more experienced instructors share materials with less experienced instructors. Instructors themselves have a great deal of freedom within their own class to make adjustments and additions to materials and to modify their instruction; there is an expectation of consistency across courses because of the shared materials, but also a sense that individual instructors are autonomous in how they choose structure their classes and the teaching methods they use.

The courses are aligned with the topics and ordering of the required textbook and instructors adhere closely to these topics and ordering. However, they also use and create additional resources to supplement their instruction, and freely share these resources with new instructors. The shared goal of the course across the department is for students to develop a deep understanding of elementary mathematical knowledge. Individual instructors have their own sub-goals for their students (such as developing problem-solving skills or confidence), but none that appear consistent throughout the department. Instructors use a variety of instructional styles, both teacher-centered and student-centered, in teaching the course, including lecture, group-work, whole class discussion, and student presentation.

Southern State Community College (SSCC)

Southern State Community College (SSCC) is a very large (approximately 36,000), multi-campus college in a large city in the southern United States. Although there are several main campuses and smaller satellite campuses, SSCC operates as a single college rather than a college district. The students at SSCC are primarily white (59%), with a large population of Hispanic students (24%), and smaller populations of Black (8%) and Asian (2%) students. There are 46 full time faculty members across the campuses, and around 200 part time faculty members.

Mathematics courses for elementary teachers have been offered at SSCC for at least 25 years. Currently the mathematics department at MWCC offers a sequence of two courses for elementary teachers. The courses and content are as follows:

> **Mathematics for Middle Grade Teacher Certification I**
> (3 credit hours)
> Concepts of sets, functions, numeration systems, number theory and properties of the natural numbers, integers, rational and real number systems with an emphasis on problem solving and critical thinking.
>
> **Mathematics for Middle Grade Teacher Certification II**
> (3 credit hours)
> Concepts of geometry, probability, and statistics, as well as applications of the algebraic properties of real numbers to concepts of measurement with an emphasis on problem solving and critical thinking.

I interviewed five faculty members at Midwest Community College. The department chair was unavailable for an interview, and so I merged the department chair interview with the instructor interview for one of the instructors, Patricia, who had once served as the department chair. Instructors of Mathematics for Middle Grade Teacher Certification are required to have high school teaching experience, and so each of the instructors I interviewed had some experience teaching high school mathematics.

- Lisa is the chair of the course committee for the mathematics courses for elementary teachers, and a full time faculty member. At the time of our interview she had taught at SSCC for ten years, and had taught both sections of mathematics for elementary teachers for eight of those years. She had also worked as an adjunct instructor while working on a master's degree, and taught the course during that time as well. This was prior to the adoption of the current curriculum, and so Lisa experienced a version of the course very different from the one currently taught. Lisa has a bachelor's degree in Spanish literature and liberal studies mathematics. Lisa taught for a short time in a Catholic school, but never finished her certification, and after earning a master's degree in mathematics has spent most of her career teaching at the college level at SSCC and another college.
- Monica is an adjunct instructor and has been teaching at SSCC for twenty years. She also teaches part time at a local university. She has been teaching the mathematics courses for elementary teachers for five years, and has taught the second course for most of that. In the semester in which I interviewed her, she was teaching the first course in the sequence for the first time in several years. Monica has a bachelor's degree in secondary education mathematics and English and a master's degree in mathematics education. She taught one year of 7^{th} grade mathematics and one year of 9^{th} grade mathematics prior to her work at SSCC.
- Nina is an adjunct instructor and has been teaching at SSCC "on and off" for nineteen years. She has been teaching mathematics for elementary teachers at SSCC for over ten years, and has significant experience teaching both courses in

the sequence. In the semester in which I interviewed her, however, she was not teaching either of these courses because she needed a break from the amount of work involved in teaching math for elementary teachers. Nina has a bachelor's degree in mathematics, a secondary teaching certification, and master's degrees in secondary mathematics education and religious education. She taught high school for eight years, and has also worked as a full time lecturer in mathematics for four years at a state university, and in a number of other teaching positions at various colleges.

- Olivia is an adjunct instructor and has been teaching at SSCC for ten years. The semester in which I interviewed Olivia was her first semester teaching mathematics for elementary teachers, and she was teaching one section of the first course in the sequence. Olivia has a bachelor's degree in mathematics and physical education and a master's degree in mathematical sciences. She has taught high school mathematics and participated in homebound teaching.
- Patricia is a full time instructor and has been teaching at SSCC for 26 years. She served as the chair of the mathematics department at SSCC five years ago. Patricia has been teaching mathematics for elementary teachers for about 12 years, and was teaching a section of the first course in the sequence at the time of our interview. Patricia has a bachelor's degree in mathematics and secondary education, a master's degree in teaching, and a doctorate in mathematics education. She has taught 6^{th}, 7^{th}, and 8^{th} grade mathematics.

Theme 1: Department autonomy in course design at SSCC.

Southern State Community College is located near a large state university, but this university is not the primary transfer institution. Most instructors acknowledge that some students do indeed transfer to this university, but that more transfer to a different university located near but not within the city (Patricia 1.6, Lisa 1.9, Monica 1.12). Few instructors were able to offer specific details about how the course transferred between universities, and instead referred to a common course numbering system. Patricia explained how this course numbering system aided in transfer:

> It used to not be that way and in that case, you know, our classes did not transfer as easily but now they transfer to the state universities, not as easily to the private universities. The topics are in there so that every place has, you know, statistics and geometry and measurement in [the second course], and every place has basic operations and the real number system and numbering systems and rational operations with rational numbers, those kinds of things, and proportional thinking, in [the first course]. (Patricia 55-56)

The statewide course numbering system to which Patricia and other instructors referred ensures course equivalency across the state and is used by all community colleges and the majority of four-year institutions in the state; those which do not use the numbering system still cross-reference their courses with the state numbering system. This means that the two mathematics courses for elementary teachers at Southern State Community College have specified course descriptions, prerequisites, and student contact hours that are shared with other two-year institutions and are transferable to four-year institutions. Both of the two courses as defined by the state are 3-unit courses, with a maximum of 48 contact hours per semester.

The interaction between instructors of the course at SSCC and instructors of the course at other universities appeared to be mediated, therefore, by this common course numbering. That is, the lack of discussion in the interviews about concerns around transferability or what was being done at other schools may be partly because the common course numbering system made this concern less salient. As long as the course at SSCC covered the necessary topics in the allotted time, instructors did not need to think about transfer.

This course numbering system may both restrict and enable SSCC's institutional autonomy in designing the course. On the one hand, the guidelines are broad. The department appeared to have full autonomy in choosing a textbook and designing a method of instruction. The course is, and has been for many years, an activities-based course in which instructors are expected to lecture as little as possible. Instead, students in every section spend the majority of their time working on explorations and activities from the activities manual that accompanies the textbook (this will be discussed in more detail under Theme 4). Patricia described the development of the course at SSCC.

> [Two instructors] used to teach the course at Southern State Community College and they developed it before textbooks were available that would support socio-constructivist learning or discovery learning, that was different from what at that time was available in textbooks, and together they worked on developing a curriculum. And for a while we were using the curriculum that they developed. We had a big fat notebook for the first course and a big fat notebook of learning activities for the second course, and they would present workshops for the people who would be teaching or might be interested in teaching in the future. And then when textbooks became available that had learning activities that were along the lines of what we wanted in our courses then we started using purchased curriculum materials. (Patricia 1.14-15)

Full time instructors such as Patricia and Lisa are still actively going to conferences, evaluating new textbooks, and running workshops to prepare instructors to teach the activities-based course that was designed for prospective elementary teachers at Southern State Community College (Lisa 1.13-14, Patricia 1.18-20). The course design was developed and is now maintained entirely by Southern State Community College. Both Lisa and Monica mentioned that the nearby university uses the same textbook (Lisa 1.44, Monica 1.26), but the only significance of the remark was that it made for ease of transfer since the university does not adhere to the common course numbering. Monica added that she mentioned the common textbook only as a matter of interest: “It’s not that we’re using the books because they’re using them.”

On the other hand, in spite of the autonomy in choosing a text and determining how the course will be taught, the department is not free to alter the structure of the course in terms of credit or contact hours, or topics covered. Other institutions, such as Midwest Community College and West Coast Community College have made changes to the number of courses, the content of courses, and/or the number of math credits offered at their respective colleges in the distant or recent past, but such a change would be difficult, if not impossible, at Southern State Community College. No instructor at SSCC mentioned this as a matter of concern, or spoke of the courses being insufficient as they were currently structured. But the autonomy of the department in designing the course is nevertheless subject to this restriction.

Theme 2: Course consistency and sharing of resources at SSCC.

Collaboration at Southern State Community College is characterized by a unified course philosophy with limited interaction among instructors. That is, the goals of the course and the method of teaching are intended to be standard across the department, which allows for consistency among courses. But instructors at SSCC rarely spoke of interacting with other instructors or of sharing resources.

Several instructors spoke of a shared course philosophy, and all spoke of the "hands-off" teaching style that is adhered to by instructors of this course across the department. A typical class session involves assigning specific explorations from the explorations manual that is published as a companion to the textbook in use for students to do in class, allowing students to work in groups while the instructor walks around, and collecting and grading explorations and homework assignments, with minimal lecture and extensive student responsibility.

Every instructor also described the class as completely different from other mathematics courses that they teach or have taught in the past. But instructors are not simply assigned the course and expected to adhere to the shared teaching philosophy. Patricia, a full time faculty member and one of the course coordinators, explained that the course is difficult to staff because of the demands of the teaching method the department requires:

> Teaching this course doesn't suit every teacher. It's not one of our easier courses to teach because it's so different. It's hard to find the people who we want, who will teach the students like we want them to be taught and give attention to attitudes and beliefs as well as mathematics, and use the manipulatives and the discovery method and not lecture the students too much, and the grading is very intense. (Patricia 1.50-51)

Therefore, the course coordinators make an effort to mentor new instructors into the teaching philosophy and teaching style. Patricia and Lisa arrange workshops to interest more instructors in teaching the course (Patricia 1.50), and even the instructors with the strongest backgrounds will have a mentor working with them during their first semester (Patricia 1.49). Each of the instructors I interviewed spoke of being trained or mentored into the course. In particular, they spoke of receiving materials from a full time instructor serving as a mentor (Lisa 1.30, Monica 1.41, Monica 1.47, Olivia 2.12), and then making changes as they saw fit.

But although the department seems to be very particular about training new instructors, the sharing and collaboration seems limited to an instructor's first semester, and perhaps even to their mentor. In my very first interview with an instructor at SSCC, Monica told me, "when I first heard that you wanted to interview us I'm like, oh! Great! I finally get to talk to [someone]" (Monica 1.40). Other comments from other instructors suggested that they didn't know much about what everyone else was doing. Nina postulated that other instructors might spend more time at the front than she did based on what she heard from students who entered the second half of the course and had taken the first half from someone else (Nina 1.55).

Of the five instructors I interviewed, Olivia was the newest, and at several points during the interview she expressed that she knew very little about what the particulars of what other instructors did, even her course mentor Lisa:

> I'm not positive if [other instructors assign projects for their students] but I happened to notice on Lisa's syllabus, I thought it said something about projects. So to be honest with you I don't know if they do or not. I have a feeling they might do some projects, but I don't know. (Olivia 1.21)
>
> I just know [Lisa] did [a particular exploration] but I don't know exactly what she had [students] do in terms of writing it out, how detailed this and that, so…I might not even take a grade on it. If I do I let them know and it'll be for the next class…. And I have no idea if that's what Lisa does or not. (Olivia 1.27)
>
> I am putting a little bit of lecture in [when I teach], that maybe some other instructors don't. I'm not sure at *all*. (Olivia 1.32)

In spite of a shared philosophy that maintains a high level of consistency across sections, instructors nevertheless seem to be left largely free to interpret this philosophy in the course of their own instruction.

Theme 3: Use of textbook and other curricular resources at SSCC

At Southern State Community College, the textbook is the foundation for content and instruction in the mathematics course for elementary teachers. The college requires students in this course to purchase the textbook, *Mathematics for Elementary School Teachers* (Bassarear, 2007), as well as the accompanying explorations manual, which is published and packaged with the textbook. Class sessions are then structured around explorations from the manual, and students are expected to complete assignments and readings from the actual textbook outside of class.

The format that all instructors at SSCC follow in teaching a class is to choose explorations from the manual and then assign these explorations for students to work on during class. There are more explorations than can be used over the course of the semester, and instructors pick and choose explorations according to guidelines in the department-wide course manual, recommendations by the textbook author, and their own discretion. The explorations are chosen to supplement the content of the textbooks, and instructors' reasoning about choosing explorations tends to be based on their own interactions with the textbook and their prior experience using particular explorations and exercises. Lisa explained that she chooses explorations that highlight the objectives presented from the book, limiting her selection to the particular objectives she wants students to know (Lisa 2.33). Nina also chose explorations to support the main concepts in the textbook, and favored the explorations that supported those concepts "in kind of a fun way…that's not too silly" (Nina 1.22). Monica and Olivia both referred to the recommendations given in the department's course manual as helping them to determine what should be stressed in a given section, and then choosing particular explorations based on their own personal discretion (Monica 2.1, Olivia 1.26, Olivia 2.14).

An appendage to this sense of the textbook being a self-contained resource for organizing content and instruction is that students are expected to learn from the textbook what they did not learn from the explorations that were covered in class. The instructors spoke of choosing explorations that emphasized what they wanted to cover or what students might have difficulty with, but also spoke of how it was unnecessary to cover everything because students would learn more when they turned to the readings and homework exercises in the textbook itself.

> A few of [the homework problems] might complement what the explorations were doing, but I also pick homework problems that cover what we don't cover in the explorations, and things where they're going to have to read the chapter and look it up and figure it out. (Lisa 2.19)
>
> There's quite a bit that I don't specifically discuss, but they have homework, so if they're doing their homework they will realize, "hey I didn't quite get this," you know. There's a lot left on their shoulders, it's a lot on them. (Olivia 1.17)

As described previously, the mathematics courses for teachers at SSCC are based on a very particular teaching philosophy and method, and it is not the textbook that determines the method. Rather, the instructors use the textbook as extensively as they do because it fully supports the method that the department at SSCC has chosen for teaching the course (Lisa 1.12, Nina 1.18). SSCC, then, relies heavily on the textbook for instruction and course content, although instructors have freedom to pick and choose among explorations and homework questions according to their own judgment. But their extensive use of the textbook is largely because they have found a text that fits particularly well with a course philosophy that came into being before the text was chosen.

Perhaps because the textbook seems to be seen as a self-contained entity that conforms well with the department philosophy surrounding the course, instructors at SSCC do not seem to rely much at all on other curriculum materials. Although Patricia and Lisa (the two full time instructors I interviewed) were familiar with other curriculum materials, it was only because they are involved in the textbook selection process. When a new edition of the current textbook becomes available, they look at other textbooks in order to determine whether they want to continue using the Bassarear text. Patricia stated bluntly that she does not use other textbooks (Patricia 1.31), and Lisa elaborated on her use of resources in general, saying, "I don't [use other resources] too much because I find that [Bassarear's] explorations manual is so rich that I don't often feel the need to go outside of that to look for other things" (Lisa 1.26).

Curricular resources beyond the textbook were not completely unheard of. Some instructors printed articles from teaching journals for their students to read and respond to (Monica 1.36, Nina 1.25, Patricia 1.31). Nina sometimes showed videos or read children's books to her students (Nina 1.26-28). Olivia and Lisa even spoke briefly of looking for online activities that they could use with their classes (Olivia 1.18, Lisa 1.26). But such additional resources were not used extensively, and no instructor spoke of using additional resources because of insufficiencies in the textbook or the explorations. In fact, Patricia spoke of minimizing the number of writing assignments on journal articles that she assigned her students because it was "too heavy" to do in addition to the homework and writing assignments that were already done in the course (Patricia 1.38).

In summary, instructors at SSCC used the textbook as a primary and largely self-contained resource, and drew on few external materials to supplement their instruction.

Theme 4: Instructional practices at SSCC.

Although instructors at SSCC spoke of helping their students develop deeper understanding of mathematical topics and learning why mathematical concepts work the way they do, they spoke even more frequently of goals related to students' attitudes towards mathematics and characteristics as mathematical learners. In the course of learning the "whys" of mathematics, students are expected to become independent learners and to believe in their own capability to approach and solve mathematical problems, because these are the skills that will enable them as teachers to approach mathematics with confidence.

Lisa added that the goal was not just a personal goal, but a departmental goal. "One of my main goals," said Lisa, "and really a departmental goal, is that they learn how to learn math independently and figure things out on their own when they need to" (Lisa 1.10). And other instructors spoke of independent learning as well. Monica distinguished the course from other mathematics courses because "students have to seek our their own knowledge" in the mathematics course for elementary teachers, unlike other mathematics courses where she tells students how to do the mathematics (Monica 1.59). Nina stated that "with our method of working in groups, we try to foster *them* coming up with their own ideas (Nina 2.104). And Patricia said that an explicit goal of the course is that students will see that they can "independently explore mathematics and continue learning mathematics" (Patricia 1.12). This goal of students becoming independent learners is reflected in instructors' expectations, described above, that students will learn on their own from the textbook what they do not learn in class, and also in the instructional methods, which will be described later.

Another common goal of helping students to develop confidence is related to the goal of helping students become independent learners, and instructors spoke about this aspect of their goals for the course as well. “I spend some time cheerleading them to get past that [math phobia],” said Lisa,” and sort of re-take the reins and realize that they’re the ones that can decide they’re going to learn it” (Lisa 1.50). Nina stated that students gain confidence from the course, and an ability to feel good about mathematics and the possibility of teaching it (Nina 1.11), adding that “the attitudinal change that comes as a result of how we do the course is heads and tails above any other positive thing you might get” (Nina 2.107). Patricia told me that in addition to “deepening and enriching their mathematics knowledge and skills,” the course is about “improving their attitudes and beliefs about the importance of mathematics and that all students can learn mathematics and that they can teach mathematics and that mathematics matters” (Patricia 1.12).

Just as the department goals are consistent across instructors, the descriptions of instructional methods in the mathematics courses for elementary teachers at Southern State Community College are also highly consistent across different instructors, and consistent with the departmental goal of helping students become independent learners. The instructors’ descriptions of a typical class session were very similar, and all depict a student-centered learning environment, with the explorations taking up the majority of the class time.

> They work in small groups; sometimes they do presentations to the class based on what they’ve been exploring, and sometimes they just work in their groups and I run around and either clarify or ask some leading questions if the group is seeming to get stuck on something. (Lisa 1.37)

> I bring stuff in and they get into their groups and I work, work, work. I am walking around and the only way they will earn their full ten points is if they're on topic… It's an easy class because then I just walk around answering questions, pointing them in the right direction… I have enough work to keep the majority of the class occupied the whole time. (Monica 1.52-56)

> As the course has gotten going they're already, they know their small groups, so I'll say 'okay today we're going to do such-and-such exploration and this is about da-da-da-da-da,' and maybe we'll read a little bit of the top, and I'll say 'okay get into your groups.' And so for almost the whole session they'll be in their small groups…and I roam around the room and ask them if they need anything or, you know, answer questions. (Nina 1.43-47)

> Typically we come in and I'll have whatever exploration or two that we're going to be doing for the day, I'll have them doing that, mostly in groups…and that will take up most of the class time. And I'm walking around and trying to give them feedback on what they're doing. (Olivia 1.22-24)

> When class starts I usually put up the learning activities that we're going to work on that day…. And then most of our class time is working in groups, I walk around the whole time answering questions or listening to what they're talking about, occasionally making suggestions, but I try not to make suggestions too often… (Patricia 1.41-46)

Instructors were very aware of the student-centered nature of the course, and that this is different from most mathematics classes that they themselves teach. That is, the instructional method is clearly unique to this particular course. Lisa attributes this partly to pacing: while she tries to do a small amount of exploration in other mathematics courses, "the syllabus is so jam-packed with material that lecture is really the only way to get through it." But in the course for elementary teachers she is able "to cover almost everything with the explorations and leave just a little bit that they have to learn on their own with just from the book and maybe not having seen it in an exploration" (Lisa 1.47). Nina differentiated between other classes, which she called "teacher directed," and this course, in which she was directing the course by laying out the framework, but that it is the students who then engage with this framework. "It's a totally student participatory class" she said (Nina 1.53).

In addition, instructors related their work in the classroom to their goal of helping students become independent learners. “I’m not teaching them anything and I’m not standing up there showing them how to work problems,” said Monica. “They need to go out there and find [it themselves].” She added, “I’m the primary resource and I walk around, and I answer questions and I point them into directions, but it’s more like, ‘well, what do you think?’ or ‘what do you remember?’” (Monica 1.16). Olivia, the newest instructor of the course, spoke of the department goals and students’ reactions: “it’s not really they [the department] want me to explain how to do things—well the students do, but that’s not the purpose of the course” (Olivia 1.12). And Lisa said, “I think any [text]book would force them to become independent learners the way we teach the class” (Lisa 1.20).

Although the instruction is highly student-centered, students are not left entirely to themselves. Instructors spoke of interacting with the students as they are working in small groups, and also of occasional whole-group discussions, and the nature and purpose of those discussions. For the most part, when speaking of working with students in groups, instructors described asking and answering questions that came up, and paying attention to what students were doing so that they could give feedback when necessary.

> I pass back old papers and I roam around the room and ask them if they need anything or, you know, and ask, answer questions. (Nina 1.44)
>
> And I’m walking around and trying to give them feedback on what they’re doing, trying to, you know, help them a little bit, get to the point. (Olivia 1.23)
>
> I walk around the whole time answering questions or listening to what they’re talking about, occasionally making suggestions but I try not to make suggestions too often… Lots of times I’m just listening. (Patricia 1.45)

Monica also spoke of monitoring the students to make sure they were on task mathematically, and both Monica and Lisa spoke of encouraging groups to interact with other groups when they get stuck:

> I am walking around and the only way they will earn their full ten points is if they're on topic. You know I do not want to hear people talking about, well, you know, did you see so-and-so, and oh, you know, that test in that other class sure was hard. No, they need to be talking math the whole time, they're really good, I mean the first, I mean it's easy, it's an easy class because then I just walk around answering questions, pointing them in the right direction. "Oh, one group can't get one part, okay, so who's got this one." (Monica 1.55)

> I run around and either clarify or ask some leading questions if the group is seeming to get stuck on something. And a lot of times I'll just encourage them to, if they're stuck, I encourage them to talk to some of the other groups where I know another group's already made some progress, and that gives them practice explaining things to each other which is really the true test of how well you understand it. (Lisa 1.37)

All instructors said they spent minimal time lecturing in front of the class, but lecture did occur around some topics, for example, when many students seemed to be struggling with a particular concept. Nina described how she might intervene in the middle of an exploration.

> And in the middle sometimes, if there are a bunch of people that have a question or they're not understanding a main concept, I'll just say 'Okay in about two minutes I'm going to talk about such-and-such.' And so then I let them finish what they're working on for about 2 minutes, give them a little warning. Try to give them a warning. So then I'll say okay, and I'll go to the board and explain whatever the concept is, like Venn diagrams or something. And then they go back in their groups. (Nina 1.45)

Patricia spoke also of preemptive discussions or lectures around topics that she knew from experience students might struggle with: "Sometimes I'll start with a five or ten minute discussion or lecture time, on homework or on some topic that maybe I have found in the past that the students need a little additional explanation on" (Patricia 1.42).

Lisa, speaking of how she approached one particular activity, suggested that such preemptive explanations might be necessitated by time constraints: “If I had all the time in the world I wouldn’t care if they went down the wrong path, but you have very limited time and I want to get as much done as possible, (Lisa 2.17). Monica briefly mentioned explaining how to use particular materials (Monica 1.52), and Patricia also described having whole class discussions about the use of manipulatives when the class uses Geoboards or Cuisenaire rods or pattern blocks for the first time (Patricia 1.46).

Olivia talked about doing some amount of traditional lecture if she herself felt a particular topic was important for the students, or terminology she wanted them to learn (Olivia 1.24). Specifically, she mentioned in the second interview that in her lesson the day before, she had stressed properties of operations as they applied to division: “I discussed some of the properties with them in terms of division, because those are the things that I think should be stressed… in that, you know, for division those properties do not hold up, like commutative, etc.” (Olivia 2.4, 2.10).

Instructors’ responses to the question about how they spent their class time were consistent with their descriptions. Each instructor reported engaging in only 0-10 minutes (of 75 classroom minutes) on lecture style presentation. The average ratio of reported teacher-centered activity (homework review, lecture, instructor-guided student practice, and re-teaching) to student-centered activity (small group work and independent practice) was 0.37 (Table 4.5), meaning that the amount of time students spend with the teacher leading from the front of the room was about a third of the amount of time they spend doing mathematics independently.

Table 4.5: Teacher-Centered Instruction and Student-Centered Instruction at SSCC

Respondent	Minutes Spent on Teacher-Centered Instruction	Minutes Spent on Student-Centered Instruction	Ratio of Teacher-Centered to Student-Centered Instruction
Lisa	20	50	0.4
Monica	20	50	0.4
Nina	20-25	45	0.5
Olivia	20	50	0.4
Patricia	9	62	0.15
Average			**0.37**

Instructors' responses to the email survey are also consistent with their responses to the interview questions about the amount of time that they engaged in whole-class lecture and discussion. The highest- and lowest-ranking activities that instructors reported that their students engaged in are listed in Table 4.6 below.

Table 4.6: Student Activity at Southern State Community College

High (>3.0)	
Work in small groups on investigations that take part or all of the class period	3.8
Work in small groups on sets of problems	3.6
Work on mathematical communication and/or representation	3.4
Work on problems for which there is no immediate method of solution	3.4
Explain the reasoning behind an idea	3.4
Make conjectures and explore possible methods to solve a mathematics problem	3.2
Discuss different ways that they solve particular problems	3.0
Low (<2.5)	
Analyze similarities and differences among several representations, solutions, or methods	2.4
Do problems that have more than one correct solution	2.2
Work individually on mathematics problems	2.2
Work on group investigations that extend for several days	2.0
Prove that a solution is valid or that a method works for all similar cases	2.0
Listen to you explain computational procedures or methods	2.0
Listen to you explain terms, definitions, or mathematical ideas	2.0
Write equations to represent relationships	2.0
Use computers to solve exercises or problems	1.6
Use graphing calculators to solve exercises or problems	1.4

Instructors rated each activity using the following scale: 1 – Never or almost never, 2 – Some lessons, 3 – Most lessons, 4 – Every lesson. Numbers given in this table are the average of the scores across the 5 instructors.

Small group work was rated as occurring with great frequency, and listening to the instructor was rated as occurring very infrequently. Students in mathematics courses at SSCC engage in a great deal of mathematical work independent from the teacher, and the work seems to consist mostly in exploring methods for solving mathematics problems, finding different solution paths, and explaining the reasons behind mathematical ideas, rather than simply doing sets of problems.

Summary of findings for SSCC.

The mathematics course for elementary teachers at SSCC is part of a common course numbering system intended to facilitate transfer between two-year and four-year institutions across the state. As such, the course must meet state requirements relating to content and credit hours. Within this structure, SSCC has developed a very specific course design guided by a course philosophy intended to help students become independent learners of mathematics. New instructors are hired for their willingness to adhere to this form of instruction, and are mentored into teaching the course during their first semester. Because of this early mentoring process, the basic structure and philosophy of the course is highly consistent across sections, but there is little structured collaboration among instructors who have been teaching the course for some time.

The textbook that is used at SSCC is the primary curricular resource for the course, and is largely self-contained. It was chosen because it fit the department's philosophy for the course for elementary teachers, and is the source not just of homework problems and general content, but of all in-class activities that the students engage in. These in-class activities form the backbone of students' experience in the classroom, and the great majority of class time is devoted to students' work on activities. The activity in the classroom is highly student-centered, with very little teacher-centered activity.

Northeast Community College (NECC)

Northeast Community College (NECC) is a smaller college (approximately 8,000 students) located in a large suburb in the Northeastern United States. Students at NECC are primarily white (71%), with smaller populations of Black (10%), Hispanic (8%), and Asian (2%) students. Mathematics is included in the Mathematical, Physical, and Computer Sciences Department, which has 19 full time instructors, 12 of whom are mathematics instructors and 7 of which are physical science instructors.

Mathematics courses for elementary teachers have been offered at NECC for at least twenty years. Historically, NECC has offered one course, but it has recently begun offering a second course, which has only been offered for three semesters. NECC offers a two-year education degree in which students are jointly registered at a local university, to facilitate transfer for students pursuing an education degree who desire to begin their education at the community college. Education courses, including the mathematics courses for elementary teachers, are co-articulated with corresponding courses at the transfer institution, use the same textbook, and cover the same topics as the university courses. The descriptions of the mathematics courses for elementary teachers offered at NECC are as follows:

> **Math for Elementary School Teachers**
> (3 credit hours)
> This course meets the math requirement for students who are enrolled in the Elementary Education, Pre K-6, A. S. degree program and who plan to transfer to [state university]. The emphasis is on problem-solving as it relates to the number system. Probability and statistics are also introduced.
>
> **Geometry for Elementary School Teachers**
> (3 credit hours)
> This course is an elective for students in the elementary education program. It emphasizes background information for the teaching of elementary school geometry. Topics include spatial visualization, measurement, coordinate geometry, similarity and congruence, and transformational geometry. Students learn mathematical theory and application, and experience the role of elementary school students through a variety of classroom activities and demonstrations.

I interviewed the department chair and four mathematics faculty members at Northeast Community College.

- Rachel is a full time faculty member at NECC and has been teaching there for 5 years. Rachel has taught mathematics for elementary teachers regularly in her time at NECC, but has only taught the first course in the sequence. Rachel's position at NECC was her first job out of college. She has an MBA, and is working on a master's degree in adolescent learning.

- Suzanne is a full time faculty member at NECC and has been teaching there for 9 years. Suzanne has been teaching mathematics for elementary teachers for all nine years that she has worked at NECC. Suzanne has a bachelor's degree in mathematics and computer science with a minor in foreign languages, a one year teaching certification, and a master's degree in applied mathematics. Prior to teaching at NECC, Suzanne held various high school teaching positions in three different locations in both Canada and the United States.
- Tracy is a part-time instructor who has been teaching at NECC for just over two years. In the semester in which I interviewed Tracy she was teaching mathematics for elementary teachers for the second time. Tracy has a bachelor's degree in computer science and worked previously as a computer programmer, before staying at home with her children for fifteen years, after which she earned a master's degree in mathematics education and began teaching at NECC.
- Valerie is a part-time instructor and has taught at NECC for 17 years. She began teaching at NECC as a full time instructor for three years before deciding to work only part time. In the semester in which I interviewed Valerie, she was teaching both courses in the sequence of mathematics for elementary teachers. Valerie teaches evening courses, and this semester was her first opportunity to teach the second course in the sequence as that course had never before been offered in the evening. She has been teaching the first course every semester since she began

teaching at NECC. Valerie has a master's degree in mathematics education and has taught high school and junior high full time, and at several four year schools part time.

- William is the chair of the department of mathematical, physical, and computer sciences, and had served as department chair for about 6 months at the time of our interview. He is also an astronomy and mathematics instructor, and has worked at NECC for 18 years. William has never taught the mathematics courses for elementary teachers, but has been involved in hiring adjunct instructors to teach the courses even before he became department chair, and had strong beliefs about the importance of the course and of choosing instructors for the course carefully.

Theme 1: Department autonomy in course design at NECC.

Northeast Community College as a whole is not strongly tied to a single institution; the education courses, however, are closely aligned with the education program at a single local institution. The department chair and instructors acknowledge that most students transfer within the state university system, and not necessarily to the same school. In fact, the college has articulation agreements with multiple institutions within the state. However, the mathematics course for elementary teachers is part of a jointly registered transfer program for education students with a local state university (Valerie 1.9).

Instructors of the math course had no personal ties with the local university as none of them had attended the transfer institution in question, nor had any significant contact with the institution. However, the transfer institution dictated the structure and curriculum for the course. Both the full-time (Rachel and Suzanne) and part-time instructors (Tracy and Valerie) stated that they had no choice over the curriculum. In fact early on, both Rachel and Suzanne expressed doubt that Northeast Community College would be of interest to my study because the material covered by the course was entirely dictated by the transfer institution and they had "limited control" over the content (email communication, June/Aug 2009). The transfer institution chose the textbook, *Mathematics for Elementary Teachers: A Contemporary Approach* (Musser, Burger, & Peterson, 2008), which is used for a sequence of two courses, and the topics that are to be covered in both courses. "They give us a syllabus, they give us, you know, what topics out of the textbook they want covered," said Valerie. "I have some room [to make adjustments] amongst the syllabus. But not too much, or then they won't accept the course. It won't transfer" (Valerie, 1.10). Suzanne expressed her frustration at trying to contact university faculty about the course:

> We have never had any say. I've reached out to [the university] faculty several times to try to find out how it is they've determined to use this textbook for the last 15 years and if there's a reason that they chose it initially and is it still just as valid that they keep this when the editions are changing so frequently, just to get a better sense of how it was chosen to begin with. But I really haven't been able to get any feedback on it. (Suzanne 1.18)

The assignment of a textbook and their lack of choice surrounding that assignment seems to have led to a sense of resignation. Responses about the quality of the textbook ranged from adamant dislike to simple acceptance:

> I don't like it at all. But I don't have a choice. (Valerie 1.8)
>
> I was just told this is the book we're using so I just accepted it (Tracy 1.10)
>
> It's hard for me to say [if I like the textbook] because it's the only one I've ever taught out of for math for elementary education teachers, and I've never had a reason [to form an opinion] where I know I don't have a say. (Suzanne 1.19)

The relationship of the course as part of a carefully articulated transfer program to a different institution, as well as the lack of communication between instructors of the course at both institutions, appeared to create a sense of little autonomy among the instructors at NECC. “Our course basically comes from [the university], so it isn’t really ‘ours’” said Rachel (email communication, 8/25/09), and there was little evidence that instructors in the department took responsibility as a whole for the design of the course at their college.

Theme 2: Course consistency and sharing of resources at NECC.

One of the things that stood out most as I analyzed the data on sharing and alignment from Northeast Community College was the lack of discussion in the interviews about interactions among faculty members. There were only two instances in which instructors spoke of interacting, from Tracy, a part-time faculty who had only taught the course for two semesters, and from Suzanne who spoke about collaborating with the other full-time instructor, Rachel.

> When I was hired first to [teach the course] I got a sheet of paper, a single sheet of paper, that just basically said cover these chapters and these topics in the chapter. That’s it. That’s the extent of syllabus that I got. So I just winged it. I did ask Rachel for copies of tests and quizzes that she gave, mostly because I had really no idea what the skill level of the students was going to be. So I didn’t want to make assignments and exams beyond their skills. But I didn’t want to make it insultingly easy either. But seeing her exams I got a feel for what they are capable of. (Tracy 1.21-22)

In the absence of mentorship, Rachel was required to seek out resources on her own initiative as needed. But what she sought out were copies of tests and quizzes, not lesson plans or assignments, and her purpose was to gauge the mathematical level of her students. This suggests that Rachel as a new instructor relied primarily on her own experiences and resources to design her instruction, and that this was largely because there were no overt attempts by the department or other faculty members to provide additional support.

Suzanne said,

> There's one other full time faculty that is teaching it [Rachel]. Initially I was the only one. And so she and I have spoken on numerous occasions about, you know, what are you covering, how are you doing it, [whether] she's got new ideas, or if I've tried something. We worked on the assessment for the course together, you know, what were fair questions, how do we pose it, what would we expect the answers to include, etc. So she and I initially the first couple years talked frequently, for myself as well because when you're the only full time faculty person teaching it then you don't feel as though you have an opportunity to bounce your ideas off anybody or find out what's working for somebody else. So it's been wonderful since we've had another full time faculty teaching it. It really, you know, I think it just adds. (Suzanne 1.39-40)

It's interesting to note that although Suzanne speaks of interacting with Rachel frequently around many aspects of the course, about halfway through her description she adds that these interactions occurred during the first couple years. Even more interesting is that she only spoke of interacting with Rachel. The composition of faculty members who teach the course at NECC is noteworthy for the fact that Valerie, a part-time instructor, has been teaching the course far longer than either of the full time instructors. And yet Suzanne appeared not to collaborate with Valerie, and even mentioned the advantage of having a second full time instructor because before Rachel began teaching the course she had no one to bounce ideas off. Valerie in turn expressed frustration at being "low on the totem pole" in decision making because of her status as part time faculty (Valerie 1.17). This is in keeping with Tracy's experience, above, of receiving little more than a sheet of paper with a list of topics to be taught.

This does not mean, of course, that instructors are not making efforts to create a quality course that will help their students learn the mathematics and learn it well. Almost all of the instructors spoke of creating their own supplementary materials (this will be described in more detail in the following section). But the resources were highly individualized, not shared, and instructors largely seemed to be doing the work for their class on their own, without significant opportunity to interact with their colleagues who were doing the same work.

Theme 3: Use of textbook and other curricular resources at NECC.

All the instructors at Northeast Community College acknowledge that the content of their course is determined by a textbook that they did not choose themselves. Rachel explained that, while instructors are free to make decisions about how to distribute points and how much time to spend on particular topics, there is a standard course outline that shows what sections are to be covered by all instructors (Rachel 1.11). Valerie explained that the topics are handed down to their department by the transfer institution (Valerie 1.9-10). Both Tracy and Suzanne expressed a sense of acceptance. Suzanne stated that she "learned to work with whatever book you have, and then you supplement as you see that you think there's things that are missing or could be improved on" (Suzanne 1.23), and Tracy "just accepted it as gospel" and "made [her] presentation follow the same outline as the textbook" (Tracy 1.10).

At NECC, then, there is a strong sense that the textbook determines the content to be taught. The textbook is not, however, viewed as a self-contained curricular resource. There is much variation in how the instructors work within the bounds imposed by the textbook, and the extent to which they draw upon other resources.

Instructors spoke with relative indifference about using other textbooks. Rachel stated that she didn't really look at other textbooks because they all seemed more or less the same (Rachel 1.6). Suzanne browsed through textbooks to "look at particular concepts to see if it's presented in a different way" (Suzanne 1.20), but also had little to say about how other textbooks compared to her own "because it's the only one I've ever taught out of and I've never had a reason [to evaluate the textbook] where I know I don't have a say" (Suzanne 1.19). And Valerie very pointedly stated, "I haven't looked enough at other textbooks because I know I don't have a choice in the matter and that would just kind of make me feel really bad" (Valerie 1.18). Still, she did acknowledge: "I have a couple I look through and I've pulled things out of," but added that it was "not anything I would rant and rave about" (Valerie 1.19).

Instructors did draw on other non-textbook resources, however. Rachel sometimes used activities from elementary curricula (Rachel 1.10). Suzanne drew on journal articles, ideas from courses she had taken in Singapore Math, and activity books for elementary students that she had collected (Suzanne 1.32-33). And Valerie, who had taught the class for over twenty years, had collected resources for teaching problem solving, including problem solving books from her experience teaching junior high, SAT prep books, and magazines for mathematics teachers (Valerie 1.18-20, 1.65). Suzanne and Valerie even spoke of supplementing the textbook extensively through visual representations that they each had developed for particular topics, independently of the book's presentation of those topics. Suzanne talked about constructing her own worksheets to give students practice connecting diagram representations to mathematical solutions of problems, and

Valerie spoke of her own experience learning about percent grids, and her subsequent efforts to incorporate them into her own instruction.

> I've created numerous activity sheets trying to help them understand concepts of whether it be multiples or factors or something of that nature, with manipulatives. I have at least fifteen word problem worksheets that I've created to give them an opportunity to practice the concepts in a concrete way where they can show it with a diagram and then they can show it with math and hopefully notice that really they're talking about the same thing. (Suzanne 1.26)

> When I discovered how to use the ten by ten grid to do percents, I really looked into that model and I actually gave workshops on it at math conferences, really a better way to teach percents, and that got added to my course. Because most of the focus [in the book] is to do percents the algebraic method. I'm like, fifth graders can't do algebra so what are you going to do? Never talk about percents until they get to 8^{th} grade? You can't, you know what I mean? Then the other [problem with the algebraic method] is there's three different ways to know how it's set up, which makes really long processes. So, me trying to finally work it out into a method that will always work, based on some common fundamentals of the problem, that's how it's developed. Because I was just unsatisfied. I more I was doing it, and they still weren't getting it. (Valerie 56-58)

In all of these instances of use of other curriculum materials, the instructors are trying to improve upon what is in the textbook, or provide more practice for content is in the textbook. Furthermore, the use of resources is individualized, and specific to particular instructors. They all use resources in their own ways, and make judgments based on their own experiences. Tracy, in fact, never mentioned the use of other curricular resources, even when prompted. "The way that I come up with my lesson plan," she said, "is that I just jot down on paper the general things covered by the textbook and I just yap" (Tracy 1.58). Although she is not drawing on other resources, she is drawing on her own knowledge of the topics, and still follows the general pattern manifested across all four instructors. That is, the instructors read the book and follow it carefully, topic by topic, but make eclectic use of their own knowledge and resources to elaborate and improve as they see fit.

Theme 4: Instructional practices at NECC.

As at West Coast Community College, the goal for the mathematics course for elementary teachers that was most consistent across instructors at Northeast Community College was for students to develop a deeper understanding of elementary mathematics. However, each instructor spoke about this goal in a different way. Suzanne talks about her goals for the class in terms of her initial expectations of what the purpose would be; her purpose is similar to purposes that other instructors at other colleges also spoke of. She expects students to already understand how to do the mathematics, but hopes that through the class they will also learn why.

> My expectation has always been that it's expected that they already know how to work with fractions, expected that they understand decimals and percentages and things of that nature, and I try and put it into a perspective perhaps, and take them to a deeper level of understanding [so that] rather than just mimic me, [they can] actually explain and understand what it is that [they're] doing and why it makes sense. (Suzanne 1.12)

However, the fact that she used the term "expectation" alludes to a difference between her ideal and a reality in which many of her students are unwilling to learn mathematics in this way. She spoke of this later in the interview.

> They say they want to be a teacher and yet already they don't like learning. And I'm thinking but you're going into a profession where you say you love learning. You want to learn something every day, you're going to, this is where you're going to live for the next forty years. And yet you're saying but why do I need to learn this. I don't understand! (Suzanne 1.60)

Tracy, on the other hand, described the type of understanding she hoped her students would develop as more "theoretical."

> [The purpose of the course is] to cover the topics, math topics, that are covered in elementary school, but the more theoretical side of it. So that not only will they be

> able to do all the work that their students do, but know more about each topic. (Tracy 1.5)

The mathematics her students need to understand is the mathematics that elementary students do, and then some.

Valerie, who is a part-time instructor but has been teaching the course longer than any other instructor at NECC, focused on the need for students to know everything there is to know about the topics they will be teaching.

> [Students should learn] all the math that they need to know to teach the math that they're currently, that they're going to teach. You know, for instance you know if I'm teaching about fractions that they have to know fractions inside and out, every fact that there is to know about fractions, and every kind of different method for teaching fractions. (Valerie 1.5)

In her description of learning goals for the course, Valerie mentioned not just mathematical knowledge, but teaching methods. Valerie spoke a great deal about connecting mathematics to students' work as future teachers. "Even though they're very specific that this is a math class, not a methods class," she said, "I can't help but overlap the two, use what they would be using to solve the problems in class, the manipulatives" (Valerie 1.26). She was, however, the only instructor who spoke explicitly about addressing teaching in the classroom or modeling good classroom practices.

Instructors at NECC (with the exception of Valerie) did not speak of other goals, but spoke only of the mathematical understanding they hoped their students would develop. And the variety reflected in how they spoke of the mathematical understanding suggests that NECC lacks unified course goals.

Similarly, instruction at Northeast Community College did not appear to be consistent across sections. Each instructor had her own way of teaching or structuring the course. Rachel, for instance, developed sets of problems for which students were required to write up solutions (Rachel 1.13), but these problem sets were unique to her class. Other differences can be seen in the other instructors' descriptions of their class sessions. Tracy's class structure is fairly traditional, with review, lecture on a new topic, and practice problems taking up the majority of class time.

> Every day with some topic covered, I usually have pre-printed Power Points on those…. I also make paper copies so the people have an outline of what we're doing for that day…. The class is an hour and a quarter so do a little bit of review. Occasionally that would be followed up by a quiz based on what was done the previous class. Have 30-40 minute lecture and then we would try some homework problems, some practice problems. That's pretty much it. (Tracy 1.33-35)

Suzanne also uses a fairly traditional structure with homework review and introduction of a new topic to the whole class, but during the homework review her students are interacting with each other rather than watching her present problems on the board. And her lectures depend upon students reading ahead of time; students determine to some extent which topics Suzanne will cover in class.

> First ten minutes or so they're working together on the homework questions that they didn't get, … so they're asking other kids in the class trying to explain it to them…. And then I'll interrupt at some point within the ten, fifteen minutes and I'll say, okay, what are the remaining questions that you haven't been able to get answered? And those are the ones I'll work out in detail on the board. And then usually I'll start by doing a review of whatever it was we left off with the previous day,… and then I start on the new material…. I've always asked them to read the section and make their own notes … And with those, whatever they tell me, that's the order I present stuff on the board. And then, by then usually I haven't gotten through all of the material and the class is done… Sometimes they'll come in and I'll have an activity ready. And I'll say, okay, you know, we've talked about this, now I want you to see what you can do with this. So I'd like to say the classes are typical and overall that's generally how I do it, but I can't say that that's what we do every class. (Suzanne 1.41-49)

Valerie is very focused on introducing teaching methods. She speaks of the activities she does in her class as "breaking up instruction," as her class is an evening class and three hours long, and hands-on activities and group problem solving are more central to her classes than with any of the other instructors.

> [I] go over homework, for as much time as they need to, with any questions they have on the homework assignment. Start a new lesson and then with the new lesson, you know, might be a hands-on activity, there might be group problem solving, we do a lot of group work, and then you know, that's kind of, the classes are, because I teach at night so it's once a week for three hours. So we do break a lot up with a lot of kind of changing up the type of activity. Because I want them to get used to using the manipulatives that they would be teaching with…. In breaking up the activity we end up doing a lot of hands-on methods stuff that you would see maybe in a teaching math course that's part of the education department. (Valerie 1.23-26)

In spite of the variety that exists across the instructors, data compiled from the questionnaires shows that there are also patterns within the department. The most noticeable pattern is that the ratio of teacher-centered to student-centered instruction is quite high (Table 4.7). At 3.32, students spend less than a third of their class time on average engaged in student-directed mathematical work. Valerie's ratio, 1.46, was far lower than the ratios of the other three instructors, who all had ratios at or near 4. This seems consistent with Valerie's description of her class time.

Table 4.7 Teacher-Centered Instruction and Student-Centered Instruction at NECC

Respondent	Minutes Spent on Teacher-Centered Instruction	Minutes Spent on Student-Centered Instruction	Ratio of Teacher-Centered to Student-Centered Instruction
Rachel	60	15	4
Suzanne	50-44	10-15	3.83
Tracy	60	15	4
Valerie	95	65	1.46
Average			**3.32**

This difference between teacher-centered and student-centered activity is also reflected in responses to the questionnaire item about how students spend their class time.

The highest and lowest levels of activity are reported below in Table 4.8. The two activities reported as being most frequent are the two activities that involve listening to the instructor. Practicing computational skills is also ranked highly. The work being done is still potentially conceptually rich. The highest-ranking activities also included explaining reasoning, working on communication and representation, and analyzing similarities and differences among different representations, solutions, and methods. It just appears that students are first exposed to much of this thinking through the instructor, rather than through their own mathematical engagement.

Table 4.8: Student Activity at Northeast Community College

High (>3.0)	
Listen to you explain computational procedures or methods	3.5
Listen to you explain terms, definitions, or mathematical ideas	3.5
Explain the reasoning behind an idea	3.3
Work on mathematical communication and/or representation	3.0
Analyze similarities and differences among several representations, solutions, or methods	3.0
Practice computational skills	3.0
Low (<2.5)	
Make conjectures and explore possible methods to solve a mathematics problem	2.3
Work individually on mathematics problems	2.3
Prove that a solution is valid or that a method works for all similar cases	2.3
Use manipulatives such as base ten blocks or fraction bars	2.0
Work on problems for which there is no immediate method of solution	2.0
Write equations to represent relationships	1.5
Do problems that have more than one correct solution	1.3
Use graphing calculators to solve exercises or problems	1.3
Use computers to solve exercises or problems	1.3
Work on group investigations that extend for several days	1.0

Instructors rated each activity using the following scale: 1 – Never or almost never, 2 – Some lessons, 3 – Most lessons, 4 – Every lesson. Numbers given in this table are the average of the scores across the 5 instructors.

Summary of findings for NECC.

The mathematics course for elementary teachers at NECC is part of a co-articulation program with a local university for education majors. As such, the course itself covers the same topics as the university course and uses the same textbook. There is no collaboration between the university instructors and the community college instructors, and instructors at NECC felt a lack of autonomy over the course. There is also little collaboration between instructors of the course within the community college. Instructors do not share curriculum materials, nor do they make distinct efforts to align students' experiences across different sections of the course.

The textbook is the source of the content to be taught. Instructors did draw upon other resources for their teaching, but each brought her own unique resources and ideas to her own classroom. Instructional goals and methods also varied across the teachers, and lacked departmental consistency. Students in the course at NECC are potentially exposed to rich mathematical ideas, but are exposed to them in a largely teacher-centered instructional environment.

Summary of Findings Across Colleges

In Table 4.9 below I present a brief summary of the findings for each group of instructors, by theme. In Chapter 5, I will discuss patterns across and within groups of instructors at the different colleges around these themes.

Table 4.9: Findings by College and Theme

	Midwest	West Coast	Southern State	Northeast
Department Autonomy in Course Design	Close relationship with single transfer institution. High autonomy in course design.	Primary articulation agreements with state college system. High autonomy in course design and structure.	Common course numbering system aids transfer across state. Course designed by SSCC faculty within bounds of state guidelines.	Joint registration program with local college for education majors. Course textbook and content chosen by transfer institution.
Course Consistency and Sharing of Resources	Extensive sharing of resources and ideas. Highly consistent courses corresponding to deliberate communication among instructors.	High level of sharing of resources and ideas; largely “top down.” Less consistent courses; instructors have freedom to make independent instructional decisions.	Little sharing of resources and ideas. High course consistency based on strong course philosophy and clear course structure.	Little sharing of resources and ideas. Very little effort at course consistency; Instructors free to make independent decisions about instruction and course design.
Use of Textbook and Other Resources	Textbook: Bassarear (4th ed.) Textbook determines order of topics and is a repository for homework problems. A course pack compiled by instructors is the primary curriculum source for the course.	Textbook: Bassarear (3rd ed.) Instructors adhere closely to topics and sequencing of textbook. Instructors create and freely share additional resources to supplement instruction.	Textbook: Bassarear (4th ed.) Textbook and accompanying explorations manual are the primary text and source of instructional material. Instructors do not draw on many additional resources.	Textbook: Musser, Berger, & Peterson (8th ed.) Textbook is chosen by transfer university and comprises content to be taught. Instructors independently draw on a variety of different resources to supplement.
Students’ Classroom Experiences	Instructors share instructional goals of deeper understanding and exposure to ways of teaching. Group work is central to instruction and there is a high level of student-centered activity.	Instructors share instructional goal of deeper understanding, but have individual sub-goals. Instructors use a variety of both teacher-centered and student-centered instructional activities.	Instructors share goals of deeper understanding, and development of positive attitudes, learning habits. Classes are almost entirely student-centered, with group explorations forming the backbone of instruction.	Goals for instruction vary across instructors. Instructional methods vary, and students are exposed to mostly teacher-centered instructional activities.

Chapter Five

Discussion

My research questions at the beginning of the study were as follows:

- How is written curriculum adopted for community college mathematics courses for elementary teachers? and
- What factors influence instructors' decisions in implementing mathematics curriculum for elementary teachers in these courses?

One of my original motivations for this study was an interest in the mathematical opportunities that are afforded students who enroll in courses for elementary teachers at community colleges. An understanding of the adoption and implementation of curriculum materials can help in understanding the learning opportunities that might be available to students in these setting and the factors that affect these learning opportunities. An additional motivation for understanding adoption and implementation of curriculum materials in particular is that, in spite of extensive research on how written curriculum becomes enacted curriculum in K-12 settings, there is little similar research in postsecondary settings, where instructors' role in relation to formal curriculum materials is likely very different from K-12 teachers' roles.

In the previous chapter, I described the groups of instructors at the four colleges in the study with attention to four specific themes. These themes illustrate how the roles of the different groups of instructors around curriculum can be characterized in the mathematics course for elementary teachers within the context of their particular college. In this section, I will discuss both the differences across the four groups of instructors, and the patterns within the groups. I begin by discussing each theme individually, and then discuss differences between each group of instructors across all themes and how these differences might impact the organization of the course and, at a level broader than my initial research questions, students' opportunities to learn mathematics for elementary teaching at each particular college.

Theme 1: Department Autonomy in Course Design

As stated above, this theme grew out of my hypothesis that the autonomy of community college instructors in adopting curriculum and designing their course might be affected by the necessity of ensuring that the course is transferable to four-year institutions. This is not a concern for the four-year institutions themselves because students enrolled in mathematics courses for elementary teachers at these institutions are likely to complete their teacher certification at that particular college or university. In my interviews, I explicitly asked instructors about transferability, and in my analysis I looked both at matters of transferability and at the autonomy of instructors within the department in designing this particular course. Descriptions of each college along this theme are re-summarized below in Table 5.1.

Table 5.1: Summary of Findings for Theme 1: Department Autonomy in Course Design

Midwest Community College	College as a whole maintains a close relationship with a single local transfer institution. Faculty are aware of the university's mathematics curriculum for elementary teachers, but make decisions about their own course independently, and have a strong sense of ownership over their course.
West Coast Community College	There is not a single primary transfer institution, and instructors are largely unconcerned with matters of transfer, which are handled by a central office at the community college. They are aware of broader trends in the mathematical preparation of teachers, and have significant autonomy in designing courses consistent with these trends that will meet the needs of their students.
Southern State Community College	There is not a single primary transfer institution, but the course is part of a common course numbering system intended to facilitate transfer and must meet state requirements relating to content and credit hours. Within this structure, the department has developed their own very specific course design guided by a course philosophy, which has been in place for many years.
Northeast Community College	The course is part of a co-articulation program with a local university meant for education majors. As such, the course itself covers the same topics as the university course and uses the same textbook. There is no collaboration between the university instructors and the community college instructors, and instructors at NECC feel a lack of autonomy over the course.

Looking across the four groups of instructors, I found that the relationship between transfer and autonomy was more complex than I had initially conceived. Each college has a very different relationship with the institutions that their students might attend, and the groups of instructors I interviewed play different roles in the design of the mathematics course for elementary teachers. On the surface, the colleges can be divided into two pairs in regard to their relationship to transfer institutions, particularly with respect to the mathematics course for elementary teachers. This course at both Midwest and Northeast Community Colleges has close ties to a single local transfer institution, and the course at both West Coast and Southern State Community Colleges does not, but is instead intended to transfer into any number of institutions in a statewide higher education system. And yet within these two pairings, there are noticeable differences in instructors' level of autonomy in designing the courses for their particular college. That is, the simplistic categorization of colleges by their relationship with transfer institutions does not account for the amount and type of freedom in course design experienced by each group of instructors.

WCCC and SSCC: Transfer to multiple institutions.

At both West Coast and Southern State Community College, instructors named at least two different universities that students are likely to transfer to, rather than a single local university. Furthermore, at both colleges, although students are more likely to transfer to a nearby institution, articulation agreements are in place for students to transfer their credits for the course for elementary teachers to any one of a number of universities in a statewide system. Neither group of instructors was overly concerned with transfer because it has essentially already been taken care of, either by a central office (at WCCC) or by a common course numbering system that guarantees statewide transfer (at SSCC).

Without a strong connection to a single institution, and with transfer ensured by structures already in place, the groups of instructors at both colleges are reasonably autonomous in designing their course. Textbooks are chosen independently by the department, and interested instructors in the mathematics department at SSCC have developed a particular course philosophy and teaching method within their own institution. However, there were some subtle differences in the freedom that the individual instructors at the colleges actually have to design mathematics courses for future elementary teachers. At WCCC, the full time instructors recently made a significant change in the structure of their sequence of courses, splitting two courses into three and offering more credit hours. Though the change may have been made in response to external factors (trends at other institutions, and the content students needed to know in order to pass the statewide teacher certification exam), it was not forced or constrained by these external factors. The full time instructors who oversee the course responded to external factors in order to better meet the needs of their students, even in the face of some level of opposition from other faculty members.

At SSCC, however, while instructors as a group have had freedom to develop a course philosophy and teaching method suitable to their purposes, a structural change similar to that undertaken at WCCC would be impossible. The statewide system creates consistency across the state at the expense of imposing restrictions. In order to guarantee transferability, the course for elementary teachers is required to match the course descriptions that are used across the state, and to be composed to two distinct 3-credit courses, meeting for 3 hours per week during a standard semester. Changing the number of credits offered, the number of courses, the mathematical topics taught in either course, or the number of hours students spend in class could only be accomplished at a state level, not an institutional level.

MWCC and NECC: Transfer to a single institution.

At both Midwest and Northeast Community Colleges, most students enrolled in the mathematics course for elementary teachers are expected to transfer their credits to a single local transfer institution. In both cases, this relationship with the transfer institution affects the design of the course at the community college, but in noticeably different ways.

The nature of each college's relationship with the transfer institution with respect to this course, however, is also dramatically different at both colleges. At Northeast Community College, the institutional ties that the course for elementary teachers has to the local university are through a program specifically designed for education majors, in which students are jointly registered at both institutions in order to ease transfer for those students who wish to begin their education at the community college. The joint registration means that the course at NECC must be directly comparable to the course at the local university. The university maintains full control over the course, and the required textbook and list of topics to be covered are handed down to instructors at the college. There is, however, little communication between the instructors who teach the course at NECC and the instructors who design and teach the course at the university. It is not evident that instructors at either institution make great efforts to communicate with each other about the course. As a result, instructors at NECC did not speak with a sense of ownership or control over the course in their interviews.

At Midwest Community College, on the other hand, the institutional ties that the mathematics course for elementary teachers has to the local university exist because most students will transfer to that university. There is no joint registration in place. There is also much more awareness among instructors at MWCC about what occurs in classrooms at the local university. In fact, all of the instructors themselves have graduated from the local university, and several of the instructors have taught the university course as adjuncts or graduate students. The instructors feel a desire to make the course comparable to what students would experience were they to take it at the university, but also have a great sense of autonomy in designing the course for the particular needs of their students. The instructors have drawn on ideas from their experience or the experience of their colleagues of teaching the university course, but have also, as a collective, independently made decisions about curriculum and course design that deviate from the curriculum and course design of the university course. In the interviews instructors at MWCC, unlike instructors at NECC, exhibited a great sense of ownership over the course they have designed and implemented.

Theme 2: Course Consistency and Sharing of Resources

Consistency across mathematics courses for teachers within the same department, and the extent to which resources are shared among instructors within the department, are both related to the question of what factors affect implementation of curriculum. More particularly, this theme addresses how standardized curriculum use operates across the department, and how the way resources and information are shared might affect this level of standardization. I present again a summary of the findings for the groups of instructors at each of the colleges in Table 5.2 below.

Table 5.2: Summary of Findings for Theme 2: Course Consistency and Sharing of Resources

Midwest Community College	Instructors work together closely in designing the course. They share resources and ideas, and actively strive for consistency across sections. Instructors make decisions in consultation with other instructors of the same course.
West Coast Community College	Instructors share resources and ideas, though most of the sharing is “top-down” in that more experienced instructors share materials with less experienced instructors. Instructors themselves have a great deal of freedom within their own class to make adjustments and additions to materials and to modify their instruction; there is an expectation of consistency across courses because of the shared materials, but also a sense of freedom for the instructor.
Southern State Community College	New instructors are hired for their willingness to adhere to the department’s philosophy for the course, and are mentored into teaching the course during their first semester. Although the basic structure and philosophy of the course is highly consistent across sections, there is little structured collaboration among instructors who have been teaching the course for some time.
Northeast Community College	There is little collaboration between instructors of the course within the community college. Instructors do not share curriculum materials, nor do they make distinct efforts to align students’ experiences across different sections of the course.

It might be expected that the more instructors interact with each other and share resources and information, the more consistent the courses will be from one section to another, but once again I found that this was not necessarily the case, and that the relationship between course consistency and sharing of resources is more complex than the aforementioned simplistic expectation. Although Midwest Community College (where there were high levels of both course consistency and communication between instructors) and Northeast Community College (where there were low levels of both course consistency and communication between instructors) seem to follow the expected pattern, both West Coast Community College and Southern State Community College do not. Below I will explain this difference, and discuss possible reasons for the difference.

First, Midwest Community College seem to follow the expected pattern in that instructors interact a great deal with each other around the mathematics courses for elementary teachers that they teach, and make great efforts to align their courses across sections. In fact, instructors at MWCC make a more explicit effort to align their courses than at any other college. They spoke of meeting frequently with other instructors, of trying out changes and reporting the results to other instructors in order to see if they wished to adopt the changes in all sections, and of doing things the same way across sections on a daily basis. Inseparable from this conscious alignment of their courses is a culture of sharing, in which resources and ideas are freely exchanged. Even instructors who no longer teach two simultaneous sections of the same course (e.g., Beth and Francine) nevertheless still discuss the course with each other when one is teaching, and collaborate around particular tasks, such as student assessment.

At Northeast Community College, on the other hand, there is very little communication between instructors about the course they are teaching, and no evidence that instructors attempt to align their instruction with other courses within the department. That the curriculum at NECC is handed down from another institution is relevant to the lack of communication and alignment. If instructors perceive that they have little collective control over the curriculum, then it seems there is little that they would actually feel the need to communicate about. Of course, this would only be the perception of the instructors. My findings show that in reality instructors are not restricted by the curriculum to particular goals or teaching styles (I will discuss this more under Theme 4) and there are many resources and ideas that they could share. But instead, instructors for the most part work independently with the written curriculum that has been given to them by the local university.

Southern State Community College is an interesting contrast to both NECC and MWCC. As at NECC, instructors at SSCC communicate little with each other about the course that they teach. However, as at MWCC, there is a high degree of course consistency. The mathematics department has a shared vision of the goals of the course and how the course should be taught, and instructors uniformly adopt that vision. In fact, instructors are hired partly for their willingness to teach using the student-directed method that the department has instituted in this course. Communication is not completely absent. In fact, new instructors are given a course mentor who will share materials and help the instructor as they begin. But after the mentorship period, instructors seem largely on their own.

The common course philosophy may help to explain both why there is so little communication, and how SSCC maintains such a high degree of course consistency in spite of lacking the same culture of communication that exists at MWCC. The goals of the course and the method of teaching are very clearly laid out, and have remained consistent for many years. Once an instructor has expressed a desire to teach the course using this teaching method, and has been successfully mentored into the course, there is no explicit reason for instructors to collaborate around new ideas or resources.

In addition, close communication may be more difficult at SSCC, the only multi-campus college in the sample. With instructors teaching at one of several different campuses, and with a large group of part-time instructors, natural opportunities for communication are reduced. At MWCC, in contrast, instructors of the mathematics course for elementary school are part of a smaller group of faculty members, teach in the same classroom, and have offices in close proximity to one another (recall that Beth and Francine even share an office space). Although instructors at MWCC make an effort to meet and discuss the course outside of their normal routine, there would also be far more opportunities for discussion in the course of their normal routine.

Finally, West Coast Community College is different from the previous three colleges in that there is a great deal of sharing of resources and ideas, but without the strong course consistency that exists at both MWCC and SSCC. This does not mean that there is no course consistency. In fact, as at SSCC, new instructors at WCCC are mentored into the course by being given not just extensive materials, but also the opportunity to sit in and observe a more experienced teacher during their first semester of teaching. Instructors extensively share materials and information with each other, but particularly with new instructors. In fact, this "top-down" sharing was most evident in WCCC. Irene had mentored Jennifer, and Jennifer had mentored Henry, and Henry in turn is now mentoring part-time faculty who come into the course, but there is less sharing evident in the other direction. This may partly explain the lack of alignment. In the absence of a very structured teaching method and course philosophy as at SSCC, each instructor once he or she has been mentored into the course brings in his or her own ideas and innovations and makes changes that might deviate from the mentor instructor's course.

The difference in sharing and awareness of what other instructors are doing at WCCC in comparison to SSCC may also be partly a matter of size. At WCCC there are only three regular time instructors who teach mathematics for elementary teachers, whereas at SSCC there are at least seven (part-time instructors of the course at WCCC may teach for one or two semesters, but at SSCC the investment made in mentoring in part-time teachers means that teaching the course is generally a long-term commitment). Having fewer people to share information with, and a single campus, may make sharing of information easier.

Theme 3: Use of Textbook and Other Resources

My interest in the adoption and implementation of curriculum is not restricted to the textbook alone, but includes other curricular resources. I was interested in knowing both the role of the official textbook in instruction, and the role of other curriculum materials. In this section I speak less about the adoption of a curriculum than about how curriculum *materials*, either those that are formally adopted or those that instructors draw upon informally, are actually used in instruction. This section, therefore, speaks to the question of how curriculum is implemented. However, because each college has adopted an official textbook, the nature of the role of the textbook in instruction speaks also to the nature of the adopted curriculum in this course. A summary of the findings across colleges around this theme is presented below in Table 5.3.

Table 5.3: Summary of Findings for Theme 3: Use of Textbook and Other Resources

Midwest Community College	Students are required to purchase a textbook, but the textbook serves largely as an outline for sequencing the material to be taught and a repository of homework questions. For instruction, instructors rely far more on instructional materials that they have collected and modified over the course of many semesters from a variety of sources.
West Coast Community College	Students are required to purchase a textbook, and instructors adhere closely to the topics and sequencing of the textbook. However, instructors also use and create additional resources to supplement their instruction, and freely share these resources with new instructors.
Southern State Community College	Students are required to purchase both a textbook and an accompanying explorations manual. The textbook and manual are the primary curricular resources for the course, and are largely self-contained. They was chosen because they fit the department's philosophy for the course for elementary teachers, and are the source not just of homework problems and general content, but of all in-class activities that the students engage in. Instructors do not feel the need to draw on many additional resources.
Northeast Community College	The textbook used is the textbook required by the university course, and is the source of the content to be taught. Most instructors do draw upon other resources for their teaching, but each brings her own unique resources and ideas to her own classroom.

As might be expected, the more central the role of the official textbook in instruction, the less central the roles of other curricular resources. The relative centrality of the textbook and other curricular resources ranged from Southern State Community College, where the textbook is almost the sole resource and guides all instruction, to Midwest Community College where instructors rely largely on the curricular materials they have collected, modified, and created as a department. However, the use of the textbook and other resources is characterized differently across colleges, particularly in relation to how and why additional resources are (or are not) used, and speaks to influences on the role of formal curriculum materials in these courses.

In three of the four groups of instructors in the sample, the textbook helps to guide content, but is not the sole resource for instruction. Instructors at Midwest, West Coast, and Northeast Community Colleges supplement their instruction and students' in-class experiences with a variety of resources, including other textbooks, elementary school-level activity books, explorations shared at teaching conferences, and so on. At the extreme, instructors at MWCC use the textbook mainly as a guide for ordering content and a repository of homework problems. The instructors feel that their textbook is very readable and a good resource for students, but their actual instruction consists of lesson plans and course materials that they have collected, modified, and created themselves from a variety of sources—so many sources that in some cases they no longer know where a particular activity or worksheet originated. The high level of communication about the course that occurs at MWCC means that the supplemental materials are constantly being changed and refined according to instructors' classroom experiences.

At West Coast and Northeast Community Colleges, the relationship of instructors to curriculum materials is similar, though not as centered around additional resources. Instructors seem to adhere more closely to the content of the textbook, but nevertheless supplement instruction with outside resources. Interestingly, NECC is the only school where instructors spoke of supplementing as making up for deficiencies in the textbook. NECC is also the only school where instructors within the department did not choose the textbook themselves. Supplementing, therefore, plays a different role at NECC than at MWCC or WCCC. At MWCC and WCCC, supplementing is part of an ongoing process to improve instruction as instructors respond to their experiences in the classroom. But at NECC, supplementing is also a way to work within restrictions that they themselves did not create. Although the instructors expressed a feeling of lack of control over curriculum, the variety of ways that instructors drew upon different curricular resources in their individual classrooms suggests that they perhaps had more curricular flexibility than they recognized, through informal rather than formal materials.

Southern State Community College is the only college of the four in the sample for which the formal curriculum actually plays a central role in guiding content and instruction for the mathematics course for elementary teachers. As described in the previous chapter, use of additional curricular resources at SSCC is scarce, and the textbook (Bassarear, 2007) is almost the sole resource for what students are expected to do and learn within the class. Instructors uniformly spoke in their interviews of being quite satisfied with the textbook, and the teaching method puts heavy reliance on the text and the accompanying activities manual. In class, instructors assign explorations from the manual and students spend the majority of class time working on these explorations. Students are expected to learn what is not covered in class from the textbook, and complete homework problems assigned out of the textbook.

The textbook was originally adopted because it fit well with a student-centered teaching approach that was already in place, and the fact that the textbook is so largely self-contained a resource compared to the other three colleges may be related to this approach. Because students are expected to be independent learners of the mathematics, a textbook that is perceived by instructors as nearly complete as possible is a desirable resource for instructors and course leaders. If the text exposition, problems, and activities are sufficient, the instructor need only direct students to the appropriate material within the textbook or explorations manual, and then can devote maximum energy to providing guidance and feedback to the students. There is no need to devote time to supplementing the text with additional activities or lecture material.

Theme 4: Instructional Practices

The theme of instructional practices helps to connect variations in adoption and implementation of curriculum for each of the four groups of instructors to the actual learning opportunities that might be available to students taking the course at that particular college. Although further studies would be necessary to gauge actual gains in student understanding, my analysis nevertheless shows distinct differences in both the goals that instructors have for their students, and the way students experience class time across colleges. A summary of findings around this theme is presented in Table 5.4.

Table 5.4: Summary of Findings for Theme 4: Instructional Practices

Midwest Community College	While the most common goal across instructors for the course is that students learn the whys of elementary level mathematics, instructors also uniformly expressed an interest in their students' future teaching careers. Instructors deliberately use interactive teaching methods they hope their students will take into their own classrooms. Group work is a central part of typical class sessions, and a high proportion of class time is spent on student-centered activity.
West Coast Community College	The shared goal of the course across the department is for students to develop a deep understanding of elementary mathematical knowledge. Individual instructors have their own sub-goals for their students, but none are consistent throughout the department. Instructors use a variety of instructional styles in teaching the course, both teacher-centered and student-centered, including lecture, group-work, whole class discussion, and student presentation.
Southern State Community College	Instructors goals are focused not just on the nature of the content to be learned, but on the development of positive attitudes and learning habits. In-class activities form the backbone of students' experience in the classroom, and the great majority of class time is spent in student work on activities. The activity in the classroom is highly student-centered, with very little teacher-centered activity.
Northeast Community College	Instructional goals and methods vary across the teachers, and lack departmental consistency. Students in the course at are exposed to potentially rich mathematical ideas, but are exposed to them in a largely teacher-centered instructional environment.

The differences across groups of instructors lay along two different dimensions, which I will discuss here. First, the instructors differ according to their goals for student learning. Differences existed both in the unity among instructors at particular colleges around particular goals, and in the overall nature of shared goals for the course for elementary teachers. Second, the groups of instructors differ in the instructors' reported levels of student-centered and teacher-centered instruction in the classroom. While the nature of goals among the different groups of instructors relates to many of the factors discussed above and helps illustrate the differences between how curriculum is adopted and implemented by instructors at each college, the nature of instruction itself is an indicator of potential learning opportunities available to students.

Learning goals.

One learning goal was consistent across all groups of instructors. Instructors hoped that their students would develop a deep understanding of elementary mathematics, and would understand not just how to do the mathematics, but why the procedures worked or made sense. Northeast Community College differed slightly from this common goal across colleges in how they spoke of the goal. Instructors at NECC all hoped students would develop a deeper understanding, but as described in the previous chapter, individual instructors spoke in very different ways about this goal. The differences are consistent with the relative lack of communication between instructors of the course for elementary teachers evident at NECC. While the goal of developing students' understanding of mathematics at a deeper level is common to such courses, and to the textbooks that have been written for the courses, it would seem that instructors at NECC were left to interpret the meaning of this goal in their own classroom. There is not a unified, single departmental interpretation, as there appears to be at the other colleges.

At the other three colleges, however, the goal of helping students develop deeper understanding of elementary-level topics in mathematics is more consistent, and differences lie primarily in the additional goals that instructors expressed. At West Coast Community College, instructors expressed a variety of goals, ranging from developing student confidence to increasing problem solving ability, but none of these with notable consistency across instructors. The instructors had strong and enthusiastic opinions about the skills students should be learning in their class, but these opinions did not necessarily reflect a consensus across the entire group of instructors.

At Midwest and Southern State Community Colleges, however, instructors shared goals in addition to the goal of developing students' understanding. At MWCC, instructors were concerned with students' connections between what they were learning and experience in class to their careers as future teachers. Although like many of the instructors across colleges they emphasized that their course was a content, not methods, course, they also spoke about explicitly exposing students to teaching methods they hoped students would carry into their own classrooms, developing habits of professionalism in their students, and discussing children's ways of thinking, more so than at any other college. Similarly, SSCC instructors also had an additional shared goal. Instructors at SSCC consistently spoke of how the nature of their course would help develop particular habits and attitudes in their students, although their concern was less with teaching practices than with learning practices. They hoped that their students would come away with the ability to be independent learners of mathematics.

The level of consensus around desired course outcomes is consistent with the levels of course consistency discussed above for all four of the groups of instructors, not just NECC. At WCCC, instructors' have some common sense of purpose, but also exhibit freedom to develop their own individual goals and purposes, much as they have freedom to modify their instruction according to their own beliefs and experiences. At MWCC, instructors' purposes of exposing students to good teaching practices reflect a unity in their own instructional practices that has grown out of close collaboration, in which they have likely had ample opportunity to discuss their purposes and how to implement those purposes in instruction. And at SSCC, instructors' goals of developing students into independent doers of mathematics is consistent with the department-wide course philosophy to which instructors of the course for elementary teachers are expected to adhere, and which promotes independent student learning by its very nature.

Nature of instruction.

The differences between the levels of student-centered instruction and teacher-centered instruction in the mathematics courses for elementary teachers among the groups of instructors were apparent in both the types of classroom activities reported and the reported percentages of class time spent on teacher-centered and student-centered instruction. Here I reproduce and combine the table of ratios of teacher-centered instruction to student-centered instruction from Chapter 4 for reference in the discussion.

Table 5.5: Reported Minutes Spent on Teacher-Centered and Student-Centered Instruction, and Ratio of Teacher-Centered Instruction to Student-Centered Instruction

College	Respondent	Minutes Spent on Teacher-Centered Instruction	Minutes Spent on Student-Centered Instruction	Ratio of Teacher-Centered to Student-Centered Instruction
Midwest	Beth	10	100	0.1[9]
	Christine	60	40	1.5
	Dana	50	40	1.25
	Ellen	40	30	1.33
	Francine	30-45	65-80	0.63
	Average			**0.96**
West Coast	Henry	80	35	2.29
	Irene	80	40	2
	Jennifer	40	40	1
	Average			**1.76**
Southern State	Lisa	20	50	0.4
	Monica	20	50	0.4
	Nina	20-25	45	0.5
	Olivia	20	50	0.4
	Patricia	9	62	0.15
	Average			**0.37**
Northeast	Rachel	60	15	4
	Suzanne	50-44	10-15	3.83
	Tracy	60	15	4
	Valerie	95	65	1.46
	Average			**3.32**

On average, instructors in the course at Southern State Community College engage in significantly more student-centered instruction than at any of the other four colleges, with a reported teacher-centered to student-centered ratio of 0.37 and with work in small groups occurring every day, for most of the class period. This is unsurprising, as the teaching method used by instructors across the department involves assigning explorations and minimizing the amount of lecture from the front of the class. Students at

[9] The ratios presented in the table are the minutes spent on teacher-centered instruction divided by the minute spent on student-centered instruction. A ratio of one means that equal amounts of time were spent on teacher-centered and student-centered instruction, while ratios lower and higher than one mean greater amounts of time were spent on student-centered and teacher-centered instruction, respectively.

Midwest Community College, where the instructional method was not as extensively student-centered as at SSCC, also engage in a significant amount of student-centered instruction, with an average ratio of 0.96, though there is more teacher-centered instruction than at SSCC. Interestingly, these two colleges are also the colleges with the most consistency in courses and instructional goals. Additionally, just as SSCC has a unified course philosophy that explicitly promotes student engagement, MWCC has structures in place to support student-centered instruction. Not only is there a high level of communication between instructors, but the college has allowed for a room specifically designated for mathematics courses for elementary teachers containing curriculum materials and manipulatives, and set up so that students are sitting in "pods" of four desks. The physical space may both reflect and enable a student-centered learning environment.

Both West Coast Community College and Northeast Community College have higher levels of teacher-centered instruction, both in the reported ratios and the reported activities. The ratio of teacher-centered to student-centered activity at WCCC is 1.76, although individual instructors' ratios varied from 1 (Jennifer) to 2.29 (Henry), and this variation may be related to the relative freedom instructors have for designing and modifying the course after being mentored into the general structure of the course.

Just as SSCC's ratio of 0.39 stood out as being particularly low in relation to the other colleges, NECC's ratio of 3.32 stands out as being particularly high, nearly twice as high as the next highest ratio at WCCC. Among the high ratios of the other three instructors, Valerie's relatively low ratio (1.46) stands out as unique. Recall that Valerie, more than the other three instructors, emphasized exposing her students to student thinking and to teaching methods. Valerie, though a part-time instructor, has taught the course for longer than any of the current instructors, and also teaches the course during a three hour evening block, rather than the much shorter 75 minute daytime blocks in which other instructors teach. If there is pressure from the transfer university that dictates the curriculum to get through a specified amount of material, shorter class sessions may inhibit opportunities to let students work independently. Still, this cannot be the sole factor as class sessions at SSCC are also only 75 minutes long.

One interesting thing to note about the amount of teacher-centered instruction at NECC is that in their descriptions of typical class sessions reported in the previous chapter, instructors show a great deal of variety in how they teach the class. Even in spite of this variety, students at NECC are still experiencing more teacher-centered instruction than at any other of the schools in the sample. The lack of communication about the course between instructors, and the lack of freedom in choosing the text and topics taught may make student-centered instruction more difficult to implement, particularly since instructors have little opportunity to observe classrooms that might be more student-centered than they themselves conceive (e.g., Valerie's).

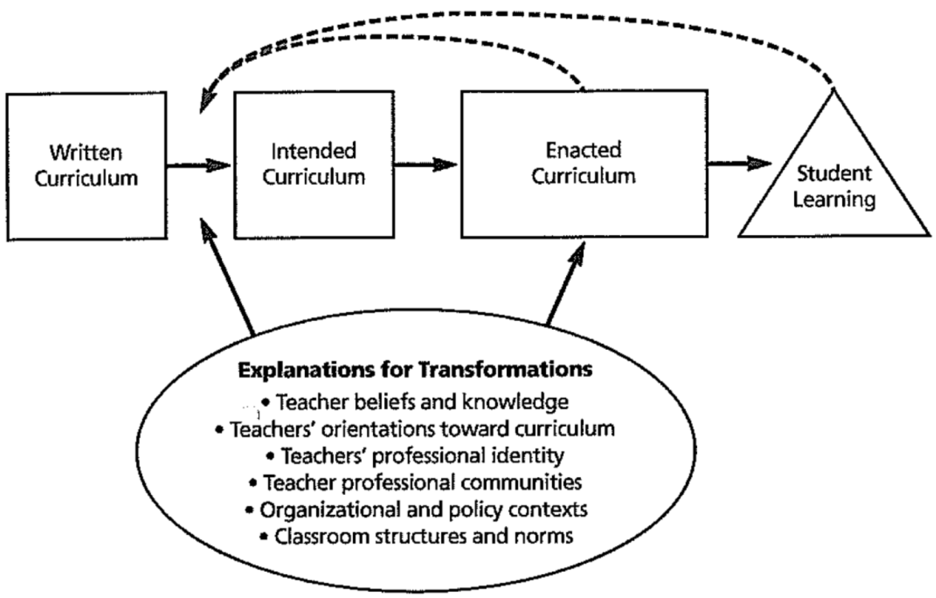
But despite the differences in student activities within the classroom, students across all colleges are nevertheless engaging in nontraditional instructional activities—working with manipulatives, understanding why procedures work, making connections between representations, and so on. Even in the most teacher-centered classrooms in the sample, at NECC, the learning that is taking place in the classroom is different from what takes place in more traditional mathematics learning settings. Instructors almost without exception feel that the mathematics course for elementary teachers is different from other mathematics courses they teach, and their instruction reflects this. In other words, the learning opportunities for students, though they appear to be quite varied across the four colleges, are also different from the learning opportunities they would experience in a more traditional classroom.

Characterizing the Colleges

The final question to address is how the influences identified in the four themes above serve to characterize the roles of instructors within the four different colleges in relation to curriculum choice and use, and thereby potentially impact the nature of learning opportunities that students at each of the colleges experience. I begin by referring once more to the two models of curriculum use that I discussed in Chapter 2.

The first is the model how written curriculum is transformed to student learning used by Stein, Remillard, and Smith (2007) to describe research on mathematics curriculum at the K-12 level. This framework (pictured again in Figure 5.1) suggests a transformation of curriculum from written materials to student learning as the instructor interprets it and enacted within the classroom. It is a cyclical process, with feedback from the enactment and student responses informing new iterations of curriculum use, and other influences affecting each step of the transformation. One of the driving motivations for my particular study was the hypothesis that such factors have differing roles on curriculum at postsecondary levels (and particularly at the community college) and that such factors, in addition to different roles of instructors in curriculum choice, can have an effect on how curriculum is transformed into classroom practice and student learning. In this final section of the chapter, I will describe how the factors presented in the themes above fit within, and in most cases extend beyond, the written-to-enacted model presented by Stein, Remillard, and Smith for K-12 classrooms. Individual instructors still engage in the transformation of written curriculum to student learning that are described in the model, but the way that this process is situated in a larger context impacts how these transformations take place.

Figure 5.1: Transformation of Written Curriculum (Source: Stein, Remillard, & Smith, 2007, p. 322)



The second is Remillard's (1999) framework of how teachers engage in curriculum development. Remillard suggested that teachers make curricular decisions in three arenas. In the *design* arena, teachers select and design tasks for students. In the *construction* arena, teachers enact the tasks and respond to students' encounters with them. And in the *mapping* arena, teachers make choices that determine the content and organization of the curriculum. My original hypothesis was that at the community college level, particularly for a small, specialized course such as mathematics for elementary teachers, it would be useful to extend this framework to include two levels, that *design*, *construction*, and *mapping* decisions would be made at both the level of implementation of curriculum (for which Remillard's framework was originally intended), but also at the broader level of curriculum adoption. This is because instructors are more likely to be involved in broader curricular decision-making. However, in my analysis I found it difficult to completely separate decisions made at each of the levels as I did in my initial re-working of Remillard's framework (Figure 5.2).

Figure 5.2: Arenas of Decision-Making in Choosing and Using Curriculum (adapted from Remillard, 1999)

	DESIGN ARENA (Resources)	CONSTRUCTION ARENA (Enactment)	MAPPING ARENA (Goals)
Level 1: Curriculum Adoption	Instructors determine the textbook and other curriculum materials to be used in the course.	Instructors decide how the class will be structured, how students will be evaluated, etc.	Instructors determine the knowledge, skills, and dispositions that students should learn.
Level 2: Curriculum Use	Instructors select/design specific activities, examples, tasks, etc. to use to present a topic.	Instructors respond to students' encounters with the activities, examples, tasks, etc.	Instructors map specific topics to the broader goals of the course.

Rather than broadening the framework to include decision-making at the level of curriculum adoption, as I did initially, a more useful means of broadening the framework for the purpose of discussion is to consider design, construction, and mapping decisions as not solely the domain of individual instructors, but as decisions that can also be made or strongly influenced at departmental or institutional levels. That is, while an instructor might make choices about how to teach a particular topic on a given day (the design arena), the choices an instructor perceives as available and the decisions that instructor makes relative to implementing those choices would be very different in a department where individual autonomy is highly valued (such as WCCC) than in a department where course cohesiveness is highly valued (such as SSCC). In this final section of the chapter, therefore, in addition to showing how the model of curriculum transformation fits into a larger context for each individual college, I will also talk about how this context shapes where key decisions are made, not necessarily at the individual level only, in the design, construction, and mapping arenas for each individual college.

Northeast Community College.

Northeast Community College is unique in the sample in that instructors within the department do not have the freedom to choose or design their own formal written curriculum. In this sense, NECC was probably most similar in structure, at least around curriculum, to what one might expect to find in a K-12 setting in that instructors are assigned a textbook and topics by an outside source (the school, district, and state in the case of a K-12 school, and the transfer institution in the case of NECC). According to the Stein, et al., framework, instructors then create intentions for how the curriculum will be implemented in their classroom, and enact those intentions. How their intentions are defined and enacted is influenced by a variety of factors, which may be unique to the school, or to the instructor.

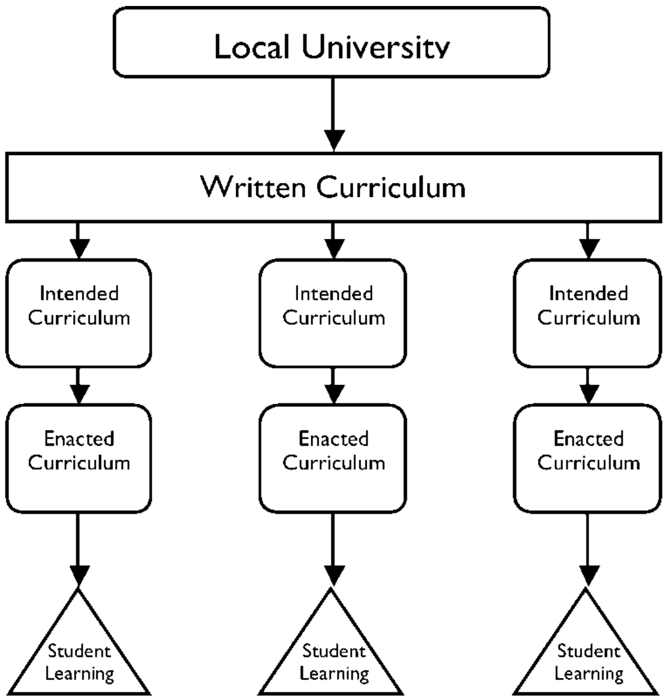
This model seems adequate for describing curriculum use at NECC, and helps to interpret the lack of communication between instructors and the variation in goals and teaching methods. Without a structure in place to help different instructors communicate about the intended or enacted curriculum with each other, or with the transfer institution that dictates the curriculum, the transformation of curriculum from written to enacted occurs primarily at the level of the individual instructor.

Research at the K-12 level has shown that the process of transformation is not a straightforward one (illustrating this is, in fact, is the intent of Stein, et al.'s framework), and so the variation between instructors is not surprising. When I was in the process of recruiting NECC instructors for participation, both full-time instructors (Rachel and Suzanne) expressed the opinion that the course would not be of interest to my curriculum-focused study because they did not have a say in the curriculum for the course. "Our course basically comes from [the university]," said Rachel in an email communication, "so it isn't really 'ours.'" This sense of limited control over the curriculum was reflected in all of the interviews as described in the findings. And yet, also as described previously, I found that NECC instructors exhibited the greatest variation across the course in terms of teaching methods, objectives, and materials used. That is, the perceived restrictions on formal written curriculum imposed by the textbook do not translate into similarities among the intended and enacted curricula of each instructor. Students' experiences in the different classrooms are largely dependent on the instructor herself and the influences and experiences she brings to her enactment of the material.

That Rachel identified the course as "not really 'ours'" may be significant as well in helping to explain why there are no structures in place for instructors to communicate about the course. Because the course does not "belong" to them as a department, there may be little motivation to work together within the department. And because there is also no significant outreach between NECC and the transfer institution, there is no concrete location for the ownership of the course, leaving each instructor to make the course "mine" instead of "ours."

The position of individual instructors' transformation of curriculum from written to enacted at NECC is illustrated in Figure 5.2 below. Although instructors share a curriculum, the curriculum is chosen by another institution with no say from NECC, and there is no significant interaction between instructors at NECC around their enactment of the curriculum.

Figure 5.3: Curriculum Use at Northeast Community College

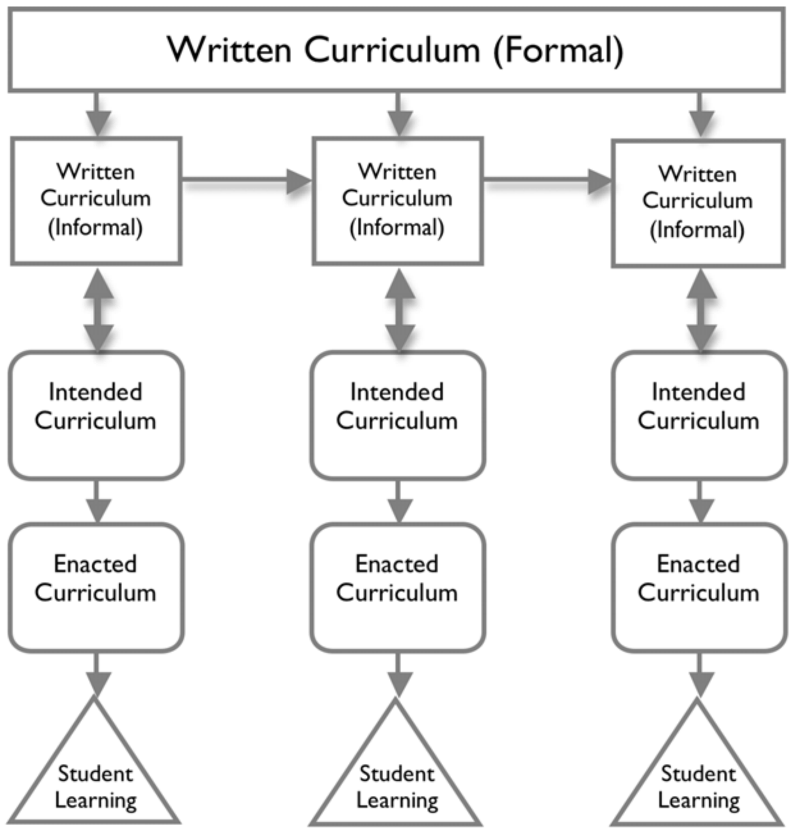


The instructors, therefore, are still the primary decision-makers in the design and construction arenas. In their descriptions of typical class sessions, instructors spoke of a variety of resources and instructional methods, which they sought out and used independently. Decisions about how to implement the curriculum are left to the instructors. Mapping decisions, on the other hand, are largely the domain of the transfer institution. The transfer institution chooses a text that organizes topics into sections and delineates particular relationships between concepts, and the transfer institution also determines which topics should be covered by the course, and how much time should be spent on each topic. Instructors at NECC are bound to these mapping decisions for purposes of transferability, and thus their role in mapping decisions as individuals is minimized.

West Coast Community College.

West Coast Community College differs from Northeast Community College primarily because at WCCC the department has freedom to choose and design their curriculum independently of the transfer institutions, and an awareness of that freedom. Although instructors still have a written curriculum and still individually transform that curriculum to an enacted curriculum, their interaction around course design and textbook choice makes necessary changes to the model (Figure 5.3).

Figure 5.4: Curriculum Use at West Coast Community College



First, instructors have influence over the written curriculum, which itself includes not just the textbook (the formal written curriculum), but activities and explorations that are shared among instructors (the informal written curriculum). The process of enacting curriculum in the classroom can lead not just to changes in an individual instructor's intended curriculum, but in the informal written curricular materials that guide the work of instruction. In the figure, this is illustrated by double-headed arrows from the curriculum transformation process back to the informal curriculum, showing that modifications to the course include modifications to the resources commonly used for the course.

Second, instructors have interaction with one another. At WCCC, these interactions in relation to their impact on curriculum use occur largely within a structure of seniority. Jennifer, when she first began teaching, learned from Irene, and Henry learned from Jennifer. Part-time instructors are mentored into the course by whoever is the course leader (currently, this is Henry), largely through the sharing of curricular resources. This is illustrated by the one-way arrows leading from the informal written curriculum of one instructor to the next. This does not mean there is not communication in the opposite direction. Irene expressed awareness of what Jennifer and Henry are doing, and Jennifer expressed awareness of the choices Henry is making in his instruction. But the data from the interviews suggested that actual curricular changes occur mostly at the level of more experienced instructors and are passed down to less experienced instructors.

At WCCC, course philosophies and classroom practices were less consistent than at either Southern State or Midwest Community Colleges, and part of this may be due to this structure of curriculum being passed down from one instructor to the next, rather than across instructors. Instructors have access to the materials and course design used by more experienced instructors, but also are given freedom to modify the course design to fit their own needs and purposes, without the immediate accountability to other instructors that is built into the culture of sharing that exists at MWCC (which will be addressed below).

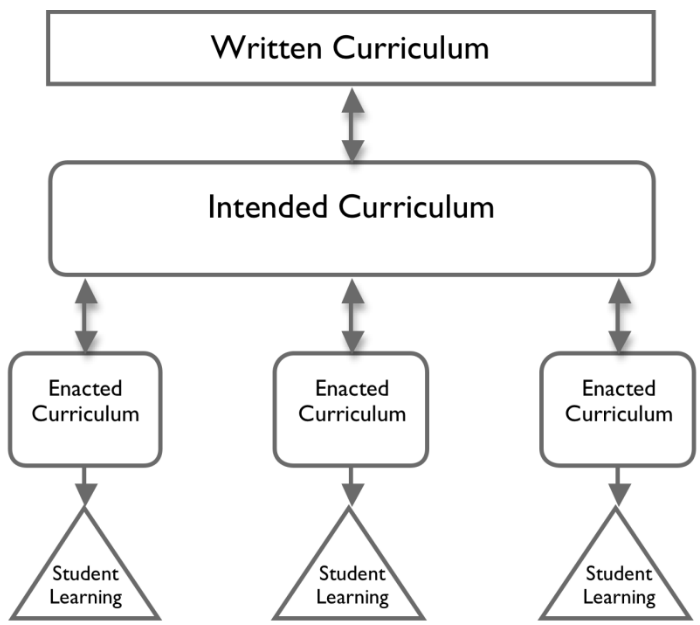
As at NECC, then, decisions in the arenas of *design* and *construction* are still largely the domain of individual instructors. However, as instructors design or modify particular activities, these activities are passed along to new instructors. Therefore individual decisions around designing instruction to implement curriculum are mediated by materials that have been shared among instructors. This is not a deliberate constraint on the choices instructors are able to make in the design arena. Instructors emphasized that new instructors are given resources to help them, but are free to choose what to use and what not to use. Still, when particular resources are made available and when new instructors do not have prior experience teaching the course (which is very different from other mathematics courses the instructor may have taught), it seems likely that the resources would guide the instructional decisions made by the instructor.

Mapping decisions at WCCC are made at the level of the department, rather than by an external voice such as the transfer institution for MWCC. Thus full time instructors are directly involved in decisions about what content to cover, and in what sequence. In the Real Number Systems course (the first in the sequence, which is taught by multiple instructors) these decisions are mediated by the textbook; instructors explicitly stated that they use the textbook to order and guide content. However, the textbook is chosen by the instructors of the course, and so while the textbook might be a guide for content and sequencing on a class-by-class basis, the instructors' initial choice of a textbook was itself a mapping decision in that they chose a textbook that fit with their beliefs about what and how topics should be appropriate covered. In the geometry and statistics courses, each of which is taught by only one instructor, that instructor has even greater freedom in mapping decisions, being accountable only to the course design as initially conceived within the department, of which they themselves were a part.

Midwest Community College.

At Midwest Community College, classroom instruction was both highly consistent and relatively student-centered. Instructors' role in curriculum use was situated in a broader context that differed quite significantly from that at either Northeast Community College or West Coast Community College. Figure 5.4 below illustrates this context.

Figure 5.5: Curriculum Use at Midwest Community College



The main difference between Midwest Community College and any of the other colleges in the sample is the level of communication and collaboration among instructors around the course and its curriculum. Although instructors had freedom to enact the lesson plans and activities of the course as they desired, they communicated deliberately and consistently about the curriculum itself. Furthermore, the formal textbook was not actually the primary curriculum for the class. Rather, the course was designed around a course pack of materials that instructors had put together, and which they revised and modified every summer.

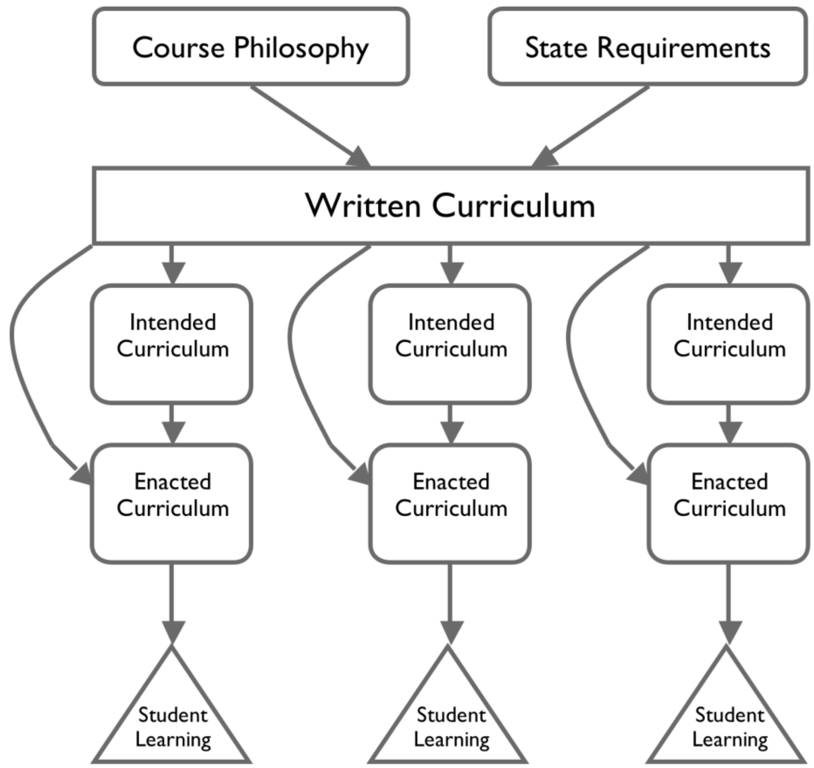
The result of this level of collaboration is both a shared sense of purpose in the course (illustrated in the figure by a common intended curriculum) and a constant interaction between classroom enactment, course purposes, and the nature of curriculum materials (illustrated by the bidirectional arrows), made possible by open communication between instructors of the course. As a result, the course is consistent across sections, but yet flexible to experimentation and change according to new ideas and instructors' experience working with students. Unlike at NECC, the curriculum is not passed down but rather chosen and developed within the college and through faculty interaction, thereby making written curriculum an active part of the transformation process, rather than an input variable at the beginning of the process.

This constant communication between instructors affects curricular decision-making in all arenas. *Design, construction,* and *mapping* decisions are a joint effort between instructors, particularly in the Number Concepts course where teaching responsibilities fall on several instructors rather than just one. As at WCCC, *mapping* decisions are partially constrained by the textbook in this course, which instructors said they used primarily to determine the sequence of topics, but as at WCCC, the textbook was itself chosen by the faculty. *Design* decisions are also made as a group, more so than at any of the other three colleges in the sample, with instructors endeavoring to create class plans that are consistent across instructors and even across semesters. *Construction* decisions are by definition made by instructors as individuals, the "unrehearsed adapting of tasks in order to facilitate students' work with them" (Remillard, 1999, p. 328), and as such they remain the domain of individual instructors even at MWCC. But their impact on other arenas of decision-making, as events that happen during the construction phase of curriculum design influence future planning, are to some extent shared among instructors. Thus curricular decision-making in general at MWCC is concentrated at the level of the department, with instructors who teach the class making decisions about curriculum for the course largely as a collective.

Southern State Community College.

Midwest Community College and Southern State Community College exhibited the greatest degree of course consistency and student-centered teaching of the sample of colleges. And yet the level of communication among instructors at Southern State Community College was drastically different from that at MWCC. The broader structure helps to show how SSCC can achieve a consistent and student-centered learning environment across the courses despite the low level of communication. Figure 5.5 below illustrates the structure around curriculum use that exists at Southern State Community College.

Figure 5.6: Curriculum Use at Southern State Community College



In this model, large curricular decisions are dually influenced by external factors (state requirements for course content and credit hours) and internal factors (the department's self-identified socioconstructivist course philosophy). The written curriculum that has been chosen to fit with both of these factors then exerts a strong influence on instructors' individual processes of curricular decision-making, with a much more direct role on the enacted curriculum. Unlike at Midwest Community College, there is little interplay between different portions of the model outside of what instructors learn and change within their own classrooms in the transformation of curriculum. Although the formal curriculum materials (in this case the textbook and the accompanying activities manual) are chosen within the department and not by outside sources (as at NECC), the curriculum is quite stable and has been in place through several editions of the textbook. Few additional resources are necessary, and so the written curriculum remains relative unchanged within the model.

The major difference between SSCC and any of the other three colleges is the existence of a well-defined course philosophy that not only delineates purposes for the course, but also describes a particular teaching method that is time-intensive but not complex for instructors to implement. The student-centered nature of the method, the sufficiency of the curriculum materials for implementing that method, and the ease of making the method and curriculum comply with state requirements for the course for elementary teachers mean there is little change in the curriculum or its implementation over time, and little need for extensive communication except with new instructors. Hence in the model, instructors' decisions in implementing the curriculum for the purpose of student learning are unconnected except through the common written curriculum.

Whereas the system in place at MWCC results in a course that is flexible to meet changing ideas and needs of students, the system at SSCC results in a course that is unconventional and yet stable over time. In addition, while the curriculum at SSCC is essentially passed down to instructors as at NECC (instead of chosen or modified by instructors as at the other two colleges), there are two crucial differences between the two institutions. First, at SSCC, instructors are chosen because they "buy in" to the course philosophy and curriculum. Instructors essentially choose to teach using the curriculum that is in place. At NECC, on the other hand, there is not a particular course philosophy for instructors to buy into, and instructors who choose to teach the course still sense that they have a lack of choice about the curriculum from which they teach. Second, at SSCC the curriculum, though in a sense imposed, is imposed from within the system. The instructors who originally designed the course were instructors at SSCC, and while they no longer teach at the institution, it is through a chain of subsequent instructors that the course philosophy has been perpetuated. The decision-making ultimately lies within the group of instructors who teach the course. At NECC, the curriculum is imposed from outside the institution, and the instructors who teach the course are not part of the decision making process.

Chapter Six

Conclusion

To discuss the implications of this research study, I return again to my research purposes. The overarching interest that drove the study was the learning opportunities of students enrolled in mathematics courses for elementary teachers at community colleges. While there is an ongoing conversation about the importance of the mathematical preparation of future teachers, particularly elementary teachers, among mathematicians, mathematics educators, and teacher educators, empirical research on the undergraduate mathematics courses that are specifically designed for prospective teachers is sparse. The decentralized nature of higher education in the United States means that it is likely that the mathematical experiences of prospective teachers in different contexts may vary widely, and community colleges, which differ in crucial ways from their four-year counterparts, are particularly underrepresented in what little research does exist on mathematics courses for elementary teachers.

In order to explore the influences on mathematical learning opportunities for prospective teachers in the community college setting, I turned to instructors' curricular decision-making, or how instructors make decisions about what will be taught, choose written curriculum materials, and implement these choices in the classroom. My rationale for doing so was that students' access to mathematical learning in the classroom is largely determined by the curricular decisions made by instructors and other involved persons. My research questions were:

- How is curriculum chosen and designed in community college mathematics courses for elementary teachers?
- What factors influence instructors' decisions in implementing mathematics curriculum for elementary teachers?

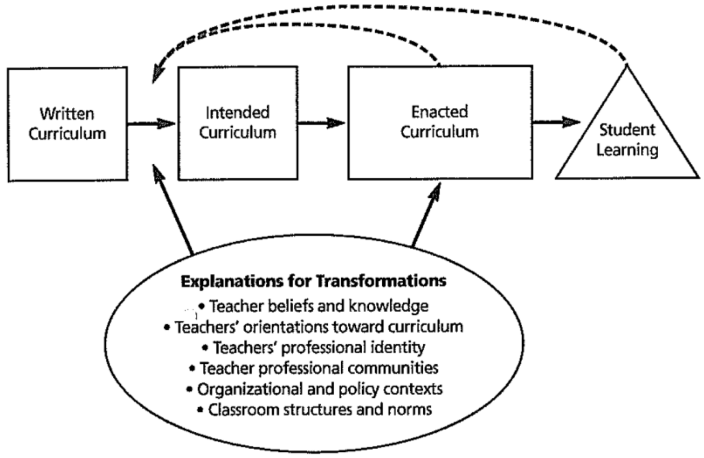
One challenge of this particular study was a conceptualization of curriculum. The context for my study lies at the intersection of several different fields of research, including mathematics education, teacher education, and higher education. The field of mathematics teacher preparation has not typically appropriated explicit discussions of curriculum for future teachers, although recommendations abound for what teachers should learn and how they should learn it (e.g., CBMS, 2001; Williams, 2001; Greenberg & Walsh, 2008). It was therefore necessary to turn to mathematics education and higher education literature for definitions of curriculum and models of curriculum use. However, studies of curriculum in mathematics education are primarily focused on formal written materials (i.e., textbooks) and teachers' interactions with them at the K-12 level, often with an eye toward implementation and reform. Such research is possibly relevant, but not necessarily directly transferable to the very different mathematical purposes and sociocultural contexts of a college-level mathematics course for elementary teachers. Conceptualizations of curriculum in higher education tend to be vastly different from those in K-12 mathematics education, with little attention to written materials and curricular resources, and a much broader emphasis on context and organization (Lattuca & Stark, 2009). Yet my personal experience teaching mathematics for elementary teachers as an adjunct instructor at a community college suggested that written curriculum materials and their use likely play an important role in the mathematical opportunities students experience and therefore merited greater attention than typically warranted in higher education curriculum models.

In this study, therefore, I used models of curriculum use from the K-12 mathematics education literature as a basis for the interviews and analysis, but also chose the sampling method and designed the interviews to be sensitive to broader curricular influences that might exist in a community college, and in a course of this nature. The models of curricular decision-making in the mathematics course for elementary teachers that emerged in the study of four community colleges situated instructors' individual decisions within structures of influences both external and internal to the college and department. I now turn to the curriculum models from prior research that I discussed in the literature review (Chapter Two) and revisit them in light of the findings of this study.

Mathematics Curriculum and the Contextual Influence in Courses for Teachers

I begin with models of curriculum use in K-12 mathematics. In Chapter Two, I presented two models that are representative of the way curriculum is generally studied in K-12 mathematics. First, the model detailed by Stein, Remillard and Smith in their 2007 review of mathematics education literature on curriculum (Figure 6.1) intends to capture the different stages of the process of curriculum enactment, and the influences on and interrelationships among those stages that have been studied by researchers of mathematics curriculum. The strength of this model is that it demonstrates that what students have opportunity to learn is not dependent merely on the formal written curriculum materials that drive instruction (be they textbooks or standards documents), but also on the intermediary processes by which the content and purposes of these materials are transformed in the context of their use.

Figure 6.1: Transformation of Written Curriculum (Stein, Remillard, & Smith, 2007, p. 322)



Second, Remillard's (1999) framework of curricular decision-making specifically identifies three different arenas in which teachers make decisions that influence and transform curriculum: the *design* arena where teachers choose and adapt tasks, the *construction* arena where these tasks are enacted, and the *mapping* arena where decisions situate specific tasks and topics within broader mathematical goals. In both of these frameworks, and in much current research on K-12 mathematics curriculum, the focus is on the decision-making of the individual teacher that transforms given curricular resources into learning opportunities for students.

My assumption in appropriating these frameworks in the context of a community college level mathematics course for elementary teachers was that similar processes would occur in this course. That is, the opportunities students have to learn material in community college mathematics courses for elementary teachers would not be dependent merely upon the written content and intentions for student learning found in the textbooks and course descriptions, but on instructors' decision-making around this content, and on the contexts that affect their decisions. However, I also anticipated important differences between the K-12 setting and the community college setting, as well as between a standard-sequence mathematics course and a mathematics course for elementary teachers, differences that would influence curricular decision-making as captured by these two models. In the case of Stein, Remillard, and Smith's framework, I sought to identify external influences (captured in their model by the *Explanations for Transformations* element) that might be unique to this particular setting. And in the case of Remillard's framework of decision-making, I modified the framework to capture decision-making at the level of curriculum design and choice, not just curriculum implementation, and used this new framework (Figure 6.2) to structure the interviews with instructors.

Figure 6.2: Arenas of Decision-Making in Choosing and Using Curriculum.

	DESIGN ARENA (Resources)	CONSTRUCTION ARENA (Enactment)	MAPPING ARENA (Goals)
Level 1: Curriculum Adoption	Instructors determine the textbook and other curriculum materials to be used in the course.	Instructors decide how the class will be structured, how students will be evaluated, etc.	Instructors determine the knowledge, skills, and dispositions that students should learn.
Level 2: Curriculum Use	Instructors select/design specific activities, examples, tasks, etc. to use to present a topic.	Instructors respond to students' encounters with the activities, examples, tasks, etc.	Instructors map specific topics to the broader goals of the course.

My initial assumption about the role of these two frameworks in the context I was studying and how to extend them for the purpose of fitting them to the context were largely focused at the level of individual instructors' decisions around curriculum. This is in keeping with the focus of the K-12 models. The models of course design and curriculum use that emerged from this study, however, showed that, differently from the K-12 setting, decisions around course design and curriculum use were not just happening at the level of the individual instructor. The models of how curricular decisions occurred at each of the four colleges in this study incorporate external factors (such as state requirements, relationships with other colleges, and collaboration with other instructors), and not just as outside influences impacting course design and curriculum use (as they appear, for example, in the Stein, Remillard and Smith model), but as integral parts of the different ways that decision-making about the course occurred in each of the four colleges.

One of the purposes of the K-12 models of mathematics curriculum presented above is to show that curriculum encompasses more than simply written materials (e.g., textbooks, topics, sequences). It also involves the enactment of written intentions, which includes not just the actual content that reaches students, but the way it reaches them: the teaching methods used, the connections drawn between topics, the mathematical practices experienced, the attitudes towards mathematics that are encouraged. To consider the mathematical learning opportunities available to prospective teachers enrolled in courses at community colleges requires considering not just what they are expected to learn as documented on paper, but how decisions are made about both *what* they should learn and *how* they should learn it. And yet looking at how the instructor alone enacts the curriculum in the classroom ignores important decisions that occur outside the instructor's planning time and classroom interaction with students.

These decision points, which I will discuss in more detail below, are not simply influences on faculty's curricular decision-making in the sense that, for example, teachers' beliefs might be influences. They instead reveal structural differences in the contexts at various colleges that have bearing upon the types of decisions that instructors are able to make, or believe themselves able to make.

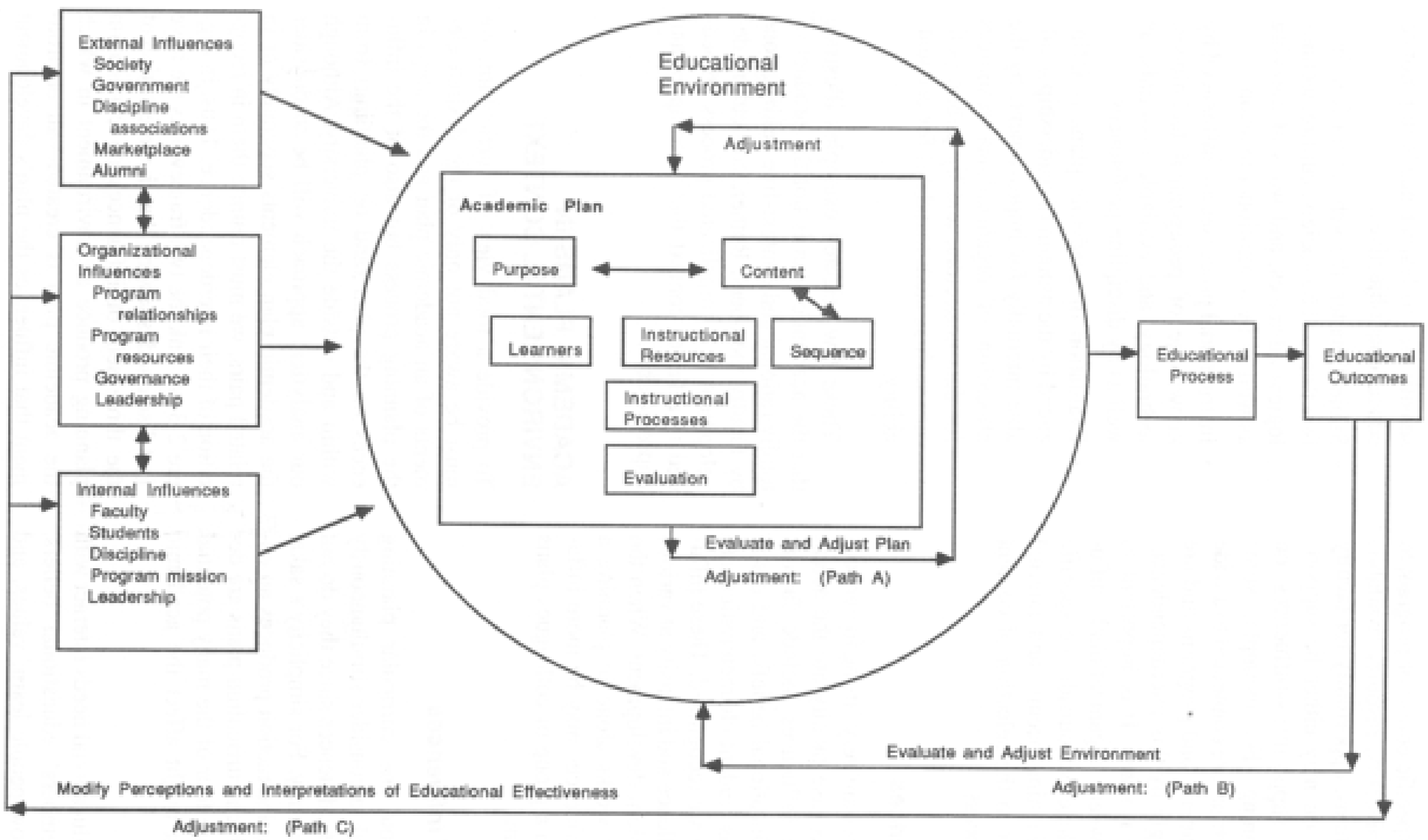
A Higher Education Perspective on Curriculum

The importance of contextual structures and influences that emerged from this study directed me toward a second perspective on curriculum from research on higher education. I had initially considered this perspective to be only peripherally important because I did not believe it to be as useful a conception of curriculum for the study as the conception I chose to frame the study, which had been largely informed by my mathematics education background. Whereas mathematics education research on curriculum tends to focus on curriculum materials (textbooks, K-12 teacher manuals, etc.), higher education research has a much more varied definition of curriculum. As discussed briefly in Chapter Two, the term curriculum might refer broadly to the educative mission of an entire college, to the set of courses offered to students, to the content of a particular discipline, and so on (Lattuca & Stark, 2009, p. 1-2). Such definitions appear far removed from the everyday decision-making inside the classroom that I was particularly interested in. And yet the breadth of this conception of curriculum allows comprehensive models of curriculum and curricular decision making at the college level, such as Lattuca and Stark's (2009) Academic Plan, or Stark's (2000) Contextual Filters Model of course planning, both of which I will describe in more detail below, to be much better suited for incorporating external influences on a faculty members' use of curriculum and role in designing a course.

While the two models from mathematics education research presented above are useful for conceptualizing the nature of curriculum as more than just written materials (as in the Stein, Remillard, and Smith model), or differentiating between types of curricular decisions that instructors make (as in Remillard's framework), my study found the two models insufficient for reflecting very important external factors and how they shape the nature of curricular decision-making, even at the level of the individual instructor, in different contexts for this course in the community college setting. The two models of curriculum from higher education research that I will discuss below help not just to show that, as a subset of higher education courses, these community college courses for elementary teachers are subject to the influences therein identified, but can also be incorporated into the mathematics education models in order to better reflect these influences.

First, Lattuca and Stark's Academic Plan (Figure 6.3) helps to revise the adaptation of Remillard's framework that I developed in Chapter Two.

Figure 6.3: Academic Plan (Source: Lattuca & Stark, 2009, p. 5)



While I initially separated out curricular decisions made around curriculum adoption and curriculum use, the study instead showed that a more important distinction occurred between *where* the decision-making was occurring. That is, decisions in the *design*, *construction*, or *mapping* arenas could be made by individual instructors, groups of instructors as a collective, other colleges, statewide policies, etc. The Academic Plan separates out those levels of influences into *External Influences*, *Organizational Influences*, and *Internal Influences*. Specific to this study, external influences could include influences by state policies, other colleges, and widespread trends in the mathematical education of teachers; organizational influences could include department-wide policies, both in general and specific to the course, and structures in place for sharing resources, maintaining course consistency, etc.; and internal influences could include instructors' own decisions, backgrounds, beliefs, etc. With these three levels of influence, Figure 6.2 could be re-adapted as follows:

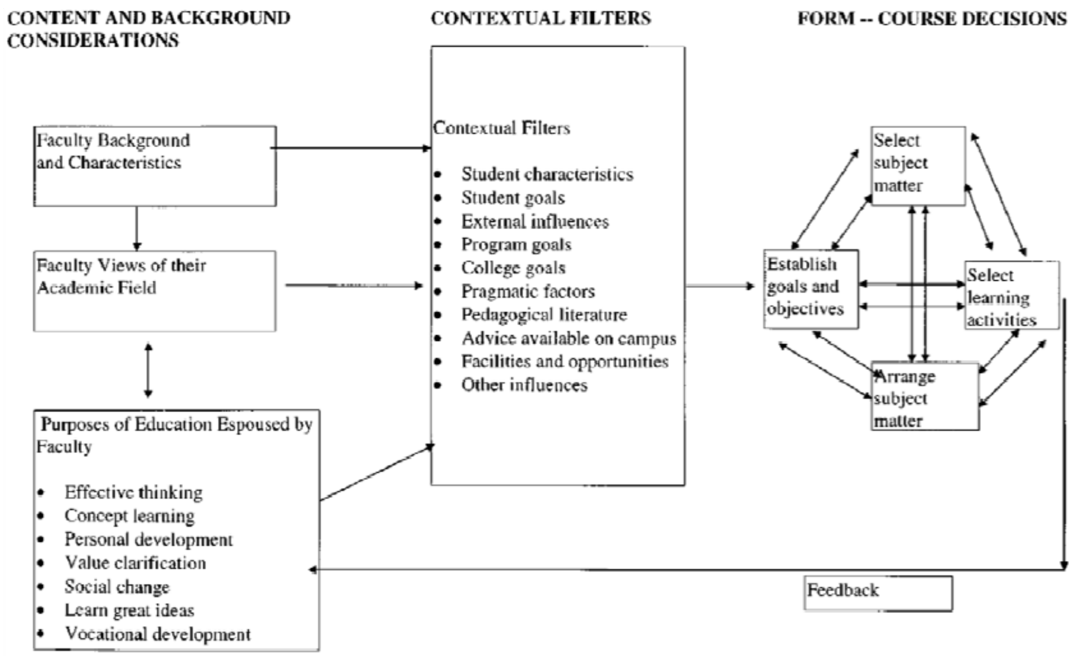
Figure 6.4: Arenas of Decision-Making at External, Organizational, and Internal Levels

	DESIGN ARENA	CONSTRUCTION ARENA	MAPPING ARENA
External Level	External influences on curriculum materials, tasks, types of tasks, etc.	External influences on instructors' implementation of curriculum	External influences on topics and sequencing
Organizational Level	Organizational influences on decisions made around curriculum materials, tasks, etc.	Organizational influences on instructors' implementation of curriculum	Organizational influences on topics and sequencing
Internal Level	Instructor-level decisions about curriculum materials, tasks, etc.	Instructor-level decisions around implementation of curriculum	Instructor-level decisions on topics and sequencing

This model would help to better identify the influences on curricular decision-making of instructors, and which influences are more salient at different institutions. For example, in the mapping arena, external influences at Northeast Community College documented in this study consist of the local university, and exert more of an influence than instructor-level decisions. This extended framework would allow salient influences to be identified, and possible explanations for influences to be more visible in patterns across the framework.

Second, Stark's Contextual Filters Model (Figure 6.5) is useful in elaborating Stein, Remillard, and Smith's model of curriculum transformation. Stein, Remillard, and Smith's model (see Figure 6.1) identifies the process through which curriculum is transformed, but the external influences on this process are not as integral to the process itself as I found them to be in this study. Here the Contextual Filters model is useful for distinguishing between different types of contextual influences, and showing the relationships between these influences and the actual decisions instructors make around curriculum. Specifically, the Contextual Filters Model separates out two different types of influences. Teachers' beliefs and disciplinary views (the first type of influence) are relatively stable and only mildly subject to influence by external factors (the second type of influence), but are "filtered through" these external factors. The beliefs and disciplinary views effects on the *form*, then, or the actual decisions about curriculum that the instructor makes (analogous to the transformations that occur in Stein, Remillard, and Smith's model), are modified by these external factors and their effect on the form. In this model, it is the influences rather than the decisions themselves that give shape to the model and the curricular outcomes.

Figure 6.5: Contextual Filters Model of Course Planning (Source: Stark, 2000, p. 430)



It is perhaps unsurprising that K-12 mathematics research would give less attention to these influences. There is likely less presumed teacher autonomy in mathematics curriculum design where teachers are expected to teach from school- or district-wide textbooks, and where content is sequential in that learning at one level is largely dependent on the mathematics that students learned in previous classes. Even in college-level courses, mathematics textbooks have been shown to have a greater impact on course design in terms of topics and sequencing than in other disciplines (Stark, et al., 1988). But mathematics courses for elementary teachers lie outside the standard mathematics sequence, and due to the small number of sections offered may be less prone to standardization across sections than large introductory mathematics classes. These external factors that bear on instructors' decision-making about course design, then, are important considerations for understanding the nature of the courses, and how instructors make decisions that influence what students have the opportunity to learn.

Just as the models of curriculum use from Stein, Remillard, and Smith emphasizes that instructor decision-making is crucial to understanding how written curriculum is transformed into student learning opportunities, the Contextual Filters Model emphasizes that curricular decision-making is dependent upon contexts that vary greatly across disciplines, and from one institution, department, or instructor to the next. Even the same influential factor can act differently on different courses or institutions. A major contribution of this study, then, is not simply to show that the context is important, but to demonstrate some of the specific contextual influences that shape curricular decisions in community college mathematics courses for elementary teachers. While in the prior sections I have discussed the particulars of each college, here I will revisit three of those particular influences on community college mathematics courses for elementary teachers that illustrate mechanisms by which the curricular decision-making of instructors is narrowed or focused. I will then discuss implications for research and for practice.

The three factors which will be described below are transfer, the textbook, and departmental structure around the course, and would qualify as “contextual filters” in the Stark’s Contextual Filters Model. They have varying degrees of influence among the colleges, but were important factors for all of the colleges in the study and would therefore likely be important factors for other community colleges in relation to curricular decisions in mathematics courses for elementary teachers.

The influence of transfer.

One of the most relevant factors for community colleges is the list of requirements of certification-granting institutions. Though the extent of the influence of transfer varied from one college to another in my study, it was always a consideration. By offering mathematics courses for teachers, community colleges are not fulfilling a general education requirement but are catering directly to a population of students who desire to use community college credits toward specific teaching degree requirements. As such, if a course does not meet the expectations of all or most teaching degree granting institutions that students might attend in terms of content and structure, the course would not have a place in the community college's mathematics offerings. Thus these expectations, whether determined by state policy (as at Southern State Community College), by a particular transfer university (as at Northeast and Midwest Community Colleges), or by trends across a variety of four-year institutions (as at West Coast Community College), partially determine and thereby constrain the curricular decisions that can be made by instructors or departments at the community college.

Though the connotation of the word "constraint" is sometimes negative, it does not have to be. Constraints can help provide structure and purpose to decisions, and can narrow the scope of decision-making so that more attention can be given to particular pressing decisions. If a sequence of courses, set of topics, and number of credit hours can be taken as a given by a community college because it is acceptable to major transfer institutions, then instructors can focus on effectively delivering content within what are usually broad and widely-accepted structures. Indeed, few instructors in this study spoke of transfer requirements as having a negative impact on their course—they simply existed, and were taken for granted. Even at Northeast Community College, where the curriculum was most strongly dictated by a transfer institution, instructors' complaints rested entirely on their lack of say in the textbook used, rather than on the content, sequencing, or general expectations for the course.

This also means that there are not likely to be significant structural differences between courses that are offered at community college and courses that are offered at four-year institutions. While it is unlikely that significant structural changes could be initiated at and "trickle up" to universities, such changes would quickly "trickle down" to community colleges simply because the courses at community colleges are expected to look, at least on paper, like their counterparts at transfer institutions.

The influence of the textbook.

The textbook as an influence on curriculum tends to be taken as a given in research on K-12 mathematics curriculum, but this is not the case in more generalized literature on higher education curriculum (note that in neither the two higher education models of curriculum design included earlier in this chapter are formal written curriculum materials explicitly included). The centrality of the textbook is particular to the discipline of mathematics and the way it has been typically taught at the K-12 level, and therefore this centrality and the nature of the role of the textbook cannot be taken for granted in the courses under study here. Because the course lies outside the standard mathematics sequence, adhering to textbook topics and sequencing for the purpose of preparing students for future mathematics courses would likely be less of a concern. I had also hypothesized at the beginning of the study that community college instructors would have a greater say in the choice of textbook for the course, and indeed this proved true in this sample. With the exception of Northeast Community College, even those instructors who were not directly involved in the textbook review process for the course felt that they could be if they chose. A valid question then is whether the textbook actually has a significant impact on course design in these classes, or if instead the textbook is a byproduct of decisions already made, in that instructors choose textbooks that fit their curricular purposes. Do instructors fit the textbook to their curricular purposes, or fit their curricular purposes to the textbook?

While the specific role of the textbook itself varied across the four colleges in the sample, from Southern State Community College where the textbook was the primary source material both inside and outside the class, to Midwest Community College where instructors had developed their own course materials and used the textbook largely for sequencing and as a repository of problems, the textbook in all cases still appeared to influence curricular decisions at department-wide and individual levels. Instructors spoke of reading the textbook carefully during their first semesters of teaching, even if they didn't read it as carefully in subsequent semesters. They spoke of choosing problems from the book, sequencing topics according to the structure of the book, directing students to the book as a resource. Even at Midwest Community College where instructors had developed extensive supplemental materials independently, the materials were originally designed to supplement a previous textbook, and were mapped to the content of the current textbook and re-designed and modified within the context of the current textbook. Whether the textbook played an explicit role in instructional decisions, or an implicit role, it nevertheless always played a role.

This supports the idea that a study of textbooks in use can tell us something about what mathematics future elementary teachers are being given the opportunity to learn at the community college level. As discussed in Chapter Three, surveys of textbooks used have been the approach of some large-scale studies concerned with the mathematical education of future teachers at four-year institutions, but if the role of the textbook is not central to curricular decisions then it may not be an accurate reflection of students' mathematical learning opportunities. And on the one hand this study does suggest that uses of a textbook can be highly varied, as evidenced by both the great variation in instructional purposes and methods across instructors at Northeast Community College even with the same textbook, and by the differences between Southern State, Midwest, and West Coast Community Colleges, who all used the same textbook but in very different ways. Nevertheless, for very few of the instructors in the sample did the course content at a broad level appear to deviate from the content of the textbooks that they used, or even the sequencing.

That this variation of textbook use would be true in a community college setting in particular makes sense. Because this course must be directly transferable to four-year institutions with teacher certification program, use of a widely-published text would ensure a generally acceptable outline for the course within which instructors could then make independent choices about presentation and instructional methods. Just as the limits placed on a course by transfer requirements would constrain the scope of curricular decision-making by the community college instructors, so too would the mathematical content of a textbook create a scope and structure of content within which instructors could make curricular decisions. This may be particularly important in community college settings (like West Coast) where it is necessary to rely on part-time instructors who may not teach for more than a semester or two before being replaced by a different part-time instructor.

However, if the textbook does play an important role in the mathematical content that students have opportunity to learn, the constraints created by use of a particular textbook are not necessarily as likely to be beneficial or enabling as the broader constraints created by transfer requirements. There is wide variety in the commercially available textbooks for elementary teachers in terms of topics and how they are addressed (McCrory, 2005; Greenberg & Walsh, 2008), and this variety may not be immediately apparent to instructors. Instructors in the sample who had some level of familiarity with different textbooks for elementary teachers generally felt that most textbooks were very much the same in terms of topics. Interestingly, when instructors spoke about their choice of textbook they frequently referred to such characteristics as readability, quality of explanations in the text, connections to teaching, and inclusion of good problems in the homework exercises, rather than on mathematical qualities such as inclusion or treatment of topics. If the perception is that textbooks are mathematically similar and that differences largely involve accessibility to students, the influence of a textbook on the mathematics that students have the opportunity to learn could go unnoticed by instructors.

The influence of departmental structure around the course.

Another major factor in how curricular decisions were made for the course for elementary teachers has to do with the structures that were in place for sharing information and sustaining instructional goals and practices. Such structures do not necessarily occur by intentional design. In this study, intentionality was only apparent at Southern State, where a strong course philosophy and concrete teaching method that had been purposefully implemented at a distinct point in the past required perpetuation. This perpetuation was accomplished by careful staffing of the course and by course mentoring, which created a sort of hierarchal structure within the department around decision-making for the course that allowed for continuity between sections and across semesters.

At the other three schools, though, interactions among instructors took definite patterns but did not appear to have been the result of purposeful decisions about how the course should be run and where decisions should be made. Even at Midwest Community College, where instructors collaborated with each other around the course for elementary teachers almost systematically, this level of communication had emerged over time (Dana began visiting Christine's classroom, and opened up communication between instructors) or through circumstance (Ellen and Beth were hired at the same time, were assigned the same office, and had both had experiences teaching the course at the university). At West Coast Community College, a semi-hierarchal method of sharing resources and information about course design seemed to occur as less experienced instructors were mentored into the course by more experienced instructors, gained experience, and then themselves mentored new instructors into the course. And at Northeast Community College, the lack of a structure for communication about the course appeared to be partly a byproduct of the lack of ownership faculty felt towards the course because the written curriculum was passed down from the university.

Structures for sharing information and sustaining instructional goals and practices affect curricular decision-making by influencing the location and extent of instructors' autonomy in making curricular decisions. Where such structures are weak or undefined (as at Northeast), instructors are more likely to draw directly on their own backgrounds, beliefs, and resources in making curricular decisions. Where structures are more defined, instructors' decisions are more strongly filtered through the influences of their colleagues, department goals, etc. Autonomy was highly valued by instructors in the sample, but autonomy meant different things in different departments and was bounded, loosely or tightly, by these existent structures.

A consequence of these differences is instructors' access to new ideas and practices. An argument can be made that when an instructor's autonomy extends to many aspects of curricular decision-making, then instructors are more likely to experiment and innovate. And yet when autonomy is not coupled with communication, instructors may not have access to positive innovations that occur in their colleagues' courses. In a small specialized course like mathematics for elementary teachers, that is so different in nature and purpose from other mathematics courses taught in a community college mathematics department, instructors' access to instructional strategies for this particular course, research on the mathematical preparation of teachers, different representations of mathematical concepts, connections to children's thinking, and so on, particularly to part-time instructors or instructors who do not teach the course as a primary responsibility, may be limited, which would lend particular value to communication. In fact, the idea of *communities of practice* (Wenger, 1998), or groups of people coming together and improving their practice through interaction, has been used in the field of education to understand teacher learning and improvement (Cochran-Smith & Lytle, 1999).

And yet communication and interaction does not necessarily occur easily, particularly at the community college. Though many instructors in the study cited the smallness of the group of instructors teaching this course as making communication easier, other obstacles to interaction existed that are likely to exist at other similar institutions. These include the reliance on part-time faculty to staff sections of the course, where part-time faculty are less invested in departmental activity outside of teaching and more likely to teach in the evening while their full-time colleagues teach during the day; multiple campuses (at large community colleges) that spread apart instructors and make interaction in everyday settings rare; and smaller course offerings that mean fewer instructors teaching the course simultaneously, and therefore less motivation for real-time collaboration. Collaboration for the sake of instructor learning would need to be a conscious and sustained effort.

Implications for Research

One immediate implication for research resulting from this study is that in the context of a community college mathematics course for elementary teachers, typical K-12 models of curriculum are insufficient for understanding how curricular decisions are made. Relegating identifiable outside influences to a single piece of the model ignores the complex relationships between those influences and how they can enable and constrain the decision-making of individual instructors. Here Stark’s Contextual Filters model is actually quite useful for highlighting some of the contextual factors that moderate instructor backgrounds and beliefs and influence the final decisions teachers make as they create and implement curriculum. These include requirements for transfer, available textbooks, and structures in place within the department for sharing of resources and perpetuation of goals and instructional methods.

But this study only serves to fill in part of the Contextual Filters model (Figure 6.4) for this particular course and institutional setting. The interviews focused on instructors’ decision-making (both at the level of curriculum design and implementation) and the subsequent analysis was able to identify many of the immediate influences on such decision-making. However, in the model, the influences of instructors' backgrounds and beliefs on curricular decisions are farther removed from the decisions themselves, separated by ("filtered through") the more immediate influences (such as, in this case, transfer, textbooks, and departments structures). Although the interviews included questions about instructor backgrounds and beliefs, I was unable to make substantial connections to the instructors' curricular decision-making. This actually supports the Contextual Filters model, which would suggest that such influences are filtered through the more immediate contextual influences. In a study such as this one that focused largely on the actual decisions, the filtered influences would be less visible.

An interesting task for future research, then, would be to focus on those individual influences: faculty backgrounds, orientations toward the discipline, and beliefs about the purposes of education and about the purposes of this course in particular. The Contextual Filters model also suggests that while these beliefs tend to be stable in the face of contextual influences, it is the beliefs and not the contextual influences that are affected by instructors' experiences with designing and implementing curriculum. There is anecdotal evidence from this study that some instructors had changed their views of this course over time, and possibly modified their instruction in other mathematics courses based on their experience teaching the course for elementary teachers. The relationship between instructor beliefs and their curricular decision-making would be an interesting and worthwhile area of study not only for the influence it might have on the mathematical opportunities of students in these courses, but also for what it might teach us about the general beliefs and decisions of mathematics instructors.

This study could also serve as the foundation for an expansion of the findings to a wider range of community colleges. In Chapter Three, I discussed my choice of methods and motivation for conducting a study of this particular size and scope. The primary motivation for choosing not to conduct either a large-scale survey study, or a very small-scale case study, was that there was an insufficient research base to build upon. However, after investigating the curricular decision-making of instructors in four very different community colleges and observing patterns and trends across those colleges, there is sufficient information to investigate the influences and structures existent in a much larger sample of community colleges. A survey for instructors (both part-time and full-time) of community college mathematics courses could be built around the particular influences that emerged from this study from which the models in chapter five were constructed, as well as factors such as instructor backgrounds. It would be interesting to know if the patterns of curricular decision-making across the four colleges in this study are generalizable to other community colleges, and if there are particular characteristics of the colleges, the student population, faculty characteristics, etc., that influence the structures.

A part of a larger scale study could include the textbook itself. The textbook in use was an interesting and unintended similarity across the colleges in this study: of the four departments, three used the same book (Bassarear) as their primary text. Given that the textbook appears to influence the content of the courses, it would be important to know which textbooks are commonly used in community colleges for this course and why they are chosen. As mentioned above, instructors in this study seemed to refer to characteristics such as readability and sets of problems when describing the adequacy of the text, and not to characteristics such as topics or mathematical quality. I initially began this study with an interest in knowing how textbooks are chosen and used in these courses, but when it became clear that it was necessary to adopt a broader definition of curriculum, specific research questions about the formal textbook were left unanswered, such as how instructors adapted textbook content or how students were expected to use the textook.

In retrospect, my initial interest in the textbook specifically was founded largely on my own experience teaching at a single institution and failed to take into account differences in curriculum development and implementation that I could not conceive without undertaking a study such as this one. As such, it was natural that my study evolved to consider curricular decisions as involving more than just the textbook. However, one result of the study is a better understanding of the possible position of the textbook in these courses, which provides a better foundation for answering questions about the specific role and influence of the textbook. Some of these questions might include questions about why one textbook is chosen over another, the nature of instructor decisions that change or modify the content of the textbook, how students use the textbook, and how faculty perceive that students use the textbook.

Finally, the issue of transfer necessarily calls to mind the potential differences between community college courses and their transfer equivalents. While many of the instructors in the study purported to be creating courses that would be equivalent to those that students might experience at the transfer institution, there could still very well be distinct differences. These differences could plausibly be for better or for worse. Differences in instructor backgrounds and beliefs, available resources, student populations, class sizes, and so on may all have an affect on students' mathematical experiences in the classroom. Because community colleges are playing greater roles in the mathematical education of future teachers and because they have been underrepresented in the little research that exists on the mathematics courses futures are required to take, a comparative study between community college courses and the equivalent courses at the institutions their students are more likely to transfer to could be valuable in identifying differences, things that either institution could learn from the other, and possible means for collaboration between institutions.

As a largely untouched area of research, but an important site for understanding and improving the mathematical education of teachers, community college mathematics courses for elementary teachers are a potentially fruitful field with many promising research possibilities.

Implications for Practice

These identified factors, and the results of this study detailed in the previous chapters, hold several implications for both research and practice. I will first discuss some of the implications for practice, and then conclude with implications for research and possibilities for future study.

Implications for instructors and course planners.

One implication that follows immediately from the factors above is that while communities of practice are widely believed to be beneficial for instructor learning, such communities do not necessarily emerge easily or naturally in this setting. Reasons for this were discussed above. It is hard to conclude from this study, however, that the locations in which communities *had* been formed were necessarily better equipped than those where they had not. Instructors at Southern State had implemented an efficient system for implementing and maintaining what was a rather innovative course design without the extensive collaboration that would have been difficult in a multi-campus setting.

That being said, there is also no evidence that greater collaboration would *not* be beneficial where there is less. Northeast instructors exhibited a wide array of instructional methods, but there was no mechanism for sharing their resources and insights and therefore instructors may not have had access to possible innovations that may have improved their own and their students' experiences, and may also have helped them to recognize the agency that they did have in designing the course. Likewise instructors at Southern State may have benefited from being able to discuss how they implemented the given curriculum and course philosophy. What this study does suggest is that, particularly for a course like this that may not have the departmental status or attention that higher enrollment courses do, efforts at collaboration would require a deliberate effort on the part of the instructors themselves. Furthermore, instructors would need to recognize that there is something to collaborate around. Collaboration can be stymied if there is not a perception that collaboration is necessary, either because the course is so well-defined as to preclude immediate need to discuss it with others, or because instructors themselves do not feel a sense of ownership over the course.

Course coordinators can play a crucial role in providing reason to collaborate. In each of the colleges in the study there was a lead instructor or more experienced instructor who played an important role, not necessarily intentionally, in determining the information-sharing relationships among other instructors. If a course leader can not only pass along information, but seek information and ideas from other practicing instructors, lines of communication can be opened. This is roughly what happened at Midwest Community College, when Dana began sitting in on Christine's courses, whereas at the other colleges course coordinators essentially took on the role of information sharer, rather than an enabler of mutual sharing.

Implications for curricular change.

At the outset I did not intend to frame this study in terms of reform. I did not wish to rest my study on the assumption that community college-based mathematical preparation of teachers, relative to the equivalent courses at four-year institutions, was "broken" and in need of fixing; rather, I was interested in identifying influences on curricular decisions and particularly those unique to community colleges. And indeed I found that the instructors I interviewed were, as a group, committed to and interested in the course for elementary teachers and in creating meaningful and relevant learning experiences for their students in settings that differed from other more standard mathematics classes that they taught.

Nevertheless, in the course of my research I came to the realization that the ideas of change and reform must necessarily be a part of a study of curriculum and the organization of and decisions around curriculum. The possibility and desirability of change in these courses (as in any course of study) is always present. Student demographics shift over time, articulation agreements and teacher certification requirements are revisited and revised, teachers seek to improve their practice and more effectively reach their students, available textbooks undergo revisions, and research adds to and alters the knowledge base on teacher preparation. Mathematics courses for elementary teachers have an important role to play in the improvement of the teaching of mathematics in elementary schools, and must themselves be receptive to change and improvement.

One important implication of the different structures around curricular decision-making in each of the four colleges studied was that these differences result in different mechanisms by which change could occur, and, simultaneously, create differences in the types of constraints that might impede change. Research on prospective teachers' mathematical learning frequently concludes with practical suggestions about how such learning might effectively proceed, recommending, for example, that students be exposed to children's thinking (Phillip, et al., 2007), or that students' attention be directed toward using pictures as a first step to solving problems rather than constructing pictures of the solution after the fact (Lo, Grant, & Flowers, 2008). Documents are issued with recommendations for what elementary teachers should be taught and how (CBMS 2001; Kilpatrick, Swafford, & Findell, 2001), and new textbooks seek to fill gaps that other textbooks lack. Those issuing recommendations for courses for elementary teachers might simply take it for granted that faculty have the primary responsibility for designing courses, and that faculty and institutional autonomy allow for the opportunity to design effective courses for elementary teachers. But the differences between departments in this study suggest that instituting new and possibly more effective practices is not contingent merely upon the knowledge and willingness of individual faculty. Change must take into account institutional context and differences in institutional contexts.

Although this notion seems intuitive, my study suggests very specific ways that different institutional organizations might impact potential for change in different ways.

Midwest Community College, for example, has the capacity for change built into the structure around the course. Instructors evaluate the course on a regular basis, try changes and report back to the group, and implement changes that seem to work. The process of change is incremental and practice-driven rather than goal-driven; that is, changes involve slow improvement upon what exists rather than adoption of new curriculum materials or instructional strategies. Even when the current textbook was chosen to replace a previous textbook, the adoption of the new text did not drastically change the course. The instructors continued to use the same activities they had been developing over the course of many years, and eventually abandoned the activities manual that accompanied the new textbook in favor of their own activities. In a setting like this, an attempt to introduce a major change would mean uprooting an extensive experiential knowledge base that instructors would be unlikely to give up entirely. Changes would be more easily introduced in smaller ways—new activities or modules that could be easily incorporated into current lesson plans, perhaps.

At Southern State Community College, on the other hand, such incremental changes would be much more difficult. Where change at Midwest Community College has been incremental and practice-driven, the change that created the course in its current form at Southern State Community College was complete and goal-driven; an entirely new course was created to better engage students in the independent mathematical learning that the old course was not accomplishing. The course structure at Southern State is stable where at Midwest it is fluid, and change in instruction, goals, or curriculum is more likely to occur and be effective through a reevaluation of the entire course. In this case, a new textbook might be a source for potential change in a way that would be less likely at Midwest. Textbooks are reevaluated every time a new edition is made available, and if a new textbook were compelling, and able to provide a level of structure and guidance to instructors similar to what the current textbook is able to do, the textbook could serve as an enabler of change.

At West Coast Community College instructors exhibit greater individual autonomy than at either Midwest or Southern State Community College. While this seems to decrease consistency among the courses, it may also be advantageous for change in that there may be more freedom for instructors to make new and innovative changes. Additionally, because instructors know one another and communicate about the course, if one instructor has success with change, there are channels open to share this success with other instructors. As at Midwest Community College, incremental change is likely easier than course-wide change, but could be more easily led by a single instructor.

Northeast Community College is a more difficult case in terms of implementing change. The course itself is bound to the university course, and it appears that community college instructors have very little say in what the university requires. Although greater collaboration with the university would certainly be an important avenue for change, a new culture of collaboration would be difficult to establish, and would require members of both the college and university communities to see value in such collaboration. However, the differences seen across instructors' teaching styles and course philosophies at Northeast suggest that instructors have more control over the curriculum than they realize. Although they do not choose or write the written curriculum, they have choices in how this curriculum is delivered, and in the resources they use to complement and supplement the written curriculum that is handed down to them. Instructors do make changes, incrementally, in their own classes, and greater opportunity for both part-time and full-time instructors to discuss the course with each other and share ideas and resources could help instructors to become more aware of the choices they do make in course design.

Again, my assumption is not necessarily that change is necessary and desirable in these courses. The efficacy of the courses in the various institutions lies outside the bounds of my study. But if change is a natural part of any course, and if research on the mathematical knowledge of teachers results in recommendations for the improvement of their mathematical preparation, then mechanisms for instituting change and implementing recommendations should be better understood and considered. Furthermore, because community colleges are playing an increasing role in delivering students their first experiences with mathematical knowledge for teaching, and because there are contextual factors that distinguish community colleges from universities, understanding mechanisms for change needs to take two-year institutions into account.

Implications for curriculum design.

Another implication relates to the textbook itself. While the textbook is not the sole determinant of curriculum, as evidenced by the variations in curricular decision-making across the colleges in my study, it did influence curricular decisions in terms of content and organization of content. And yet the instructors appeared to choose and evaluate the textbook less on the basis of content than on its accessibility and usability for students. Perhaps such features are even more salient in a community college setting where, as an open-access institution, a larger portion of the students are more likely to have weaker mathematical backgrounds. The National Council on Teacher Quality report on mathematics courses for teachers at four-year institutions, *No Common Denominator* (Greenberg & Walsh, 2008), leveled criticism at many commonly used mathematics textbooks for prospective teachers, including the Bassarear text used by three of the four colleges in this sample. The basis of the critique was the quality and quantity of mathematical ideas in the textbooks, and yet these were not the concerns that drove the instructors' evaluations of their textbook.

This is not to say that the instructors were unconcerned with the mathematics. But because the content and purposes of the course are so different from the content of other more standard mathematics courses, the textbook may actually be a source that instructors turn to in order to understand what *should* be taught in this course. Instructors' textbook choices therefore may not be explicitly attuned to content, but more attuned to presentation of the content and how this presentation fits with their beliefs about teaching the course.

Textbook designers, then, might do well to consider the educative aspects of their curriculum, and be able to explain and justify curricular choices not just to students but also to instructors who may not be familiar with curriculum for elementary teachers. That some instructors in this study did not seem to differentiate between most available textbooks based on content does not signify that they are poor teachers or mathematicians, but rather that it is a very different course. If instructors are to be able to make mathematical distinctions when choosing textbooks, they need to have a basis upon which to make those distinctions. The idea of educative curriculum materials is not unfamiliar to research K-12 mathematics curriculum research (Ball & Cohen, 1996), and could also be productively conceived of in thinking about educating mathematics teacher educators.

Appendix A

Database of Study-Eligible Community Colleges in Michigan

COLLEGE	WEBSITE	Location	Setting	Percent Financial Aid	No. Students	25+/-25	Part/Full	Male/Female	Ethnicity	Other (+1%)	Graduation /Transfer	El Ed Major?	El Ed Math?
Kellogg Community College	www.kellogg.edu	Battle Creek	Small City	80	5,553	47/53	66/34	33/67	White (75%)	Black (8%) Hispanic (2%)	16	no	yes
Jackson Community College	www.jccmi.edu	Jackson	Rural	77	6,173	42/58	57/43	37/63	White (84%)	Black (5%) Hispanic (3%)	**14/27**	no	yes
Delta College	www.delta.edu	University Center	Rural	78	10,406	34/66	58/42	44/56	White (81%)	Black (8%) Hispanic (4%)	17%	**yes (30)**	yes
Mott Community College	www.mcc.edu	Flint	Midsize City	76	10,455	45/55	64/36	39/61	White (60%)	Black (17%) Hispanic (2%)	11%/14%	no	yes
Kalamazoo Valley Community College	www.kvcc.edu	Kalamazoo	Rural	66	11,113	34/66	59/41	47/53	White (79%)	Black (11%) Hispanic (3%) Asian/PI (2%)	12	**yes (59)**	yes
Washtenaw Community College	www.wccnet.edu	Ann Arbor	Large Suburb	40	12,068	45/55	68/32	45/55	White (68%)	Black (15%) Hispanic (3%) Asian/PI (3%) Non-res (3%)	10%/7%	**yes (29)**	yes
Schoolcraft College	www.schoolcraft.edu	Livonia	Small City	55	12,148	38/62	62/38	44/56	White (75%)	Black (8%) Hispanic (2%) Asian/PI (3%)	23%	no	yes
Henry Ford Community College	www.hfcc.edu	Dearborn	Small City	68	13,983	39/61	62/39	42/58	White (51%)	Black (22%) Hispanic (3%) Asian/PI (2%)	7%	**yes (55)**	yes
Grand Rapids Community College	www.grcc.edu	Grand Rapids	Midsize City	77	15,212	30/70	56/44	49/51	White (77%)	Black (11%) Hispanic (6%) Asian/PI (3%)	16%	**yes (64)**	yes
Lansing Community College	www.lansing.cc.mi.us	Lansing	Midsize City	69	19,465	39/61	67/33	45/55	White (66%)	Black (8%) Hispanic (5%) Asian/PI (2%)	11%/12%	**yes (6)**	yes
Wayne County Community College District	www.wcccd.edu	Detroit	Large City	69	20,504	49/51	78/22	30/70	Black (64%)	White (17%) Hispanic (2%)	8%/7%	**yes (9)**	yes
Macomb Community College	www.macomb.edu	Warren	Midsize City	42	22,081	35/65	62/38	48/52	White (76%)	Black (6%) Asian/PIA (2%) Non-res (5%)	12%	**yes (8)**	yes
Oakland Community College	www.oaklandcc.edu	Bloomfield Hills	Large Suburb	52	24,532	42/58	67/33	42/58	White (63%)	Black (15%) Hispanic (2%) Asian/PI (3%) Non-res (8%)	12%/21%	no	yes

Appendix B

Interview Protocols

INSTRUCTOR INTERVIEW 1 – CURRICULUM CHOICE

BACKGROUND: Structure of the course within the college, professional background of the instructor, etc.

1. What is your current position in the college?
2. How long have you been teaching at your college?
3. What did you do before coming here?
4. What is your educational background? What degrees have you earned, and where did you earn them?
5. What courses are you teaching this summer? What courses did you teach during the fall and winter semesters of this past year?
6. Which of the courses offered for elementary teachers are you currently teaching, and which have you taught in the past?
7. How long have you been teaching these courses? Do you teach them regularly?
8. What topics are covered in each course?
9. Where do most of your students transfer?

MAPPING (Goals): Questions about the overarching goals of the class—the knowledge, skills, and dispositions that students are to learn.

10. What would you consider to be the purpose of this class? Ideally, what should students learn in this class?
    a. What *knowledge* should students come away with? If the course is successful, what are examples of some things they should know?
    b. What *skills* should students come away with? What should they be able to do?
    c. What *dispositions* should students come away with? What attitudes do you hope they will have/develop?
11. Why do you consider these things to be important for the students to learn?

DESIGN (Resources): Questions about how the textbook and other resources are chosen for use in the course.

12. Tell me about the process by which this textbook was selected.
    a. What was/is your involvement in the textbook selection process?
    b. How often does the textbook come under review?
    c. What do you consider the most important considerations for choosing a textbook for this class?
    d. What other considerations do people involved in choosing the textbook consider important?

13. Tell me about your current textbook.
    a. How long has this textbook been in use? What textbook was used before? Why was this new textbook chosen?
    b. What are some good things about the textbook?
    c. What is not as good about the textbook?
    d. In which ways does the textbook support the class purposes you described earlier?

14. What other resources/curriculum materials do you use when you teach this class? (For example: other textbooks, activity books, online resources, journals, etc.)
    a. How did you acquire these other resources?
    b. Why do you use them?
    c. Do other instructors use the same resources?

CONSTRUCTION (Enactment): Questions about how the course is structured, what a typical class session looks like, how students are evaluated, etc.

15. Is there a common syllabus used from class to class (semester to semester, teacher to teacher)? If yes, how is the syllabus written? Who is involved in this process? If no, what is the same and different about the syllabus? What choices have you made, independently, about the syllabus and design of the course?
16. Tell me about a typical class session.
17. What structures have you built into the class to tell if students have learned?

CONTEXTUAL ISSUES (If not addressed previously)

18. Many students will transfer to another institution to complete their education degrees. How do you ensure that this course will transfer?
19. What makes the content of this course different from other mathematics classes you teach (or have taught, or that other members of your department teach)?
20. Is the way you *teach* this course different from the way you teach other mathematics courses? How is it different, and how is it the same?
21. How do the *students* who take this course compare to students enrolled in other courses? Are there any student characteristics, either in their backgrounds or in their approach to the class, that are unique to this particular course? Do you have students who are taking this course for a purpose *other* than transferring credits to an education program?

INSTRUCTOR INTERVIEW 2 – CURRICULUM USE

1. Describe what you did in class today; from the time you walked in the door to the time you left the classroom.

DESIGN (Resources): Questions about planning the lesson, how the instructor chose activities, examples, etc., and how the textbook and other resources were used in the planning phase.

1. Tell me about the content that you covered today.
    a. Did you use the textbook in determining the content you would teach today? If so, how?
    b. Is there any content you taught today that was *not* covered in the textbook? Is there any content you taught today that you did not feel was covered well by the textbook?
    c. Is there any content covered by the textbook in this section that you did not cover? Why did you choose not to cover this content?
    d. Have you taught this topic in previous semesters? If so, did the way you covered the content in this class differ from previous classes? Why did you make the changes you made?
2. [If an activity or some form of seatwork was used in class] Tell me about the activity you used.
    a. How did you develop this activity?
    b. Have you used this activity before? If so, what changes did you make to the activity (if any) prior to using it in this class? Why did you make these changes?
3. What are students expected to do between now and next time? How did you choose what to assign the students?
4. When planning your lesson, what did you expect students to find particularly challenging?

CONSTRUCTION (Enactment): Questions about how the lesson was actually carried out, what went well, what didn't go as well, what changes the instructor made and why, what the instructor might do differently.

5. What do you think worked particularly well in this class session?
6. What didn't work as well, and do you know why?
7. Did you make changes to anything you had planned? What were those changes, and why did you make them?

    Prompts:

    a. Did you make changes to how you presented mathematical topics?
    b. Did you make changes to what content you presented?
    c. Did you make changes to the order in which you did things in class?
    d. Did you make changes to the tasks/problems you assigned students to do in class?
    e. Did you make changes to the work you assigned the students for homework?
8. What would you do differently next time?
9. How is this class typical of other class sessions? Describe a class session that was very different from this one.

MAPPING (Goals): Questions about how this class fit into the broader goals of the course.

10. What did you intend for your students to learn today?
11. How well do you feel they learned it?
12. In our first interview, you said that the purpose(s) of this course is/are… In which ways did this particular lesson address those particular purposes?
13. Tell me about the relevance/importance of the topic you covered today. How does it fit into the curriculum and the purposes of the course?

COMPARING TEXTS

Have the instructor read/skim the selection from his/her textbook.

14. Can you point to some specific things that you like about this textbook passage?
15. Can you point to anything you dislike, or feel could be improved?
16. Do you feel this section is typical of the rest of the textbook?
17. Do you think this section is an easy or hard resource for teaching, and why?
18. Do you think students find it easy or hard to use this section as a resource for learning, and why?

Have instructors read the second selection. Ask the following questions, and then do the same for the third selection.

19. Is there anything about this section that stands out to you as interesting or unusual?
20. How does this section seem to compare, for better or for worse, with your own textbook selection? (Is there anything you like? Anything you dislike?)
21. Do you think it would be easy or hard to use this section as a resource for teaching, and why?
22. Do you think students would find it easy or hard to use this section as a resource for learning, and why?

DEPARTMENT CHAIR INTERVIEW

BACKGROUND: Structure of the course within the college, professional background of the instructor, etc.

1. What is your current position in the college?
2. How long have you been in that position? How long have you been working at your college and what did you do before becoming department chair (if applicable)?
3. What did you do before coming here?
4. What is your educational background? What degrees have you earned, and where did you earn them?
5. [If teaching] What courses are you teaching this summer? What courses did you teach during the fall and winter semesters of this past year?
6. Have you ever taught the course offered for elementary teachers?

- Can you tell me about the department? What sort of involvement do you have with mathematics?
- How many mathematics instructors are there? Part-time? Full-time?
- Can you describe the student population a little? Are students typical undergraduate age? Older? Younger?
- Where do most of your students transfer?

MAPPING (Goals): Questions about the overarching goals of the class—the knowledge, skills, and dispositions that students are to learn.

7. How long have these courses for elementary teachers been taught at your college? Why do you offer these courses?
8. Ideally, what should students learn in this class?
    a. What *knowledge* should students come away with? If the course is successful, what are examples of some things they should know?
    b. What *skills* should students come away with? What should they be able to do?
    c. What *dispositions* should students come away with? What attitudes do you hope they will have/develop?
9. Why do you consider these things to be important for the students to learn?

DESIGN (Resources): Questions about how the textbook and other resources are chosen for use in the course.

10. Tell me about the process by which this textbook was selected.
    a. What was/is your involvement in the textbook selection process?
    b. How often does the textbook come under review?
    c. What do you consider the most important considerations for choosing a textbook for this class?
    d. What other considerations do people involved in choosing the textbook consider important?
11. Tell me about your current textbook. How long has this textbook been in use? What textbook was used before? Why was this new textbook chosen?

CONSTRUCTION (Enactment): Questions about how the course is structured, what a typical class session looks like, how students are evaluated, etc.

12. Is there a common syllabus used from class to class (semester to semester, teacher to teacher)? If yes, how is the syllabus written? Who is involved in this process? If no, what is the same and different about the syllabi? Does the syllabus have to go through an approval process?
13. How do you choose who will teach this course? Is it easy or hard to find instructors for the mathematics course for elementary teachers?
14. As a department, how do you ensure that the content, structure, and teaching of the course are appropriate to the course purposes?
15. What is the process by which the course comes under review?

16. What resources are available to teachers of this course? (Prompt: resources might include tutoring for students, manipulatives, computers and computer programs, or classroom spaces—classrooms conducive to groupwork)

CONTEXTUAL ISSUES (If not addressed previously)

17. Many students will transfer to another institution to complete their education degrees. How do you ensure that this course will transfer?
18. What makes the content of this course different from other mathematics classes taught within the department?
19. Do you have a sense that the teaching demands of this class are different from the teaching demands of other mathematics classes?
20. Do you have a sense that the students who take this course differ from students enrolled in other courses? Are there any student characteristics that are unique to this particular course? Are there students who are taking this course for a purpose *other* than transferring credits to an education program?

Appendix C

Instructional Practices Questionnaire

1. Below are learning activities that some instructors have their students do when they teach mathematics to elementary teachers. In your mathematics course, how often do/did students do each of the following activities?

   1 – Never or almost never
   2 – Some lessons
   3 – Most lessons
   4 – Every lesson

   a. Explain the reasoning behind an idea.
   b. Work on problems for which there is no immediate method of solution.
   c. Use computers to solve exercises or problems.
   d. Write equations to represent relationships.
   e. Practice computational skills.
   f. Use graphing calculators to solve exercises or problems.
   g. Listen to you explain terms, definitions, or mathematical ideas.
   h. Listen to you explain computational procedures or methods.
   i. Analyze similarities and differences among several representations, solutions, or methods.
   j. Prove that a solution is valid or that a method works for all similar cases.
   k. Work on mathematical communication and/or representation.
   l. Work individually on mathematics problems.
   m. Make conjectures and explore possible methods to solve a mathematics problem.
   n. Discuss different ways that they solve particular problems.
   o. Work in small groups on sets of problems.
   p. Work in small groups on investigations that take part or all of the class period.
   q. Work on group investigations that extend for several days.
   r. Write about how to solve a problem in an assignment or test.
   s. Do problems that have more than one correct solution.
   t. Use manipulatives such as base ten blocks or fraction bars.

2. How long (in minutes) is a typical class period?

3. On a typical day in your math class, about how many minutes are/were spent on each of the following? (I understand this may vary from class to class, so approximate as best you can.)

   a. Administrative tasks
   b. Homework review

c. Lecture-style presentation by instructor
d. Instructor-guided student practice
e. Re-teaching and clarification of content/procedures
f. Work in small groups
g. Independent student practice
h. Other (please specify)

4. Below are learning goals that some instructors have for their students in mathematics courses for future teachers. How often do you take each of these learning goals into account when you plan for instruction?

   1 – Never or almost never
   2 – Sometimes
   3 – Often
   4 – Always

   a. Perform elementary-level computations.
   b. Gain a deep, conceptual understanding of elementary-level topics.
   c. Learn elementary-level topics at a college level.
   d. Explain mathematical ideas to others.
   e. Learn how children think about mathematics.
   f. Learn about effective teaching methods.
   g. Express mathematical ideas in multiple ways.
   h. Develop habits of professionalism.
   i. Become familiar with national or state standards (NCTM, etc.).
   j. Work effectively in groups.
   k. Be able to justify or prove mathematical assertions.

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