The do's and don'ts of teaching reform mathematics in rural Iowa

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The do’s and don’ts of teaching reform mathematics in rural Iowa

by

Annie Hall Pettit

A thesis submitted to the graduate faculty
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

Major: Education,

Program of Study Committee:
Jennifer Seymour, Major Professor
Corey Drake
Thomas Alsbury

Iowa State University
Ames, Iowa
2006

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Graduate College
Iowa State University

This is to certify that the master's thesis of

Annie Hall Pettit

has met the thesis requirements of Iowa State University

Signatures have been redacted for privacy
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ABSTRACT

In 1989, the National Council of Teachers of Mathematics published the first Standards document. Since then, numerous instructional materials such as textbooks funded by the National Science Foundation (NSF) have been published that are more aligned with the Standards than traditional materials. This study focused on what teachers in rural Iowa faced when they implemented NSF-funded textbooks at the secondary level. A comparative case study methodology was used to compare teachers' experiences at two rural schools that continue to use the textbooks to teachers at two other rural schools that have discontinued their use.

The results showed that teachers faced multiple factors in several areas—the school, teachers themselves, professional development, students, and the community. An emergent issue was teachers providing supplementary material for extra skills practice, especially to address standardized tests and the concerns of the principal and the community. The results also surprisingly showed that continued or discontinued use of reform textbooks did not cleanly correlate with whether or not the teachers believed in reform mathematics curriculum materials. Some teachers who continued to use the textbooks were not wedded to reform teaching, while others who discontinued use still taught in a reform-oriented way. To conclude, the teachers gave advice to other rural schools who were interested in adopting reform textbooks. Among the suggestions given, teachers discussed the importance of learning from other teachers' experiences using the textbooks; this study provides access to six different teachers' experiences.
INTRODUCTION

Research has shown there are multiple, coordinated factors influencing the continued or discontinued use of reform mathematics curriculum materials. There are five main categories of factors that typically influence novel curriculum implementations—school, teachers, professional development, students, and the community (Alsbury, Shaw, & Hand, 2004; Bay, Reys, & Reys, 1999; Cohen & Hill, 2001; Dillon, 1993; Sarason, 1990; Schoen, Cebulla, Finn, & Fi, 2003). These factors have differing degrees of influence in various settings. Rural schools are one very important setting in which very little research is being conducted (Beeson & Strange, 2000, 2003). There are three important reasons why implementation of reform curriculum materials in rural contexts needs to be studied. First, the principle of equitable access to high quality mathematics instruction means that all students, urban and rural, should have opportunities to engage in meaningful mathematics. Second, the findings from urban and suburban contexts that have been studied may not generalize to rural contexts. Finally, investigating rural schools is essential to Iowa’s future mathematics education success as 68% of the schools are classified as rural (National Center for Educational Statistics, 2001a).

In Iowa, there are some rural teachers who have implemented the curriculum materials “successfully” in that they are still using them with no intention to stop. Meanwhile others have been unsuccessful in that they have reverted to traditional curriculum materials. This research investigates how teachers addressed the different factors in continued and discontinued implementations. The intention is to provide a better road map to rural teachers wishing to fulfill the goal of Iowa’s Every Student Counts professional development
project—that all students will have access to high quality problem-solving based mathematics instruction advocated by the National Council of Teachers of Mathematics (NCTM) (Every Student Counts, n.d.).

The research question is: Which of the factors commonly associated with curriculum material adoption did teachers address, and how did they address them, in continued and discontinued implementation of reform mathematics curriculum materials in rural Iowa schools? To be clear, this study is interested in the participating teachers' perceptions of the factors relative influence on their experiences implementing the curriculum materials. For the purposes of this study, only mathematics curriculum materials that were developed with National Science Foundation (NSF) funding will be considered reform curriculum materials.
LITERATURE REVIEW

NSF-Funded Mathematics Curriculum Materials

After the publication of *Curriculum and Evaluation Standards for School Mathematics* in 1989 by the National Council of Teachers of Mathematics (NCTM), textbooks were written that provided materials to help create the envisioned reformed mathematics classrooms. The NSF funded selected teams of authors to write textbooks that were aligned with the NCTM *Standards*. Thirteen projects were funded to develop these materials for students in all grades as shown in Table 1 (ARC Center, 2006; Dossey, McCrone, Giordano, & Weir, 2002).

<table>
<thead>
<tr>
<th>Table 1. NSF-funded textbooks</th>
<th>Elementary</th>
<th>Middle School</th>
<th>Secondary</th>
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<tr>
<td>Everyday Mathematics</td>
<td>Connected</td>
<td>Core-Plus Mathematics</td>
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<td></td>
<td>Mathematics Project</td>
<td>Project (CPMP):</td>
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<td></td>
<td>(CMP)</td>
<td>Contemporary Mathematics in Context</td>
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<td>Math Trailblazers: A</td>
<td>Mathematics in</td>
<td>Interactive Mathematics</td>
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<tr>
<td>Mathematical Journey</td>
<td>Context</td>
<td>Program (IMP)</td>
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<tr>
<td>Using Science and Language</td>
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<tr>
<td>Arts</td>
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<tr>
<td>Investigations in Number, Data, and Space</td>
<td>MathScape</td>
<td>MATH Connections: A Secondary Mathematics Core Curriculum Initiative</td>
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<td></td>
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<tr>
<td></td>
<td>Middle Grades</td>
<td>Integrated Mathematics: A Modeling Approach Using Technology (SIMMS)</td>
<td></td>
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<tr>
<td></td>
<td>MathThematics</td>
<td>(STEM)</td>
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<tr>
<td></td>
<td>The Middle School Applications Project</td>
<td>Application Reform in Secondary Education (ARISE): Mathematics: Modeling Our World</td>
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<td></td>
<td>(MMAP)</td>
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This was the first time multiple curricula that reflected the academic research on mathematical thinking, teaching, and learning, became widely available and advertised (Schoenfeld, 2002).

The textbooks were written so that students encounter topics from several content strands such as algebra and geometry every year, in contrast to traditional textbooks that separate the topics into courses. Daniel Brahier (2000) said,

The topical areas of algebra, geometry, discrete mathematics, and so forth, are merely content organizers that were never intended to build walls between those areas of study. Virtually any algebra problem can be represented geometrically, and geometry problems can be represented by algebraic expressions or equations (p. 73-74).

While a typical, traditional text shows the procedure for solving a mathematics exercise or question, gives several examples, and then has the student solve twenty or more of these same types of questions, the NSF-funded textbooks were written using a different approach. While each textbook has a slightly different format, they all use problems to introduce mathematical concepts to students. The students are guided through a series of problems that help them discover or understand a mathematical concept. These problems were designed to be real-world problems so the students learn mathematics in context (Huntley, Rasmussen, Villarubi, Sangtong, & Fey, 2000). Furthermore, the integration of technology, especially graphing calculators, became more heavily emphasized (Thompson & Senk, 2003).

The participants in this study have taught or continue to teach with Core-Plus Mathematics Project (CPMP). It was one of five programs deemed “exemplary” by the United States Department of Education out of 61 mathematics textbooks in 1999 because it
provided evidence of being effective with many populations in various locations (Thomas, 1999). CPMP lessons center around investigations that are completed over a period of several days (Huntley et al., 2000). Each lesson in CPMP starts out with an activity completed by the entire class called Think About This Situation. This activity is intended to connect the lesson to students’ prior knowledge and generate a discussion for the upcoming investigation (Schoen et al., 2003). Then students complete an investigation in pairs or small groups. Questions, referred to as Checkpoints, are provided to help guide the students to the big mathematical ideas. After the completion of the investigation, the class comes together for a discussion. Then the students are assigned several homework problems that they are to complete on their own (Schoen et al., 2003).

The reform called for the teacher’s role in the classroom to change as well. The teacher no longer stands at the board and lectures the entire time but facilitates problem solving (Lubienski, 2000). This shift can be seen in CPMP. For example, the teacher directs the classroom discussion during the Think About This Situation (Coxford et al., 1997). During the investigation and classroom discussion, the teacher serves as a facilitator. He or she walks around the room helping students and questioning them about their thinking on the topic. Then during the discussion, the teacher calls on different students to explain their findings and helps the entire class understand the final results (Coxford et al., 1997).

Factors Influencing Curriculum Implementation
As mentioned earlier, there are five main categories of factors—school, teachers, professional development, students, and the community. The following sections will explain the categories and multiple factors within each. To be clear, the factors within each category are not an exhaustive list but typical examples identified in the literature.
School

Within the school, there are a variety of influences including the administration, other mathematics teachers, the school board, and school policies. The administration’s role is multi-faceted as they must understand the mathematics reform (Goldsmith, Mark, & Kantrov, 2000), be a liaison between teachers and parents (Reys, Chavez, & Reys, 2003), and support the teachers (Bay, Reys, et al., 1999). Teacher support involves sending teachers to professional development workshops and providing time for teacher collaboration (Bay, Reys, & Reys, 1999; Stevens, 2001). The administration also needs to foster an environment that is supportive of the reforms (Stevens, 2001).

Other mathematics teachers can play an important role. Teachers have mentioned the importance of working with their colleagues when implementing reform curriculum materials (Bay-Williams, Reys, et al., 2003). Being able to ask questions, share ideas, and plan upcoming lessons with another person helped teachers in the implementation process (Bay-Williams, Reys, et al., 2003). Implementing any new curriculum materials can be difficult so having colleagues to share successes or difficulties can also be helpful (Van Boening, 1999). Learning from one another and having support while change is occurring can help teachers modify their teaching practices (Secada & Adajian, 1997).

In the broader bureaucracy of a school, the school board needs to support the teachers during reform curriculum adoption and use (Dillon, 1993). School board members may receive phone calls from parents raising concerns about the program. Teachers can become discouraged if they feel the board is taking the parents’ side (Dillon, 1993).

The multiple, interrelated policies of a school influence implementation in complicated ways. Cohen and Hill (2001) found that teacher “learning was a key element in
connecting policy with practice” (p. 6). Yet if the finances are not available, then teachers do not have these opportunities to learn (Cohen & Hill, 2001). Besides funding for professional development, teachers need materials to implement the reform materials (Glatthorn, 2000). In addition, the school’s assessment procedures are another important policy issue. Darling-Hammond and McLaughlin (1995) argue that schools should evaluate their curriculum and testing procedures to remove any aspects that conflict.

**Teachers**

The impact of the teachers in reform curriculum adoption must not be underestimated. They play a large role in how well the students achieve (Schoen et al., 2003) and in how the students view the curriculum materials (Bay, Beem, Reys, Papick, & Barnes, 1999). If the reform practices do not fit their philosophy of teaching or mathematics, teachers can ignore them altogether or adopt pieces of the reform but still leave their traditional teaching practices unchanged (Bay, Beem, et al., 1999; Cohen & Hill, 2001; Jones, 1997). In some cases, teachers may need to change their beliefs if the use of reform curricula materials and teaching practices are to be sustained (Cohen & Hill, 2001; Jones, 1997).

This is particularly true because teachers often feel overwhelmed when encountering reform curriculum materials (Van Boening, 1999; Romberg, 1997). The content, teaching practices, teacher and student roles, and assessments are very different than what most teachers have experienced (Romberg, 1997; Stevens 2001). Since the NSF-funded textbooks were designed around the 1989 Standards (Senk & Thompson, 2003), students learn concepts in such areas as algebra and functions, geometry, statistics, and probability (NCTM, 1989). This can be problematic for teachers because they may not have the content knowledge or may have never taught some of the concepts before (Romberg, 1997).
Furthermore, the concepts and procedures are presented through contextual problems that students work on in groups (Senk & Thompson, 2003). The teacher's role is no longer to demonstrate procedures that students copy (Senk & Thompson, 2003) but facilitate group work, guide discussions, and ensure the intended mathematics embedded in the problems was learned (Coxford et al., 1997). The issue of assessment will be discussed in the section considering students' influences on curriculum implementation.

Professional Development

Various studies have shown that professional development plays a significant role in teachers' implementation of reforms (Cohen & Hill, 2001; Schoen et al., 2003). The length and content of the professional development workshops is vitally important. The most successful workshops last at least a week and explain the rationale and setup of the curriculum materials, engage the teachers in the curriculum materials as learners and teachers, and demonstrate the assessments involved (Bay, Reys, et al., 1999; Briars, 1999; Cohen & Hill, 2001). Without a solid understanding of the curriculum materials, the teachers will have a hard time teaching it the way it was intended.

Students

Teachers report multiple pressures that students bring to bear on teachers' abilities to successfully implement reform curriculum materials. Reform curriculum materials often involve a radical departure from what students are accustomed. It takes time for the students to become comfortable with the reform materials (Bay, Reys, et al., 1999). After the adjustment, many students favor the reform curriculum materials over a traditional approach and consider mathematics as relevant to their futures (Bay, Beem, et al., 1999; Gresalfi & Boaler, 2005). Teachers who have used reform curriculum materials have noticed the high
levels of mathematical thinking their students exhibited (Bay, Reys, et al., 1999; Van Boening, 1999).

Teachers also report that the general issue of assessing students is particularly difficult (Walen & Williams, 2000). For example, multiple, open assessments are supposed to be used with reform curriculum materials, but teachers can find it hard to gauge student achievement with these assessments. Traditional assessment requires only evaluating whether or not a student’s solution is identical to the teacher’s. Open assessments require teachers to recognize that a different solution might be as good as, or better, than their own. This is clearly a more difficult task (Romberg, 1997). Students’ scores on state standardized tests are another significant factor affecting teachers’ ability to implement reform curriculum. Many tests that states use focus on material that the reform curriculum materials do not emphasize, and teachers are concerned with this mismatch (Walen & Williams, 2000).

Community

The community, especially parents, has ideas of what it means to know and do mathematics. Typically their views align more with traditional curriculum materials (Cooney & Shealy, 1997). Several researchers have suggested that a school should involve the parents in the adoption process and possibly have parent liaisons to help understand the viewpoints and concerns of parents (Dillon, 1993; Goldsmith et al., 2000). In addition, it is important to inform the parents about the curriculum materials, their rationale, and the mathematics they involve (Goldsmith et al., 2000; Johnson, 1992). This can help address parental concerns which usually include pedagogy, content, and effectiveness of the curriculum materials (Bay-Williams & Meyer, 2003). Teachers can hold curriculum nights where the parents learn about the curriculum materials and experience them as learners, send letters home explaining
the content involved in the homework, and listen to parental concerns (Bay-Williams, Reys, et al., 2003; Goldsmith et al., 2000).

Involving the parents and community early is important. Research has documented that some programs have failed largely due to the fact that parents have been left out of the process (Bay-Williams & Meyers, 2003; Peressini, 1998). If parents do not know how to help their children with homework or perceive the program is ineffective, they understandably get very emotional and vocal about their concern for their child’s education and opportunities (Bay-Williams & Meyers, 2003).

The Rural Context

Despite the large number of rural schools, they have largely been ignored by education researchers (Beeson & Strange, 2000). Overall, approximately 44% of schools and 16% of students in the United States are located in rural settings. In several parts of the United States, the percentages are much larger. This is the case in Iowa where 68% of the schools are classified as rural, accounting for 29% of Iowa students (National Center for Educational Statistics, 2001a, 2001b). Thus, studying the rural context is important to understanding why and how reform mathematics curricula implementations succeed or fail. Equal opportunity in education requires that all students have access to reform mathematics curriculum materials, including rural students. If mathematics is to be “for all students” (NCTM, 2000, p. 12) and all students are to have a curriculum that is “mathematically rich, offering students opportunities to learn important mathematical concepts and procedures with understanding” (NCTM, 2000, p. 3), then rural students need to receive the same attention as other populations. When President George W. Bush announced No Child Left Behind (NCLB) in 2001, he stated, “These reforms [NCLB] express my deep belief in our public
schools and their mission to build the mind and character of every child, from every background, *in every part of America* [italics added]" (NCLB, 2001, ¶ 1). In a diverse, wealthy country, the ideal of equal opportunity is seen as a basic human right. Education Trust and NCLB are just two examples of highly-visible, strong political forces advocating equal opportunity for high-quality education.

Despite the importance of the community, the context of reform is often considered extraneous to the efforts inside of the school (Howley, 2003). As Sarason (1990) has clearly stated,

> No major educational problem is only a "within system" problem—that is arising in and comprehensible only in terms of an encapsulated school culture. . . . That means that any action that stays within the system—based only on its own resources, personnel, decision-making processes, and planning—is misconceived, parochial, and likely to fail (p. 35-36).

What occurs in schools is influenced by the society and the particular communities in which they operate. The community’s beliefs about what mathematics should be learned and how it should be learned can determine what it allows the school to do (Dillon, 1993). Furthermore, the relationships among the people in and out of the school and their personal life circumstances (Howley, 2003) also influence how a community will or will not support curriculum reform efforts (Sarason, 1990). Howley (2003) said, “...context must assume equal importance with the technical concerns of curriculum and instruction” (p. 219).

Given the importance of the context in which the school operates, understanding rural communities and their relationships with schools is fundamental to this study’s ability to accurately characterize the participating teachers’ efforts to implement reform mathematics...
curriculum materials. Rural communities and schools are often described as being like family. They are safe, close, and comfortable (Herzog & Pittman, 1995). In rural settings, the school and community are closely linked with the school often seen as the center of the community (McClelland, 1997). Because of size, the community and school personnel can interact in ways that are not possible in larger communities (Howley & Eckman, 1997). Parents know school personnel and interact with them often outside of school in multiple settings such as 4-H, church, grocery shopping, and exercising (McClelland, 1997). These close personal relationships between parents, teachers, and administrators are often taken for granted. “It is a part of everyday life in rural schools” (McClelland, 1997, p. 110).

Briars (1999) stated that systemic mathematics reform “requires a lengthy and complex process” (p. 32). This statement refers to research on urban and suburban systemic reform. This may be less true in a rural setting, where the number of school personnel involved is far fewer; there are usually only one to three high-school mathematics teachers, a principal, and a superintendent. The number and power of people peripherally involved may be more complex, however, because of the nature of rural communities. If the community does not like or understand what is happening at the school, it may be easier for them to voice concerns because of the community-school relationships (McClelland, 1997). Therefore, while rural teachers may have fewer difficulties coordinating their implementation efforts, one conjecture is that the community may play a larger role in rural settings than previous studies have documented in non-rural settings.
METHODS

Participants and Methodology

In order to determine the participants for the study, this study used the State of Iowa Department of Education’s definition of rural. According to Shawn Snyder, Chief of Bureau of Planning, Research and Evaluation, Iowa uses the Locale Codes determined by the Census Bureau to define rural (Shawn Snyder, personal communication, September 8, 2005). The Locale Codes were created in the early 1980s and are “based on both the proximity to metropolitan areas and on population size and density” (National Center for Educational Statistics, 2000, Locale Codes Section, ¶ 1). Every public school has a locale code which can be found through the United States Department of Education (National Center for Educational Statistics, 2006). This study used schools that had “rural” Locale Codes.

The methodology used in this study was a comparative case study (Bogdan & Biklen, 1998). A case study is an in-depth examination of a bounded system (Merriam, 2001). A comparative model was chosen so that two contrasting cases, teachers who continue to use reform materials and others who have stopped using them, could be studied. Two rural schools continuing to use an NSF-funded secondary mathematics textbook were compared to two other rural schools that have stopped using the same textbooks.

The total number of participants was six, three who continue to teach with the reform materials and three who have stopped. Pseudonyms are used for the teachers and school names. To help the reader pair teachers with their schools, the teachers and school names have the same first initial. In addition, the schools that have continued to use the textbooks are named after presidents while the other schools are named after vice-presidents as
summarized in Table 2. Of the three teachers who still use NSF-funded mathematics textbooks, Nancy and Nicole taught at Nixon and Ethan taught at Eisenhower. Of the three who have switched curriculum materials, Samuel and Sophie taught at Sherman school district and Caleb at Calhoun. Because this study is located in a rural context, the schools often have just one full-time mathematics teacher at the middle-school or secondary level.

<table>
<thead>
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<th>Table 2. Schools and Teachers</th>
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<td><strong>Continued Use of Textbooks</strong></td>
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<tr>
<td>Nixon High School:</td>
</tr>
<tr>
<td>Nancy</td>
</tr>
<tr>
<td>Nicole</td>
</tr>
<tr>
<td>Eisenhower High School:</td>
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<tr>
<td>Ethan</td>
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</table>

The Schools and Communities

The schools have around 30-40 students per grade with Nixon being the exception with 60-70 students. Because of its size, Nixon is the only one of the schools that has more than one full-time mathematics teacher. It has two. Every school has another teacher who teaches at multiple grade levels, middle school and high school, or at another school part-time.

Each school district continues to use reform mathematics curriculum materials at one grade level—elementary, middle, or high school. In fact, several schools use or have used them at multiple grade levels. At the secondary level, Sherman and Calhoun used the reform textbooks for 1-5 years while Nixon and Eisenhower have used them for over eight years.

Nixon and Eisenhower schools are both on block schedules, while Sherman and Calhoun are not. Until a few years ago, Sherman did have block scheduling. This school policy is important because it was one reason Eisenhower and Sherman adopted the reform
textbooks. Two teachers, Ethan and Sophie, were not advocates of block scheduling. Yet, when the decision was made, they both chose to use reform textbooks in order to make better use of the extended class time. Ethan reasoned that the traditional approach of lecturing for 60-80 minutes would not be the best way for students to learn mathematics. Sophie felt that using the reform textbooks corresponded well with block scheduling because it allowed ample time for data collection during the group investigations.

The student population of each school is made up of students from multiple small towns spread across farmlands. Samuel described the setting as being “as much a farming community as it is small towns.” Sherman is located within a county that includes a city with a population over 50,000 people. The other schools are not close to any midsize or large city. Ethan described his school setting as a family. He said,

It’s more family. That’s the good thing about small schools….In a smaller school, it’s everybody knows everybody and everybody does care about you and you know who you’re reaching out to touch. And I think that’s a good thing about being in a small school.

Teachers

The participants in this study had a wide range of teaching experience. Samuel and Nancy had less than eight years experience and the others had over 15. The three teachers, Nancy, Nicole, and Ethan, who continue to use the reform textbooks have done so for about eight years. Caleb, Samuel, and Sophie used the specific textbook of this study for five years or less. Sophie teaches at the secondary and middle-school levels and she continues to use a reform textbook with the middle-school students. Because the focus of the study is on the
Data Collection

These teachers were all interviewed using semi-structured interviews (Esterberg, 2002). The pronoun "I" in the following refers to the first author¹ who conducted all of the interviews. The semi-structured approach allows the participant to share their opinions in their own words. The interviewer has topics she would like to ask, but the participants' responses help determine the direction of the interview (Esterberg, 2002). Two interviews were conducted with each participant. For the convenience of the participants, most of the interviews were conducted by phone. Only two interviews were conducted in person. The first interview for each participant involved asking the open-ended question, "Tell me about your experience with this curriculum." Without any other prompting, all but one of the participants talked about each category of factors—school, teachers, professional development, students, and the community. Follow-up questions were asked to have the participant expand on an issue in more depth. Some questions were general such as, "Tell me more about that." Others were more specific when the teacher was commenting on one of the factors. For example, when a teacher mentioned attending a workshop, I asked what they focused on at the workshop. The second interview served two purposes. It allowed me to ask clarifying questions from the first interview. In addition, I asked questions related to factors that appeared in the literature that the participant did not mention during the first interview. The questions were framed by stating that research has indicated that there are other factors

¹ There will be a second author when portions of this thesis are published.
teachers *sometimes* report, and the researcher was curious if the participant felt these influences or not.

**Data Analysis**

The analyses focused on locating emergent themes because teachers’ perspectives were the focal point of this study. Analysis of the data was done using a form of open coding. Key words were assigned to data that matched the factors from the literature such as parent reactions as well as new key words that emerged from the data such as teacher changes to the curriculum materials. Within each factor, coding was then done to identify themes that occurred across teachers. This was followed by focused coding that allowed a more in-depth look at the data based on the emerging themes (Esterberg, 2002). Software for conducting the analyses was Transana (Fassnacht & Woods, 2005) which allows coding of linked audio or video data and transcripts. In Transana, the interview clips were stored in a separate collection for each teacher. As the interview was transcribed, open coding was conducted by the researcher. To create summaries of the themes across teachers, groups related to the factors were created from the key words. Then new collections were created across the teacher collections based on common key words. This allowed for the comparison of teacher comments.

**Reliability and Validity**

Because all research is “concerned with producing valid and reliable knowledge” (Merriam, 2001), several measures were taken to insure validity and reliability during this study. Member checking was used for each participant. I had them look at the data from their two interviews as well as the tentative conclusions I had drawn from the data and asked them if the results were valid for their situation.
Then inter-coder reliability was addressed by having the second author, the major professor, code 20% of the total number of clips for each participant. These clips were randomly selected using a random number generated list. The inter-coder was supplied a Transana database with only the clips she was to code, the list of keywords with definitions, and examples when useful (not clips being coded). The inter-coder reliability was 80%.
RESULTS

The results will highlight the teachers’ experiences, especially how the rural context may present different issues than other settings. First a description of the teachers’ views of the textbooks and why the teachers thought that they continued or discontinued the use of the textbooks will be given. This will be followed by the teachers’ experiences with the five categories of factors—school, teachers, professional development, students, and the community. The results will conclude with the advice the participants had for other rural teachers looking to adopt the textbooks.

Continued or Discontinued Use of NSF Curriculum Materials

One might think that teachers using reform materials were strong advocates and that those who have stopped would oppose their use and prefer more traditional material. The results were not this clear cut. The following section describes the teachers’ views of the textbooks and why they continued or stopped using the reform textbooks as the primary curriculum materials.

Nixon and Eisenhower

Nancy specifically looked for a school where she could teach with an NSF-funded textbook. She really believed in this approach, and if her school stopped using the textbooks, she would look for another job. Unlike Nancy, Nicole did not initially have a favorable impression of the textbooks. While Nicole does like them now and has argued to keep them, she still did not share Nancy’s dedication. Nicole said, “I was not in favor of it at first, but I am now. I’ll teach whatever they want me to teach. If they want to decide to do something else, then okay.”
The teachers at Nixon continue to use the textbooks because they believe in how the books are structured and their approach to mathematics. Despite the negative community reactions in the Nixon school district, Nicole said they have not gotten rid of the textbooks because “we [the teachers] really think it’s better [than traditional].” Nancy and Nicole thought they had to do several things to sustain the textbooks’ use—publicize the positive aspects, keep test scores up, and keep the administration informed. Nancy also added that if there was any change in staff, they would need to help the new teacher. She said, “If there’s any change over in staff, we have to make sure they’re on board and getting the help and resources they need. And hopefully [attend the professional development]. I believe in that workshop.”

Ethan’s views fell between those of Nancy and Nicole. Ethan felt that the curriculum materials were not perfect, but “they were the best we were aware of for what we hoped to accomplish.” He continues to use them because he also likes the approach the books take toward learning mathematics, and he sees how much mathematics his students are learning. Ethan is confident they will continue to use the textbooks “as long as they are working for the kids we teach.”

_Calhoun and Sherman_

Caleb’s position was interesting because, although he had four summers of professional development experiences with the materials before adopting them, he was not comfortable with the “teacher as facilitator” model. While Caleb felt that the activities were good, the way the textbooks were to be implemented with group work and a less directive teacher role did not suit him. He said, “It didn’t fit me [the teacher’s role with the reform textbooks] as well as the way I do it, for better or worse.” Therefore he stopped using the
textbook. He prefers to create his own curriculum, yet Caleb still incorporates some similar activities to the ones found in the reform textbooks but they are “more teacher-directed rather than textbook directed.”

The situation at Sherman was different than the other schools because Sophie and Samuel were not at Sherman when the textbooks were adopted. Sophie had seen the textbooks before she started her current position and became “intrigued” by them. Despite being in a school where the decision was made to stop using them at the secondary level, she still believes in this approach to teaching mathematics and continues to use reform textbooks at the middle-school level. Unlike Sophie, Samuel had never heard about them or the reform teaching style before he started. He said that even though “they looked completely foreign,” he tried to implement the textbooks when he started. He commented,

I gave it my best shot. If I could have found success from a student standpoint, and I was getting the content they needed to them, I'd still be doing it. I really couldn't find where I was able to plug in stuff at the right time because I didn't know.

Currently he would not be willing to use the textbooks as a primary instructional tool because he does not feel that the students could learn enough mathematics with the reform textbook being the sole curriculum materials used. He still uses several reform textbook lessons when he wants to extend the content from traditional textbooks.

There were multiple reasons why Sherman stopped using the reform textbooks. Samuel said of the decision to discontinue using the textbooks—

It was a combination of my frustration, the parents' concerns, the fact that we had a lot of frustrated juniors and seniors who didn't know what to tell colleges how much
math that they had. And I think the administration was concerned about test scores too.

Sophie listed similar reasons for the discontinued use, and she stated "definitely the community was involved." She also added that it probably did not help that the school district had so many mathematics teachers leave to teach in larger school districts (not necessarily because of the reform textbooks). Since there was a new mathematics teacher at Sherman every couple years, it seemed that there was no continuity in the textbooks' use as each new teacher had to figure out how to optimally implement the textbooks.

**Five Categories of Factors**

As they tried to implement the curriculum materials, all of the participants in some form or fashion had to address each of the five categories of factors—school, teachers, professional development, students, and the community—but with differing degrees of emphasis. As mentioned earlier, five of the six participants discussed all of these categories without any prompting. However, within each factor, the research literature identified several key issues that teachers sometimes had to be prompted to discuss. For example, the teachers did not initiate a discussion on how they assessed their students. In addition, two issues not listed in the literature review emerged from the interviews—all of the teachers reported modifying the curriculum materials in very similar ways and the teachers discussed the pressure the teachers felt to prepare students for college mathematics. Keeping in mind that there was not a clear cut distinction in the use or discontinued use of the textbooks, the following sections answer the research questions by detailing (a) commonalities across teachers regarding each factor and (b) how they dealt with or would suggest handling each of
the factors based on their experiences. The results conclude with participants' advice for others trying to implement reform textbooks.

**School**

The most salient school influence was the administration, specifically the principals. Their support or skepticism of the reform textbooks was apparent to the teachers. Other mathematics teachers and school policy played a role as well, while the school board was not a concern for most of the teachers.

*Administration*

In these schools, the administration is primarily the school principal. When the reform textbooks were first adopted by each school, the principals were all supportive. Some became more involved such as the principal at Eisenhower. When Ethan first said he wanted to adopt the textbooks, the principal said, "You are the [mathematics] expert. You're supposed to know what you're talking about." Ethan then took the principal to an informational meeting on the textbooks, and after adoption, the principal participated in professional development with the teachers. As a result, Ethan said that the principal "was pretty convinced" about the program and said "this makes sense. This is how people like us who don't know anything about math learn math." Even though all of the principals did not get as involved, each teacher expressed that they felt supported by his or her principal.

While the curriculum materials were being implemented, three of the four schools hired a new principal at least once. Except for Eisenhower, these new principals had more skeptical views of the mathematics curriculum materials. The teachers said that they believe these principals felt that a traditional curriculum would be better. After the principal at Sherman helped make the decision to discontinue using the reform textbooks at the high-
school level, he turned next to the middle-school level. Sophie refused this principal’s request to stop using the reform curriculum materials at the middle-school level. Sophie said, “I could see if somebody else [a new principal] came in; I could see that being an issue they wanted to discuss.” Nicole had similar sentiments on the future of their program. She said, “He [the new principal] has not put pressure on us to change yet. I don’t know what’s going to happen in the future.”

With constant principal changes, the teachers saw how important it was to always have his or her support. According to the participants, they felt that the principal needs to inform new teachers about the reform materials, send teachers to professional development that focuses on their specific reform textbooks, allow teachers to adapt the materials to best fit their students, and listen to their teachers. In order to see the importance of all these, the principals have to be knowledgeable about the curriculum materials.

At Sherman and Nixon, the two schools that received a significant number of parent complaints, many complaints were made to the principal. When the school board raised concerns at Nixon, it was the principal who had to address their concerns. Sophie and the teachers at Nixon felt that it was partly the teachers’ role to educate the principals. Sophie commented,

I think one thing people forget is involving the administration because you as a teacher, as a department, you’re in mathematics so you really see...what is new in your area. Administrators are kind of all over the place and need to be educated on issues sometimes.
If teachers do not inform the principal, then the principal may get misinformation from other places. "Keep administrators aware of changes, aware of the program so they have good information, not misinformation from other sources," advised Nancy.

School board

Most of the teachers expressed that the school boards were not involved in their decision and use of the textbooks. If they had any interaction with the board members, it was individual members raising concerns because of their own children. The school board at Nixon was the only one that asked any questions, and they were about test scores. The principals handled these concerns raised by the school board so the teachers never had to speak directly to the school board.

Other mathematics teachers

Other teachers clearly impacted the participants, and it is notable that teachers from the past as well as the present were important. While most of the participants were at their respective schools during the first couple years of implementation, this was not the case for Samuel. Sherman had multiple teachers since the textbooks were first adopted. Sophie believed this "revolving door" of mathematics teachers may have contributed to some problems with the use of the curriculum materials. When Samuel first started teaching, he found that the previous teachers may not have optimally implemented the program. He described former teachers' approaches as "turning the kids loose."

Because of the rural setting of the schools, only Nixon had two full-time mathematics teachers. When the textbooks were first adopted, Eisenhower did have two full-time teachers, but that has since changed. The other teachers work alone. Ethan, Nicole, and Nancy all found it very valuable to have another teacher to discuss ideas and to make adjustments in the
materials as needed. Ethan found the collaboration especially helpful the first year in determining what worked and what did not. Samuel found it frustrating trying to implement the materials without any help. Sophie echoed his sentiments as she continues to implement reform materials at the middle-school level. She knows that teachers at other, larger schools are able to interact with one another. She wishes there was time or an organized meeting that would bring together teachers from different schools to discuss their experiences.

**Policy**

While it is expected that school policy will have an effect on curriculum material implementation, some teachers in this study also were able to change some school policies. To use the reform textbooks appropriately, schools must allocate their budget to provide teachers with the manipulatives, materials to complete the investigations, and calculators. Some teachers were more fortunate than others to have these materials. Eisenhower did not have the money to buy calculators for all its students. Because of the socioeconomic level of most of Ethan's students, he did not feel comfortable asking the parents to buy calculators. He said,

There was a limit to the amount of material we could give the students [out of the textbook]. . . . I came to the conclusion we will do the stuff that we need the calculator on in class. And we'll have a classroom set of calculators. Anything that is needed outside of class, I've got to give them something else because they have to do homework.

The students at Nixon could buy their own calculators if they wished. The teachers found that it was often the special education students that did not have their own calculator so the
teachers pushed the administration to buy calculators for these students to have for the year. While costly, the administration consented.

Like the teachers at Nixon, Ethan was also able to push for some changes in his school district with the use of the curriculum materials. Ethan had been urging the administration to require the students to take three years of mathematics. When the reform textbooks were adopted, the administration agreed because of the setup of the curriculum materials.

Ethan was never a proponent of block scheduling, but recall that the longer time periods were one reason he adopted the new textbooks. After implementing it for a few years, Ethan convinced his principal that because the 80 minute periods resulted in less time overall than a traditional 50 minute period that met daily, he did not have enough time to enact many of the textbook activities. He said he needed even more time to teach. He was able to have his schedule modified so the students met everyday for 50 minutes their freshmen and sophomore years.

Because of the size of the schools, the teachers were able to set the policy of textbook adoption and discontinued use. At Nixon, Sherman, and Eisenhower, the teachers decided to adopt the textbooks. Only Calhoun had a committee. When Caleb decided to stop using the textbooks, he did not have to ask anybody. When the teachers at Nixon made changes in the curriculum, they were able to make that decision themselves. Nancy said,

The nice thing about being a small district, the two of us [mathematics teachers] really make decisions and then ask the administration to check off on it. . . . You don't even get to make decisions like pulling a chapter out and moving a chapter in because it affects so many people [in a large district].
Teachers

Many of the teachers discussed their goals of teaching and changes they made to the curriculum materials in very similar ways. This was also the case for what they thought their teaching role was with the textbooks although several teachers were not comfortable with this role. The variation in content knowledge made several teachers more at ease with teaching certain concepts more than others, but the teachers felt like they also gained a better understanding of certain mathematical concepts.

Teaching goals

There were two major goals that the teachers had for their students—to learn to think and solve problems as well as not have mathematics be a hindrance in the students’ futures. Both of these goals mentioned by the teachers were ones that several teachers noticed the curriculum materials trying to emphasize. Caleb said the textbooks are “guided mainly by real-world applications and problem-solving.” In addition, all students are supposed to use the materials so they learn important mathematics such as algebra and geometry. Nancy said with these textbooks “there can be classrooms with everyone [all ability levels] in them.”

The most common goal the teachers mentioned was having the students “learn how to think.” Ethan said, “If kids learn how to learn, then they’ll be ready to go ahead and to learn and be prepared to do everything they want to do.” The teachers thought that if students knew how to learn, they could take control of their own learning and apply what they have learned in different situations. Nicole summed up what many teachers felt—

Well, they really need to learn to be problem solvers, and to be more independent.

Not just learn the sequence of steps so they can do that sequence of steps on a similar problem. Hopefully they are learning to think and being able to apply some of the
things they have learned. And if they get in situations, even if it is something new, maybe they can relate it to something they've done before and apply something there. They really need to be problem solvers.

The other goal that was mentioned most frequently by the teachers was that mathematics would not be a limitation in the students’ futures. This included both the workplace and college. Nancy commented that “whatever job they choose, not have the mathematics be a limitation for them.”

Changes to curriculum materials

Making changes to the curriculum materials was an emergent but not surprising factor that arose. Recent legislative decisions mandate standardized testing that often emphasizes skill memorization. Also, several NSF-funded textbooks have added skill practice after the initial publications. All of the participating teachers felt the textbooks did not provide enough practice on mathematical skills such as solving equations. To remedy the lack of skill questions, the teachers supplemented with traditional materials. The teachers described these supplemental changes in terms similar to Ethan’s statement that they were adapting the curriculum materials so it would “satisfy our need.” The teachers said the textbooks did a nice job of developing the content and showing where it was used, but they found that their students needed more opportunity to practice the skills. While Nancy was hesitant to supplement at first, she later saw its importance. She said,

I think it’s important for them to have a little practice. It’s probably most important for the average student. The low student kind of gets bogged down in worksheet after worksheet and high students don't need that much practice. But an average student, to be really confident in a skill they need, they need some extra practice in my opinion.
The teachers said another reason they supplemented was standardized tests. Ethan said, “If you want the downside of them [the textbooks], they doesn’t always provide the drill and practice that will make the students successful on a standardized test and really firm up the skill part of it.” Nicole said the test scores had dropped when they initially implemented the textbooks. Since using supplementary skills practice, the students’ scores on the Iowa Test of Educational Development (ITED) and ACT have risen at Nixon. Nancy also saw other consequences from supplementing. Nancy commented,

I think the parents like seeing algebra worksheets that look familiar whether they can help or not. And the administration sees and can tell others that we’re willing to change, to adapt to make it absolutely the best program that we can offer.

Nancy also said it would have been “a harder fight” with the community and administration if they had not made these changes.

While all of the teachers supplemented, they each decided to do this at different times during implementation. Ethan did it right away. From his professional development experience, he knew that his students would need the additional practice. He made the supplemental changes as he went through the program the first year. Sophie also saw that she needed to supplement as she started using the textbooks. Nicole said it took a few years before the teachers at Nixon made any changes. “It took several years for us to get there to know what we needed and to start supplementing.” Samuel ran into the same problem. When he started teaching, he saw the need to supplement, but he did not know all the places this needed to happen. He said that if he was going to continue teaching with the textbooks, “I’m going to have to supplement in those places, and I had no clue when I was going to come up against that because I hadn’t taught here long enough.”
Supplementing with traditional materials was the major change the teachers made to the curriculum materials, but several schools also made other changes. Even though the teacher's edition of the textbooks states that students needed to complete an entire book before moving onto the next one, the teachers said they cut out units or moved several around because of time and standardized tests. To get through more of the textbooks, teachers at Eisenhower had started teaching from the textbooks at the end of eighth grade. The teachers at Nixon had also made several changes so the students could take more mathematics. Students are given the option of taking two mathematics classes at once so they were able to take calculus or statistics their senior year. The teachers at Nixon have also made the fourth year of the course resemble a traditional college algebra course to help prepare their students for college mathematics.

**Content knowledge**

Sophie and Caleb mentioned the textbook writers included content that is not typically found in traditional textbooks such as discrete mathematics. Because of this, some teachers encountered mathematical topics they had never taught nor studied as a student. They used their experiences from the weeklong professional development workshop, the textbooks, notes in the teacher's edition, and other textbooks to help prepare to teach these topics.

Even if some of the content was familiar to the teachers, several discussed they learned "why" something happened. Sophie said that "it's made me a better teacher. I understand a lot of the concepts better having taught this material." Nicole felt that her better understanding of mathematics was one reason she began to like the textbooks. "I've learned a
I learned a lot of content on why something works or what it’s used for. It was enlightening for me. There’s a lot of good stuff, a lot of good math to learn,” she said.

Role as teacher

Despite the positive views of the textbooks exhibited by most of the teachers, they said it was still initially difficult to teach with the books. Caleb said it was difficult to adjust to the textbooks “providing the activity” and “leading the discussion.” He was accustomed to being in front of the room leading the activities himself. Nicole said it was difficult to adjust to teaching the reform curriculum materials after teaching traditional materials where the teacher’s role was to tell students information. She felt that it was “hard to let the kids do the investigation without you helping them. It’s really hard to see them struggle with that and not just supply them with an answer and get ahead of where the investigation is.”

No matter the situation, most of the teachers described the role of the teacher while using these curriculum materials quite similarly. They said their role was “to be a facilitator.” It was not the teacher’s role to state facts but “to be a guide” and ask “good questions.” Nancy said,

I certainly do feel like a facilitator of the learning. I’m helping them come up with the new learning, the new connections, the new applications. I certainly don’t feel like I’m dispensing information. I don’t feel like that’s my job. I mean, what I want from them is for them to take ownership of their learning so they feel like it’s their job to do the thinking, and it’s my job to help them do that thinking rather than me doing the thinking for them or showing them how to do it.

Often, there is a tendency to think facilitator means complete hands-off. Samuel said,
I think there's a tendency to abuse it both from the standpoint of teachers' initiative to put any effort into things. It was certainly easy to set the kids loose and sit there and read a magazine all day which I think may have happened before [with the teachers who were previously at Sherman].

This “hands-off” view was also presented to Samuel at the 1½ days of professional development that he attended. Samuel said that he learned at the 1½ days of professional development run by other teachers that he was “to not help the students too much” and provide “minimal structure” so “the students can do the learning.” He described these teachers’ viewpoints being “as long as everybody knew what, when, where, and how, the kids were pretty much on their own.” He added, “they [the teachers who ran the professional development] were fine with that. And I wasn’t. I saw how the kids were struggling.”

For several of the participants, the distinction between traditional and reform teaching was not so clear cut. Samuel found he had to direct teach part of the lessons to give the students a good foundation. Otherwise they did not know what to do. Several other teachers also found themselves directly teaching but for other reasons such as time or being more comfortable with a more direct role. Caleb said, “I enjoy being up in front and leading [the lesson] and seeing those lights go on as they discovered things.” Several of the teachers found they played a multiple roles; they were “guides” at certain times, and at other times they clarified the mathematics concepts and any misconceptions that occurred.

Teachers talked often about balancing these roles. Nancy said that after students completed investigations, they were to come together as a class for a “summarizing activity to make sure that they learn what they were supposed to get out of that investigation.” According to several teachers, helping the students process the information and clearing up
misconceptions does not occur by just telling the students information. It happens more by asking good questions, having class discussions, and on rare occasions telling the students something after they have had an experience with the content. Ethan said,

The whole point is that there is supposed to be some investigation and grappling with the issues themselves. If you just step in and say, "Here's how you do it and this is what you need," then we've lost the exploration. That's kind of a key feature of what the [textbook] is all about.

The teachers felt that it was mandatory that they help the students learn the intended mathematics and clear up any misconceptions. Sophie said,

I think there are a lot of activities that are good activities to do and you can get caught up in just doing those activities and not necessarily have kids understand the math behind what was happening. I see my role really as that—to help them process and understand the math behind things.

It is not easy to fill these multiple roles. Nicole felt with the teachers’ multiple roles, it was much more work than teaching with a traditional textbook. “There is a lot more involved teaching [with these reform textbooks],” she said.

**Professional Development**

Four of the teachers were able to attend an intensive, weeklong professional development workshop run by some of the developers of the curriculum materials. In fact, these four attended the workshop more than once. At the workshop, they learned such things as how to handle group work and the large amount of student paperwork, use of technology, and how to pace the course material. The teachers said they also were able to ask questions of other teachers who had used the curriculum materials. They said the three most valuable
aspects of the professional development were understanding the setup of the textbooks, seeing how the mathematical strands such as algebra are developed throughout the textbook series, and experiencing the curriculum as learners. Nancy explained,

We certainly spent a lot of the time going through the material as if we were a student so we were familiar with the investigations and familiar with the problems. And we did those as if we were in a class [that used this textbook] so we did the investigations in a group and the workshop leaders would launch the lesson and then we would follow up with summaries with what is supposed to be learned.

These four teachers all felt that the professional development was extremely valuable. What they learned at the workshops really helped them implement the textbooks. Sophie used the reform curriculum materials at both the middle-school and high-school levels before attending any professional development. She said, “What I did the first year was not as good. I think I’ve done it better since. . . . After my first year I went to the training, and that really helped a lot.”

Nicole and Samuel did not attend this type of professional development, but they thought it would be helpful. Because of the time of Samuel’s hiring, he was unable to attend any type of professional development before he started. He saw fairly quickly he would need some guidance on implementing the materials. He said, “When I got into it, I tried initially to teach it as I would a traditional curriculum. And that didn’t work very well. That’s when I talked to the principal and said, ‘I need some training on how this is supposed to work.’” He went to a workshop that lasted 1½ days run by teachers at a nearby school. They focused on the goals, advantages, and the teacher’s role in the program. Samuel felt that their emphasis on “letting the kids teach themselves” and “minimal structure as far as the planning and
implementation of what was going on” was not appropriate. He had seen students struggle in his classroom and felt these ideas would not help them. Nicole did not attend any professional development. She did attend a one-day meeting of teachers that use the textbooks but did not find it helpful. She commented, “It’s difficult to get a lot of help with that in just one day.”

**Students**

The most influential student factor was achievement tests. The teachers discussed these tests quite a bit. Another factor that was influential and not emphasized in the literature was the pressure of college mathematics. Despite these two forces, most of the teachers felt the textbooks were good “for all students.” Even though students faced some difficulties while using the textbooks, most had favorable attitudes towards them.

*Mathematics for all students*

Neither Nixon nor Eisenhower track students by ability in mathematics classrooms. Although Sherman and Calhoun had separate tracks, all students used the same textbooks and covered similar material, just at a different pace and depth. One reason why the teachers at Nixon and Eisenhower support the use of these textbooks is the inclusion of all students in the same mathematics classroom. Nancy said, “The favorite thing I have about it is that it’s a quality program for all students. It works for special education students, average students, and it works for very top, bright students.” Ethan echoed these sentiments. He saw that all the students could be involved with the mathematics, no matter their ability.

Teachers became more animated when discussing the fact that students who would typically be in general mathematics classes were now learning algebra and geometry. Nicole said,
I have kids stay in math [who] never would have before. And maybe, maybe aren't as
good as they should be [after] they've taken four years of math. Maybe they're not as
good as your typical four-year math student, but they're in math.
She emphasized that this also exposed them to mathematical ideas that they otherwise would
not have seen. "They're taking math. They're not taking general math where you add and
subtract." While Nicole was not referring solely to special education students, Nancy
specifically focused on them. She said, "We didn't have special education kids that would
take algebra I, geometry, algebra II. That was just rare, very rare." She explained they had
special education students using the reform textbooks for three years which is about the
equivalent of algebra I, geometry, and algebra II.

Ethan said just listening to the students discuss the mathematics justified the use of
the textbooks. He said, "You want justification, just come listen to them. You can hear them.
They're talking math. They're discussing math, and they're arguing about this or that with the
whole point that they are learning something and gaining from that." Because Ethan's classes
are heterogeneously grouped, he has special education teachers in the classroom as well. One
of them said, "These kids are learning a ton of math. This is good. This is the way it should
be."

Attitudes and difficulties
A common question that students ask in a typical, traditional mathematics classroom
is "When are we ever going to have to use this?" Several teachers mentioned they rarely
heard this question asked. Caleb commented, "They [the students] get the sense that maybe
they won't [use it], but they get the sense that there is probably somebody out there who
would do this type of stuff." He described how he does have to give traditional worksheets
when students go on a regularly-scheduled school trip. Then he did hear the above question of relevance.

The teachers explained that the textbooks include lessons that relate to real life. Ethan shared the story of one male student who started off slowly in his academic career but has since applied himself. Ethan said, “We’ve gotten into the section where they talk about angular velocity and linear velocity and those kinds of things. And he just ate it up. Now you’re talking about motors and pulleys and you just listen to the argument.” Several of the teachers saw that the students did enjoy the lessons. Caleb said,

They did just an informal survey, just for this activity they were doing. They asked the kids what their favorite subject was and math came in second to P.E. I thought that was fantastic. I thought that was some validation for what was going on. I don’t think in a traditional classroom where they’re just sitting in class everyday doing problems, I don’t think that’s going to happen.

Samuel was the only teacher who received negative reactions from his students. While he did comment that the students did like the lessons, most were happy to see the school switch back to the traditional textbooks. He said he felt that most of his students had already given up when he arrived. To him it seemed the students had fun doing the activities, but were concerned they were not being mathematically prepared to go to college.

The teachers who had students transitioning into the program felt that the students did not have too much difficulty adapting to the materials. The biggest difficulties were the amount of reading and working in groups. The teachers noticed that the large amount of text and vocabulary used hindered students who had difficulty reading. Ethan commented that managing the group work is probably the most difficult aspect of implementing the
curriculum materials. When Caleb used the textbooks, he found that the best students did most of the work in the groups. After he stopped using the textbooks, he had students work in pairs which he found more productive. Nancy said group work was a focus of the weeklong professional development workshop, so clearly the textbook developers were aware of the issue. Nancy found that it was initially easier to have groups of three so she could teach them how to work in groups.

Caleb said one of the difficulties he faced when first trying to implement reform curriculum materials was getting the students to think about a problem. He said he told them just to think about it, but they “did not know how.” As the students became accustomed to it, he said their ability to think improved. All of the teachers mentioned that their students were good problem solvers and able to reason through problems. Caleb shared a story about two former students who moved to another school district. The students were taking a class at a community college at the time. Caleb said,

One kid I talked to, he was very honest about it. He said, "We were definitely behind in some of the skills. But it didn't take us very long to pick those up. . . . But that didn't take too long to catch up. One day the professor wasn't there so he just sent over a worksheet of some non-routine, problem solving things." And he just said, "The kids from [the class], they looked like deer in the headlights. They didn't know how to do any problem that they hadn't previously been taught how to do." And he just said, he and this other kid that I had said, "Well, that was fairly routine for us." Caleb’s former students did not have any difficulty solving the non-routine problems while their new classmates did not know what to do. One of Caleb’s goals was to teach students
how to think and solve non-routine problems because he felt that students could pick up the necessary skills later. He said,

I guess if they're behind in some skills, if they're taught right, they can pick them up pretty quickly. But the ability to think takes a lot of practice. If they've never done that before and they get to some point where that's expected, it's a little harder to learn.

*Achievement tests*

The teachers said they realized how important achievement test scores have become in this age of accountability. One problem they saw with the textbooks is that their content and setup do not align well with the ITED or ACT tests. For example, Nicole and Sophie both mentioned that their students have a solid understanding of statistics, but this material is not tested. In addition, students are often tested on content before they encounter it in the curriculum materials. Samuel said,

The content that was being taught, it seemed like everything was being delayed beyond what I would consider a reasonable amount of time. We have kids who are taking standardized tests with certain expectations and they haven't had that exposure until almost they weren't going to be tested on it anymore.

The teachers at Nixon school encouraged the juniors to wait until the summer to take the ACT to ensure they learned the necessary content.

Several teachers felt the pressure from parents and the principal to have high test scores. Nancy said that the teachers at Nixon are "constantly battling" to prove that their test scores are good. In fact, she said the school board always wanted to know the test scores to compare them to the scores obtained when a traditional program was in place. The teachers at
Nixon school acknowledged that the scores did decrease at first, but now they are improving. They reported that recently over 80% of the juniors tested “proficient” in mathematics according to the state specifications. Samuel said that the principal and parents at Sherman were also worried about how low the scores were on the ITED and ACT tests. Samuel had noticed the computation scores had been decreasing and were below the national average. While Ethan commented that he did not feel any pressure from the parents, several school personnel were concerned when an entire class of sophomore had low scores. He told them that the students were learning—

> It comes back to bottom line. The bottom line is "Are kids learning?" I can tell you better that sitting in my classroom listening to those kids talk than I ever can looking at a standardized score. That standardized score only goes so far.

Ethan acknowledged that in a small school, there will be entire classes that do not perform well on standardized tests. He also said that students do not always try on these exams because they get tired.

Even though computation scores may have decreased for some schools, several teachers said their students scored very high on the problem-solving sections. Teachers at three different schools all mentioned that the science reasoning portions of the ITED and ACT tests were very high. Sophie said, “That score [science reasoning] was always really high which you know it [the test] was a lot of reading and interpreting data. That’s exactly what [reform textbooks] have you do.”

The standardized tests have played a role in the adaptations teachers have made to their mathematics programs or curriculum materials. Sophie said that one of the reasons Sherman adopted the textbooks was that they were looking for something new to boost their
test scores. Once the textbooks were adopted in other school districts, the achievement tests still influenced teacher decisions. Caleb said, "There is some pressure, some pressure whether it's direct or indirect to do some more of those traditional things because that's what is tested." Nancy said part of the reason they cut out units from the textbooks or moved units around was to better align with the ITED and ACT tests. Recently teachers such as Sophie and Nancy have used the test scores in discussions with principals and parents to validate the decisions they have made regarding the reform textbooks they are using.

College influence

Another emergent factor was preparing students for college. Preparing students for success in college mathematics has had a number of different influences on the teachers. It has served as validation that students coming out of their reform mathematics programs have been successful at college. The teachers at Nixon, Eisenhower, and Calhoun reported that their students have done well in college mathematics. Surveys sent out to former students are one way the teachers collected this data. Another was speaking directly to the students. The teachers have had the opportunity to speak with a number of former students. Caleb said, I talk to a lot of kids. When you have a small school, you live in the area, and your kids have gone through . . . and you see their friends so you get a sense of how they're doing. They've done real well in college for the most part. That's more important to me than what they might get on an ACT test or something like that.

Ethan agreed that the overall success of his former students and the preparedness of his students was more important than test scores. Ethan also said that his students were prepared for college when they used a traditional textbook, so he felt that the reform textbooks are not "a panacea." Nicole said that before the teachers supplemented with skills practice, some of
the students did struggle at college. After making this adaptation of the curriculum materials, she said the students have told her their college mathematics classes have been fine.

While these successes of former students were encouraging, some of the teachers also felt college mathematics limited options. Caleb recognized that college mathematics classes have not changed much over the last few decades. He said, “If you change too much at the high-school level, then they're not prepared for some of the things that they need when they get to college. So that changes things a little bit too.” Students at Sherman became frustrated when they filled out college applications because they did not know how to answer the question of how much mathematics they had compared to a traditional sequence of algebra, geometry, and algebra II. Being a new teacher, Samuel did not know what to tell them because he did not know either. Sophie said that they had to change the name of their classes from integrated I to integrated algebra I because several colleges were not familiar with integrated mathematics. Samuel felt that Sherman “needed to be lined up with what colleges were interested in seeing from our graduates.”

Community

Community reactions

There was a wide range of community reactions to the textbooks. Caleb and Ethan had relatively few complaints or concerns from the community. They could not say exactly why this occurred, but they both attributed it to such factors as the school having a good reputation with the community and the location of the school. Caleb thought a higher-income area would have more problems because the parents in these areas have certain expectations for their children’s futures and feel that a traditional mathematics program would better help
their children meet these expectations. Ethan thought that his longevity at the school played a role as well. He said,

I think I would be safe in saying that most people there, they kind of take what I have to say and say, “He knows math... and we’ll go with what he says. If he says it’s good, then it’s good, and that’s the path we should go ahead and follow.”

Ethan has had numerous occasions where former students and parents have made comments showing they appreciate the reform materials. Ethan said, “I’ve had parents tell me that too. Their son or daughter just seems like they know an awful lot about things they [the parents] have no idea about.”

On the opposite end of the spectrum, Nixon and Sherman have had numerous complaints. Nicole said, “We take tons of heat from our community. They don’t like the program.” The community has pushed hard for the school to switch. While Nixon has kept using the reform curriculum materials despite this pressure, Sherman has stopped. While the community was not the only reason for its discontinued use, both Samuel and Sophie said it played a role in the decision. They especially found the pressure coming from parents whose children were college-bound or were people in key positions in the community. It seemed that discussions with concerned parents did make the teachers worry about the potential drawbacks of the curriculum materials.

The teachers felt that one large reason for the complaints was the lack of understanding of the curriculum materials. “To me, people fight things as much because they don’t understand it or it’s different than what they’ve done before,” Sophie said. Nancy found that the parents did not understand why the teachers were not teaching in the same way as when they went through school. They did not see why it had to be different for their children.
These parental concerns became more complicated with the fact that the parents had difficulty helping their children with homework. Unlike traditional textbooks, there are not examples at the beginning of each section for them to reference. Nancy found “the more supplementing we do, the more comfortable the parents are. The more worksheets they see that look familiar to them, the more comfortable they are.”

Other common parental concerns the teachers at Nixon and Sherman heard were the students not being prepared for college, the overuse of calculators, and the ACT or ITED scores not being high enough. Nancy said,

They are very concerned that this is not “real math.” This is not academic math. That this is fluff and this is not a hard math so they think it is not getting them [their children] ready for college. It has taken us a long time to [communicate] that we have a lot of kids doing very well in college.

Samuel also found that the parents thought their children did not know much mathematics.

Informational meetings

Sherman was the only school district that had any type of informational meetings for the community. Sophie was not at Sherman before the textbooks were adopted so she does not know if there were meetings held before implementation, but the school had several while she was there. According to Sophie,

We talked about what was going to be studied; we talked about the graphing calculator; we talked about how the class was structured, especially that kids would be doing group work and using the technology and working together. This was to emphasize that it was different than what they had maybe done before. And to try,
more or less to calm people and to ensure them that if they had concerns or questions to come talk to us.

She felt that the informational meetings were successful at the time as the parents were very responsive. Perhaps one aspect she would have changed about the meetings would be to do a lesson with the parents. While the parents were supportive at first, it appeared that the high teacher turnover led to less than optimal implementation and little adaptation to materials to help the students succeed which eventually led to parent concerns.

Nancy also felt that parent meetings would be a good idea. She had talked with teachers from other schools who found the meetings beneficial. Based on the community reaction, Nancy realized it may have been a good idea for Nixon to hold a meeting when it was first adopted and perhaps Nixon should consider having one now. She felt that not having any meetings has led to the “rocky roads” they have been on. She said,

It is always a constant fight. . . . There was nothing given to the parents. It was just started. And so they have no idea why we do this. . . . We didn't do anything up front to explain why in the world we would choose to do this, what benefits they would see in their own student and the student population as a whole, nothing.

The teachers at Nixon addressed parental concerns at parent-teacher conferences, but they both felt they needed to do a better job of advertising the positives of the textbooks. While Nicole does not know if a community meeting would really help, she felt the teachers still needed to exhibit what is good about the program.

**Most Important or Influential Factors to Address**

At the end of the interviews, the teachers were asked which, if any, of the factors they mentioned would be the most important or most influential to continue using the reform
textbooks. Simply getting stakeholders support was the common theme across participants—some emphasized the principal, others the parents, and others the community—but the bottom line was that you need to build support by educating everyone. Sophie said,

> Communication is something that we don’t do enough of in education. We kind of get going on and doing our own thing day-to-day in the classroom. We just need to keep communicating with people, with the community, parents, and administrators as to what it is we’re doing and what we’re trying to accomplish. I guess that would be the most important.

Of the three teachers who mentioned the principal, Ethan felt that everything would run more smoothly in a school where the principal was supportive. The support of the principal was also important if people in the district had concerns. Caleb stated,

> I think [the support of] the administration you’d first have to have. I think that would be very helpful, probably to have that more than anything. I think in many situations there is going to be some resistance. And if they’re not on board and willing to back you up, then that could make it very difficult.

Besides having the support of the principal, Ethan said that it was difficult for teachers if they did not have parental support as well. To help minimize parental and community concerns, two teachers discussed the importance of deciding before a school adopts a reform curriculum how to supplement the textbooks with skill practice to prepare students for standardized tests.

While the teachers focused primarily on external factors, several teachers touched on their beliefs. If they did not believe in the curriculum materials, the teachers said they would
not be using them. Nancy felt that her beliefs were positively influenced by the professional
development and what she saw in her classroom from her students.

**Advice to Other Schools**

When asked what advice the participants would give to other teachers looking to
adopt the reform textbooks, across all of the participants they mentioned each category of
factors in approximately the same rate of frequency. In addition, two teachers discussed the
importance of speaking with other schools that had already adopted the textbooks. The
advice will be discussed in the same order that the factors were discussed throughout this
paper—school, teachers, professional development, students, and community.

When preparing at the school level, the teachers felt that it was important to have the
support of the principal. Teachers felt that the principal needed to be knowledgeable about
the curriculum materials to answer any questions that people in the district may have. Also
within the school factor, Nancy mentioned the issue of policy with ensuring the students had
calculators. As several teachers mentioned, it is difficult to implement the curriculum
materials without calculators.

In terms of preparing themselves as teachers, the participants’ advice to other teachers
was to ensure the curriculum materials fit with their personalities and the goals they have for
their students as well as to have a proper attitude toward the curriculum materials. Ethan said,

*If you think there is a chance it's going to fail, then you're not going to be successful.*

*If you're not ready to make a commitment to something, then that's not going to work
and it's not going to be successful.*

Like the principal, teachers need to be knowledgeable about the curriculum materials. They
should research them and look at data found in the research literature. Sophie said, “Be ready
for people to ask you questions. If you can defend yourself, have good data and good
information, I think you'll be all right.” The participants emphasized that teachers need to
realize that using reform textbooks is a growing process and that modifying materials to meet
the school’s needs is part of that process. Teachers felt adding skill practice was necessary to
ensure that the students had enough practice to learn the skills and perform well on
standardized tests. One teacher mentioned that using supplementary materials could also help
with the community reactions because the community would see mathematics that was
familiar to them. Besides adding practice, schools may have to alter the program so that
students have the option of taking calculus or a college mathematics course their senior year.

Three teachers also thought it was important to attend a professional development
workshop. Even though Nicole never attended the professional development workshop, she
thought it would be valuable as well. She suggested trying to get someone to come to the
school districts to lead a workshop because it is not always feasible for the teachers to leave
their homes for a week.

While discussing the students, Caleb said that the reform materials would be new for
the students as well so teachers need to be patient with their students. Caleb said,

If what they've previously had is a traditional program, to switch to this is a pretty big
step for the students. You'd have to be really committed because you are probably
going to get some resistance from the students at first because it is different.

Finally, the community factor was discussed by multiple teachers. Sophie said it
would be great to involve community members in the process of informing others. She said,
“Involve others—whether it’s a parent committee or a representative sampling from the
community. Maybe [focus on] the people you think would go out and speak well of what it is
you're trying to accomplish, to help sell it." Another teacher said it may not be possible to include parents in the decision, but "they need to be made aware why that choice was made and what benefits there are." Even though Caleb did not have many community concerns, he felt that it would be valuable to have meetings and "educate" the community. Because the course titles are not Algebra, Geometry, Algebra II with the reform textbooks, Caleb said that parents would ask him if he still taught algebra and geometry. He had to explain that the material was interwoven.

Along with the five categories of factors, two teachers also discussed the value of speaking with teachers at other school districts who had already implemented the textbooks. Sophie said, "I would get out and visit a school or two to see how they use it and how it works for them. Ask a lot of questions. Ask questions to the teachers teaching this curriculum." Since every teacher supplemented with skill practice, learning where to supplement at the beginning of implementation would be helpful. Nicole said,

It'd probably be helpful if you had figured out where to supplement. We have all these supplementary materials that go with it. You know, it was a huge undertaking, but you just had to go through it for a couple years to figure out, "we need to do this, we need to do that." You might be able to get some advice from somebody else who is already doing that so you don't have to go through that learning curve also.
DISCUSSION

The rural setting brought forth issues that teachers in other contexts may not face—the ease of adoption and the importance of professional development because of isolation. In addition, the participants discussed at length the need to supplement the textbooks with skills practice. They also commented about the importance of building a network of awareness to keep the principal and the community informed.

The Adoption Process and Early Implementation

The school policy of adopting reform textbooks or making changes to the materials may be simpler in a rural setting. In three of the four schools, one teacher decided the reform materials were the direction the school should go in the mathematics program. The adoption process took place quickly as the only other person that had to agree with the decision was the principal and possibly the other mathematics teacher if there was one. This adoption process can be difficult if there is a larger mathematics department or the decision is made for the teachers by the curriculum director or the administration. For most of the participants, the textbooks were never forced on them. Cohen & Hill (2001) and Jones (1997) mention that teachers’ beliefs often need to change before they can implement and sustain the use of reform textbooks. The participants in this study who decided to implement the reform textbooks already believed in them. Getting a larger number of mathematics teachers to “change their beliefs” is not as relevant in a rural district. However, what Cohen & Hill (2001) and Jones (1997) stated applied to the teachers in this study who were not part of the decision-making process. Nicole said that she originally did not like the textbooks, but she came to believe in them after seeing what her students learned. This change did not take
place for Samuel largely due to the situation at Sherman—having teacher turnover and inconsistencies in the program before he came. Samuel found that the students already had a negative attitude toward the textbooks and they lacked knowledge about topics that the previous teachers were supposed to have covered.

The situation at Sherman illustrated what can happen if the mathematics teacher who adopts the program leaves. If there is turnover, it can be hard to adapt the curriculum materials to fit the needs of the school such as using supplemented materials to help with skills practice. The teachers said they did not know where to supplement the curriculum materials until after they had used the textbooks. Having stability in the mathematics program seems especially important in a rural school because of the ease of stopping the programs. At Sherman and Calhoun, getting rid of the reform textbooks was shown to be as easy as or easier than adopting them. Ethan mentioned that if he left Eisenhower and another teacher was hired, the new teacher would be able to make changes to the mathematics program. Caleb and Ethan referred to themselves as “the entire mathematics department” so they had an influential voice in the direction of the mathematics program at their respective schools. Having a mathematics department of one to two teachers allows rural teachers to have a large voice in determining the mathematics program.

Teachers at Eisenhower and Nixon as well as the literature (Bay-Williams, Reys, et al., 2003; Van Boening, 1999) mentioned the importance and benefits of discussing implementation strategies with colleagues, especially during the first few years. This may not always be feasible in rural secondary schools because there is often only one mathematics teacher. Since many secondary rural teachers are alone in implementing the reform materials, professional development is important so teachers can interact with other teachers along with
gaining a better understanding of the curriculum materials. The isolation caused Samuel to finally ask the principal to send him to some type of professional development because he did not understand how to properly teach with the textbooks.

The “hands-off” teaching approach presented to Samuel at the 1½ days of professional development did not sit well with him. Four of the other six teachers were able to attend a weeklong, intensive workshop run by several of the curriculum writers. Nancy said they went through lessons as they would actually be used in the classroom so they, as teachers, would understand how the lessons would unfold. Because of time, Samuel was unable to do this at the workshop he attended. The participants said that professional development was very helpful. The experiences of these participants demonstrate that the type, length, and leaders of the professional development are important. The longer, hands-on professional development was more effective than a two-day workshop that only described the textbooks. The literature also found this to be true (Bay, Reys, et al., 1999; Cohen & Hill 2001; Schoen et al., 2003).

Skills Practice and the Community

The literature did not discuss or offer advice on how to supplement the curriculum materials with skills practice; in fact, it was discouraged (Schoen et al., 2003). While the teachers felt it was important for the students to focus on skills, several did express their reluctance to supplement. Caleb said that he did use supplementary skills practice when he taught with the textbooks, and he continues to do so now. He stated, “I reluctantly spend time on some things that I just as soon not spend time on, but they are necessities with the system of assessment that we have. Sometimes you do what you have to do.” Even though Darling-Hammond and McLaughlin (1995) suggested that schools remove the conflicts between
curriculum materials and testing procedures, this may not be possible if schools want to use reform materials. Most of the participants wanted to go through the curriculum materials as intended but perhaps that is not realistic in the current age of standardized tests. The literature discussed teachers’ concerns about a potential mismatch between reform materials and standardized tests (Walen & Williams, 2000). The participants modified the curriculum materials to help minimize the mismatch between the textbooks and standardized tests. They wanted their students to continue to focus on the development of concepts as emphasized in the reform textbooks while still being able to do well on standardized tests.

Knowing when to supplement was also important. Nixon did not supplement right away, and the teachers said that their students’ test scores did go down. That caused concern among the community, the principal, and the school board. In contrast, Ethan included skills practice from the start. He hypothesized,

Maybe even as far as the community, when they see we're doing the other old-fashioned algebra too, what they know something about, maybe that has something to do with why they're thinking, "Yeah, he's teaching some of this other stuff [traditional material] too so it [the reform textbooks] can't be all bad." I don't really have any reason to know that, but I guess that's what I would say.

Naturally parents want their students to be successful. This includes doing well in mathematics class, on standardized tests, and in college. If they perceive that this will not happen, they justifiably become concerned (Bay-Williams & Meyers, 2003; Peressini, 1998). Nancy said, “At first it was somewhat combative, and people were defensive. We were defensive over our program and parents felt like they were fighting for their kids.”
Network of Awareness

From this study, it was not clear why some communities and principals were very concerned with the use of these textbooks while others were not. For example, despite the fact that Nixon had high test scores, they encountered many concerns from the community and the principal while Eisenhower did not experience resistance even though their test scores were average. At Sherman the community initially supported the textbook use, but later became discontent and influenced the decision to discontinue using the textbooks. In contrast, Nixon struggled with their community perceptions of the textbooks from the beginning, and yet Nixon teachers continue to use the textbooks. Nonetheless, the consensus among the teachers still seemed to be that in order to successfully implement the textbooks it was important to build a network of awareness that included principals and the community.

The teachers felt that it is important to inform the community and the principal of the unique benefits of the reform textbooks, while simultaneously emphasizing the skill supplementation teachers provide to prepare students for standardized tests. Keeping them informed needs to be an ongoing process with (a) there being parents every year that will encounter the materials for the first time and (b) the large turnover of principals in rural districts. Creating this network of awareness would make implementation easier because of the support structure in place from key people within and outside the school—the principal and the community.

I originally conjectured that the community may play a larger role in rural settings. It may be, however, that the rural community’s role is not necessarily more influential than in a large community, but community members’ relationships with school personnel would cause the concerns or lack thereof to be brought forth differently. In smaller schools, the
community and school personnel interact more frequently and in ways that are not possible in larger schools (Howley & Eckman, 1997). These interactions are often taken for granted (McClelland, 1997) so rural community members may feel more comfortable about calling the principal or a school board member directly to raise their concerns as was the case in this study. This relative ease of access can be detrimental but can also be beneficial to teachers efforts to implement reform curriculum materials. For example, Ethan commented that he had been at Eisenhower for a long time and the community knew him personally so they trusted his decision to adopt the reform textbooks. Caleb said that he had talked with other teachers from non-rural areas of the state at the professional development workshops. From these conversations, Caleb found that communities in more affluent areas might raise more concerns because of the desire to have students score highly on standardized tests so they could attend top-notch universities.
CONCLUSION

The teachers discussed having to address all of the categories of factors gathered from the literature—school, teachers, professional development, students, and community. Only one aspect of the student factor was surprisingly not an issue for participants; how to assess students in the classroom. Rather, the participants’ primary assessment concern was the potential mismatch between the standardized tests and the reform textbooks. This concern spawned additional concerns not found in the literature review—(a) where and how to supplement with skill practice and (b) how to prepare students for college entrance exams and coursework.

Future research is needed to study what occurs in states that have “high-stakes testing” in which student graduation depends solely on test results as Iowa does not use standardized tests for this reason. Future research is also needed on the potential mismatch of reform textbooks and traditional college classes and the effects this has on students. Additional research in other rural contexts is warranted to see if the results of this study can be generalized as limitations of this study include the small number of schools and teachers as well as the context. Rural Iowa may not be the same as other rural settings around the country.

It is the hope that the teachers’ experiences and advice in this study will be helpful in guiding other rural teachers in the adoption and use of reform mathematics curriculum materials. As Goldsmith et al. (2000) suggested—

Make connections with people in other districts that have adopted standards-based curricula. Their experiences and perspectives can help alert you to important issues
and point you toward available resources, and they may have practical advice about
the selection and implementation process. (p. 22)
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