

PUTTING PROFESSIONAL DEVELOPMENT INTO PRACTICE: HOW
TEACHERS PROCESS, IMPLEMENT, AND DISSEMINATE
SPECIALIZED KNOWLEDGE OF STANDARDS

by

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DEDICATION

This dissertation is dedicated to my family, who helped make this possible. Mom and Dad, thank you for supporting me and believing in me. I will be forever grateful to you for enabling me to become who I am today and for encouraging me to pursue mathematics education. To my brothers, thank you for being by my side during this adventure. And finally, to my furry family, especially my kids, Anakin and Leah, thank you for providing me happiness and comfort.

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ABSTRACT

This study provides a detailed account of how teachers disseminate knowledge of the Common Core State Standards for Mathematics to peers through school-based professional development. The design was a qualitative case study of four school district-based cohorts of middle grades teachers who led professional development in their schools and districts. Data was collected using interviews and school-based observations as each cohort was followed for eight months. The findings lead to a suggested framework for how teachers facilitate school-based professional development after having received professional development themselves, in a “teach the teachers” model. Data analysis produced a variety of results. Among other challenges, a lack of communication among school leaders created a barrier to dissemination. Although challenges were present, every cohort was able to facilitate effective professional development for their peers. The cohort members found that celebration of small successes during the process helped them persevere. The quality and depth of knowledge shared at the school level was diluted compared to the original presentation of the material, especially regarding the Mathematical Practices. This study provides encouraging results for future use of the “teach the teachers” model, which can be improved to maintain the quality of teacher-led, school-based professional development.

1. STATEMENT OF THE PROBLEM

Introduction

National mathematics education reform for the improvement of student learning is not a new idea. The launch of Sputnik and the beginning of the space race led to reform efforts in the “new math” era of the 1950s and 1960s, and as outlined in Chapter 2, new reforms have followed nearly every decade since. Most recently, in 2010, the National Governors Association Center for Best Practices (NGACBP) and the Council of Chief State School Officers (CCSSO) published the *Common Core State Standards for Mathematics* (CCSSM), detailing content and practice standards for K-12 education that are informed by the most effective models from states across the country and from countries around the world. These standards are meant to provide consistent guidelines for all students, regardless of where they live, as well as to provide teachers and parents a common understanding of what students are expected to learn.

The Common Core standards specifically state that they “do not dictate curriculum or teaching methods” (NGACBP & CCSSO, 2010, p. 5). While such flexibility is embraced in the culture of American schooling, it leaves each state, district, and school to cope individually with the responsibility and challenge of successfully implementing the CCSSM in the classroom. As with all previous reform movements, effective implementation of the CCSSM reform relies on its ability to address the “interconnections between the issues expressed by the simple words *why*, *what*, and *how*” (NCTM, 1970, p. 456). Schools risk focusing on the *what* – the standards, practices, and suggestions for sequencing that can be found in the CCSSM document – without taking

time to contemplate, understand, and thoroughly embrace the *why* and the *how*.

Professional development focused not only on the CCSSM standards, but also on how to teach to these standards, is necessary for the Common Core movement to be successful.

If a narrow concentration of attention on Content Standards characterizes the CCSSM reform effort, then it is likely to become just another postscript in the chronology of mathematics education. However, if teachers are offered professional development time to collaboratively improve their instructional practices, deepen their understanding of mathematics, and develop their capacity to implement CCSSM then this reform effort has the potential to improve students' mathematical learning. (Larson, 2012, p. 112-113)

As of 2013, “All but four states have adopted the complete Common Core Standards” (Parker, 2013, p. 1). Official adoption is often accomplished through formal approval via the state legislature or a governing body of the state education system. A survey study done in the Fall of 2011 on over 12,000 teachers of grades 1-12 mathematics revealed that about 90% of those surveyed reported having heard of the CCSSM and about 80% have read at least the standards for the grade they teach. About 30% of these teachers stated their belief that the CCSSM are “pretty much the same” as their former standards (Cogan, Schmidt & Houang, 2013). In the same study, roughly 1/3 of the representative sample of teachers reported that they had not participated in any sort of activity preparing for the implementation of the CCSSM (Schmidt, 2012). In the two years since this study was published, those numbers have no doubt changed significantly. However, states, districts, and schools continue to struggle with the difficult task of preparing for and actually implementing the Common Core State Standards.

Implementation of the Common Core State Standards has taken many forms and differs in appearance in every state of the nation. In August 2012, the State Spotlights

report published by the Council of Chief State School Officers highlighted particular implementation efforts in a few states. From this report it can be seen that each state is paving its own path towards the implementation of the CCSS and the creation of appropriate curriculum and instructional techniques. Some states such as Tennessee are hiring paid consultants or training their own exemplary educators to facilitate summer training on the CCSSM. Many states including Indiana, Ohio, New York, New Mexico, Vermont, Tennessee and North Carolina are creating Web-based resources where information such as curriculum maps, transition and implementation tools, and toolkits that “[unpack] the standards for all grades” (CCSSO, 2012, p. 6) can be stored and accessed by teachers. Ohio, in particular, provides strategies and resources for diverse learners in their online toolbox. At the time of this report, many states were in the process of creating plans outlining how implementation would occur and creating lists of suggested resources that needed to be created, but few had actually implemented the CCSSM.

The State Spotlights report (CCSSO, 2012) also noted some of the professional development efforts underway throughout the nation. In conjunction with a local school district, Missouri’s Department of Education developed a Common Core State Standards professional development series that was later modified for use statewide and delivered through a train-the-trainers model. Idaho created Common Core toolboxes for English language arts and mathematics that include a standards overview, instructional materials and resources, professional development resources, and information on the new assessments. Many states including New York, West Virginia, Kansas, and North

Carolina have created tools that demonstrate and instructional shifts that support the new standards; however, many of these tools are only for the elementary grades.

The state of Kentucky serves as the laboratory and demonstration site for Learning Forward, a highly regarded national professional learning organization, to create an ongoing Common Core-aligned professional learning model. As a requirement of Kentucky's Senate Bill 1, the state has created Leadership Networks that are "intended to build the capacity of each district" (CCSSO, 2012, p. 9) as they implement the CCSS. The Leadership Networks have created resources including "curriculum maps and pacing guides, gap analysis protocols, grade level shifts, planning and pacing processes" (CCSSO, 2012, p. 9) and follow operational guidelines and expectations on a three-year timeline of work and expectations. The Learning Forward organization also works with Georgia, Illinois, New Hampshire, New Jersey, Utah, and Washington as "critical friend" states to help in piloting and evaluating tools and strategies (Hirsh, 2012).

Like other states, Montana's schools and education agencies are working to implement the CCSSM in the most logical and effective way possible. As the fourth largest state in the nation with extremely low population density, a relatively high number of school districts, and a history of independence and local control for schools, Montana has professional development needs that differ greatly from the majority of states. To further complicate the issue, Montana's education programs do not have adequate funding to develop and disseminate the kinds of comprehensive resources that Kentucky and other states are using. The diversity of Montana's school districts and schools, the isolation created by long distances, and limited resources for statewide implementation

efforts emphasize a need for innovative models of professional development. This research study examines one such model and its effectiveness in supporting standards-based instructional change in mathematics.

Statement of the Problem

The Common Core State Standards for Mathematics are about far more than just reorganizing how content is taught or about creating consistency across states, but teachers may not recognize that. The CCSSM are a step in the direction “toward greater focus and coherence (NGACBP & CCSSO, 2010, p. 3)” of curriculum in the United States. By clearly delineating what content is taught at each grade level, the new standards “provide more detailed and specific expectations of students” (Achieve, 2010, p. 3). The standards also set high expectations for how students approach mathematics by requiring rigorous standards for mathematical practice at all grade levels. The Common Core content standards, the mathematical practices through which those standards are enacted, and the learning progressions that organize them, are, for many, a new way of teaching. No longer is it adequate for teachers to focus on one grade level or narrow band of subject matter. Instead, they must look to the future mathematics their students will need to learn and also deeply understand the prerequisite knowledge that their students must possess. Unless teachers are given the motivation, the opportunity, and the professional resources to make these changes, the reform promised by the CCSSM is at risk. The authors of the *Priority Research Agenda for Understanding the Influence of the Common Core State Standards for Mathematics* note that “if the CCSSM initiative results in only superficial, cosmetic changes, we will not see improved student performance”

(Heck, Weiss, & Pasley, 2011, p. 3).

Implementation of the Common Core State Standards for Mathematics is reform that can only be successful if teachers are well-educated on the standards. There is little point in introducing standards for a more focused and coherent curriculum unless teachers are willing and ready to make the necessary changes to their teaching practice to bring the standards to life. Theoretically, teachers embrace the idea of the CCSSM. “Up to a third of (teachers) find themselves not well prepared to teach (the CCSSM), yet they are committed to the task” (Cogan et al., 2013, p. 8). However, this commitment does not always play out in practice. Currently, only one-fourth of teachers say that they would drop a topic they currently teach if CCSSM places that topic in a different grade, and even after reading excerpts about 77% of teachers say that CCSSM are “pretty much the same” as the previous standards they were following (Cogan et al., 2013, p. 2). This failure on the part of teachers to recognize the need for reform and the extent to which the CCSSM are different from previous curriculum reforms represents a major challenge to the implementation of the CCSSM.

School-Based Professional Development in Montana

The first challenge, then, is to offer meaningful professional development that will move teachers beyond awareness – and perhaps anxiety – into effective implementation of the CCCSSM. This means helping them see how their curriculum choices and classroom practice must change. “Improvements in student learning can come only from a strategy focused on improving instruction” (Larson, 2012, p. 110). The second challenge is to offer such professional development in a state like Montana where widely

varying district support structures, local control and independence, rural isolation, and limited resources call for a differentiated and school-based approach to teacher learning. Montana, not having established Leadership Networks, is not necessarily in the same position as Kentucky in creating a systemic standards-based professional learning model. However, the state is experimenting with several initiatives that have the potential to broadly influence the implementation of the CCSSM. One of those initiatives is a state-funded project titled Standards-based Teaching Renewing Educators Across Montana (STREAM).

The STREAM project provides structured professional development for middle grades mathematics teachers that builds their knowledge of Common Core content and pedagogy while helping them transition from traditional teacher learning environments into a school-based professional development model. STREAM is Montana's first experimental statewide effort to provide professional development on the implementation of the Common Core State Standards for Mathematics. Funded through a Mathematics and Science Partnership (MSP) that originates with the U.S. Department of Education, the STREAM project is administered through Montana's Office of Public Instruction. The project is tasked with two primary objectives: (1) "Scale-up the impact of the MSP program across Montana by creating a statewide systemic, research-based and sustainable approach to improve student achievement and teacher content knowledge of Montana Common Core Standards for Mathematics" and (2) "Design and deliver interactive, on-demand, high-quality learning modules for mathematics or science through statewide and regional professional development using various venues including school-based and

distance learning” (MCCSM Proposal Narrative, 2012, p. 3-4).

To meet the first objective, STREAM uses a professional development model that employs the idea that reaching a critical mass of teachers can afford change within the entire community of teachers. To meet the second objective, the project is exploring delivery and dissemination models that can reach isolated rural teachers without sacrificing the qualities of effective professional development. The STREAM project is piloting a three-phase model blending face-to-face and online learning in an effort to meet research-based criteria for effective professional development. See Chapter 2 for a more complete discussion of these criteria, which include content-focused activities involving opportunities for active learning; collective participation of teachers from the same school, grade, or subject; coherence with other learning activities; and extended duration of professional development in terms of both the total number of contact hours and sustained engagement over time (Garet, Porter, Desimone, Birman & Yoon, 2001).

In its pilot year, the STREAM project is providing professional development to a well-defined group of 55 teachers in 15 school districts across Montana. At the same time, the project is developing and producing its professional development materials with the intention that they will be made widely available and used by many teachers in a variety of venues. Design teams that include classroom teachers, higher education faculty, and professional developers have created a set of materials for each of four themes: Mathematical Practices and STEM, Number Systems and Operations, Fraction-Ratio-Proportion, and Teacher Learning and Leadership. Materials include three-hour workshop sessions, three-week online modules, and “Sharing Your Practice” vignettes

that include exemplar lesson plans, classroom video, and teacher reflection.

STREAM participants are known as “seed teachers” to reinforce the fact that a major expectation of their professional development is to disseminate knowledge through school-based learning in their home districts. Teacher teams create Strategic Plans to support Logic Models developed by their administrators to enable successful implementation of CCSSM supported by STREAM materials. The three-year program will add new partner districts each year while continuing to support strategic planning and implementation in the original districts. This study takes place at a critical juncture in the implementation process of the STREAM project, when teacher participants transition from receiving professional development to sharing their practice with peers. This is also a critical time in the greater context of national implementation of CCSSM and in the reform of mathematics education in the United States.

Definitions

Specialized Knowledge: Borrowing some of Deborah Ball’s language, specialized knowledge refers to all of the knowledge needed for teaching. In this situation, specialized knowledge is the embedding of the Mathematical Practices while using and sequencing content in specific domains as documented by the CCSSM. This includes knowledge of how to create and manage learning communities in the professional workplace while making use of leadership, motivational, and accessibility skills. In the context of this study, also included in specialized knowledge is how to use problem solving, especially in STEM activities, to motivate the use of Mathematical Practices.

Within Montana’s stages of implementation continuum, there are two distinct

stages which call for implementation of the Common Core Standards. The first, Stage 4, calls for implementation in the classroom. Specifically, “Educators design, adapt and use evidence-based best practices and guides to support effective deliver of the curriculum and assessment progress measures to support learning for all students through focused, coherent, and rigorous instruction” (Montana OPI, 2012). The second stage, Stage 5, is implementation in schools and districts. “Throughout the school year teachers engage in horizontal (e.g., grade level) and vertical (e.g., cross grade level) conversations to be sure that every student has multiple learning opportunities and experiences to master standards required for student success at the next grade level” (Montana OPI, 2012).

Implementation: In this study, implementation will be used to refer to implementation of the Common Core State Standards in schools and districts, as set forth by Stage 5 of the Montana Office of Public Instruction “Montana Common Core Standards Stages of Implementation Continuum” (opit.mt.gov, 2012) This will not be referring to how teachers actually implement the standards in their own classrooms or how this classroom practice affects student learning.

Dissemination: In this study, dissemination will be used to refer to the process of implementation within school and across districts. Dissemination will be used in reference to the sharing of specialized knowledge participants gain through professional development and then share with school district peers. Dissemination and Implementation will be, for the most part, used interchangeably throughout this paper.

Research Questions

How do teachers process and disseminate content knowledge and pedagogical

practices learned through professional development? In particular, how do they acquire and pass on knowledge of the Montana Common Core Standards for Mathematics (MCCSM)? This study explores these questions within the context of the STREAM professional development experience which provided teachers specialized knowledge of the Common Core in the areas of the Mathematical Practices and Teacher Learning and Leadership (TLL) with specific attention to the domains of Number Systems and Operations (NSO) and Fractions, Ratios, and Proportions (FRP).

1. What elements of STREAM do teachers identify as most valuable to support dissemination of information about the MCCSM?
 - a. What structures do teachers identify as most valuable to support dissemination of specialized knowledge about the MCCSM to peers?
 - b. What messages do teachers take away from professional development about the Common Core?
2. What factors influence school-based dissemination of specialized knowledge of the MCCSM?
 - a. What supports, needs, and barriers do teachers identify as influencing their ability to disseminate the MCCSM?
 - b. How is school-based dissemination of specialized knowledge about the MCCSM hindered or enhanced by existing resources and opportunities?

Significance of the Study

The results of this study have significance at several levels. In the immediate context, the findings will provide the STREAM project's professional development

designers with a snapshot of program effectiveness and information about how factors are being translated into classrooms and schools, helping to ensure effective implementation and dissemination. By identifying the most effective resources for supporting CCSSM implementation, the findings of this study will also inform the designers about ways to revise and improve program materials in the future for use across the state and beyond. Findings from this research can potentially inform CCSSM professional development in other states as they seek tools and models to bring the Common Core Standards into classrooms.

The questions asked in this study also address issues raised in the Horizon Research *Priority Research Agenda for Understanding the Influence of the Common Core State Standards for Mathematics* (Heck, Weiss, & Pasley, 2011). The authors recommend case studies, relational studies, status studies, and others that will “provide the field with a reasonably broad and deep understanding of the influence of the CCSSM” (p. 1). This research advances the goals of the research agenda to examine state, district, and teacher responses to the standards. The Horizon group calls for research to answer questions about how programs and contextual factors influence CCSSM implementation; how implementation varies across districts, and what implementation strategies are most effective. At the teacher level, the research agenda seeks to understand what CCSSM learning opportunities exist for teachers and how they use them; how they translate learning into practice, and how they view change. The questions posed in this study contribute to this portion of the Priority Research Agenda.

2. REVIEW OF LITERATURE

Introduction

This research examines school-based teacher learning and leadership as the product of participation in the STREAM project, a uniquely blended approach to professional development. The STREAM project used inquiry-based workshops, online learning modules with facilitated peer discussions, assignments linked to classroom teaching and student learning, and mentoring to prepare participants to facilitate teacher-led, school-based professional development. STREAM activities included lesson planning, design, and analysis; peer observations and lesson study; and rich, multi-layered mathematical tasks to develop teachers' understanding and implementation of the Common Core State Standards for Mathematics. Because the blended professional development model employed in the STREAM project is quite unique, it is not surprising that no existing research studies address the full model. However, there is an extensive body of research addressing the individual components and strategies that make up the model.

Additionally, the STREAM professional development project expected teachers to facilitate similar school-based professional development experiences for their peers using various combinations of the methods, models, and tools described above. Therefore, it is important to highlight research-based criteria for effective professional development and how the components of STREAM professional development meet these criteria.

This chapter begins with a brief history of the Common Core State Standards for Mathematics. Literature on teacher learning, professional development related to reform mathematics, types of professional development, and features of effective professional development is then reviewed. Finally, to provide context for this study, the chapter concludes with a detailed description of the structure, content and design of the STREAM project.

Common Core State Standards for Mathematics (CCSSM)

The Common Core State Standards (CCSS) are a set of high quality expectations in English Language Arts (ELA) and Mathematics. The mission statement for the CCSS is to “provide a consistent, clear understanding of what students are expected to learn, so teachers and parents know what they need to do to help them. The standards are designed to be robust and relevant to the real world, reflecting the knowledge and skills that our young people need for success in college and careers” (NGBPTS & CCSSO, 2013).

CCSSM Timeline

The following timeline discusses only the mathematics standards; a very similar timeline can be found for the ELA standards on the Common Core State Standards Web page (<http://www.corestandards.org>, 2012). In July 2009, representatives from higher education, K-12 education and the research community formed work groups and feedback groups to begin creating mathematics standards. In November 2009, a preliminary draft of the CCSSM grade-level standards was released to states, individuals, and groups. States then provided feedback on that document and on two additional drafts.

In February 2010, Kentucky became the first state to adopt the Common Core State Standards, before they were publicly released.

In March 2010, the first public draft of the CCSSM was released and made available for public feedback. On June 2, 2010, the final version of the CCSSM was released. Along with this release, the Validation Committee, established in September 2009 to offer expert validation regarding the process of creating the CCSSM, published its final report. This report stated, “Unlike past standards setting efforts, the Common Core State Standards are based on best practices in national and international education, as well as research and input from numerous sources....The Common Core State Standards represent what American students need to know and do to be successful in college and careers. Once the standards are adopted and implemented, states will determine how best to measure and hold students accountable for meeting these standards” (Doyle, 2010, p. 1).

Adoption of the CCSSM

In November 2011, Montana became the 46th state to adopt the Common Core State Standards. As of June 11, 2013, 45 states, Washington D.C., four territories, and the Department of Defense Education program have adopted the CCSSM. The remaining states that have not adopted the Common Core State Standards are Alaska, Nebraska, Texas, Indiana, and Virginia. Minnesota has adopted the ELA Common Core State Standards but they have not adopted the CCSSM. States that have not adopted the standards offer a variety of reasons for why they have chosen not to adopt. “According to Les Morse, deputy commissioner at the Alaska Department of Education and Early

Development (EED), that decision was based almost solely on the state's (Alaska's) reluctance to give up full control over its own standards" (Education Northwest, 2012, p. 24). In Virginia, state education leaders believe their state standards are on par with the CCSS. "'We're already in the process of implementing college- and career-ready standards, not only in the instruction that's provided but also the assessments that students take,' said Charles Pyle, spokesman for the Virginia Department of Education. He added that the department incorporated some pieces of the Common Core mathematics system into Virginia's standards, which strengthened what already was in place" (Wolfgang, 2013, p. 1). Nebraska has also shown pride in its state standards but is performing an alignment study to determine whether their existing standards meet the quality and rigor of the CCSS.

Some individuals have publicly criticized federal government funding that they believe is tied to or used to encourage the adoption of the Common Core State Standards. Texas Governor Rick Perry has stated, "The academic standards of Texas are not for sale" (Burke, 2013, p. 1). Extreme conservatives, such as Glenn Beck, criticize the standards as a round-about way for the federal government to take over education, a criticism that standards supporters dispute. Other interest groups such as teachers' unions are moving forward with respect to the CCSS with caution. "In a speech last week, American Federation of Teachers President Randi Weingarten reiterated her support for the standards but said it is unfair to tie high-stakes tests to those standards until teachers and school administrators have had time to truly understand and implement them" (Wolfgang, 2013, p. 1). "Michigan and Indiana recently moved to 'pause'

implementation of the Common Core Standards until the issues surrounding fiscal impact and education policy could be fully considered....Indiana's 'pause' specifically asks for a review of the educational standards and a study for how much implementing the Common Core will really cost" (Williams, 2013, p. 1).

Montana Common Core Standards for Mathematics (MCCSM)

As of the 2011-2012 school year, Montana has 419 public school districts and 826 schools, with 142,347 students in public schools and an additional 11,607 students in private or home schools. School enrollment ranges from less than 50 students (one public school has only one student enrolled) to over 500 students, with 13 schools whose enrollment is more than 1000 students and one high school with over 2000 students enrolled (Montana Office of Public Instruction, 2012). A little over 6% of the total population of Montana identifying as Native American, and Montana's Indian Education for All Act aims to close the American Indian achievement gap and integrate cultural content into Montana's public school curriculum. For this reason, the 15% adaptation that all states are allowed to make to the original Common Core State Standards has been used to infuse Montana's standards with standards specific to Native American culture. An example of this adaptation that is typical of additions to both the mathematics and the ELA standards is:

CCSSM 1.OA.2: Solve word problems that call for addition of three whole numbers whose sum is less than or equal to 20, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem. (NGACBP & CCSSO, 2010, p. 15)

MCCSM 1.OA.2: Solve word problems within a cultural context, including those of Montana American Indians, that call for addition of three whole numbers whose sum is less than or equal to 20, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem. (Kendall, Ryan, Alpert, Richardson, & Schwols, 2012, p. 10-11)

Montana also elected to include an overview document in the MCCSM, consisting of a table of domains, clusters, and associated mathematical practices for each grade band.

CCSSM Implementation

“The common core will not be self-implementing – executing this overhaul of expectations for students and teachers represents tremendous undertaking” (Hirsh, 2012, p. 3). Many organizations are taking action towards creating tools and resources for the implementation of the CCSSM. In January 2012, Education First and the EPE Research Center surveyed the 46 states and Washington D.C. that had adopted the CCSS. They found that every state has developed some type of formal implementation plan, with the exception of Wyoming, which indicated that work on its plan is underway. “Every state, except New Hampshire, has a fully developed plan to provide teacher professional development aligned with the CCSS (20 states) or is in the process of developing such a plan (25 states)” (p. 2). The stages of Montana’s implementation plan are shown below in Figure 1, followed by the timeline shown in Figure 2.

Figure 1. Montana Common Core Standards Stages of Implementation

Montana Common Core Standards Stages of Implementation Continuum						
	Explore			Implement		Sustain
Stages	Stage 1 understand MCCS	Stage 2 Align Curriculum and Instruction	Stage 3 Align Student Progress Measures	Stage 4 Implement in classrooms	Stage 5 Implement in schools and districts	Stage 6 Evaluate Assessment Data to make school- wide systematic changes
CCR	All Students Graduate College and Career Ready					
Descriptors	The Montana Common Core Standards for each grade and subject area have been thoroughly studied and are understood.	District Curriculum has been revised or created that aligns with the MCCS at each grade level and provides a common sequencing to facilitate teacher collaboration at the school level. Educators have identified instructional materials that are coherent, consistent, and comprehensive and support effective learning of the ELA, literacy and Mathematics standards.	Educators establish measurable learning progressions and how students' understandings of ideas develop, evolve, and progress to establish measurable goals. Student assessments have been identified to measure the established goals. A foundation of understanding for formative assessment is established.	Educators design, adapt and use evidence-based best practices and guides to support effective deliver of the curriculum and assessment progress measures to support learning for all students through focused, coherent, and rigorous instruction.	Throughout the school year teachers engage in horizontal (e.g., grade level) and vertical (e.g., cross-grade level) conversations to be sure that every student has multiple learning opportunities and experiences to master standards required for student success at the next grade level.	Educators evaluate data collected from interim and summative assessments. Processes are established to make systematic changes based on data results.

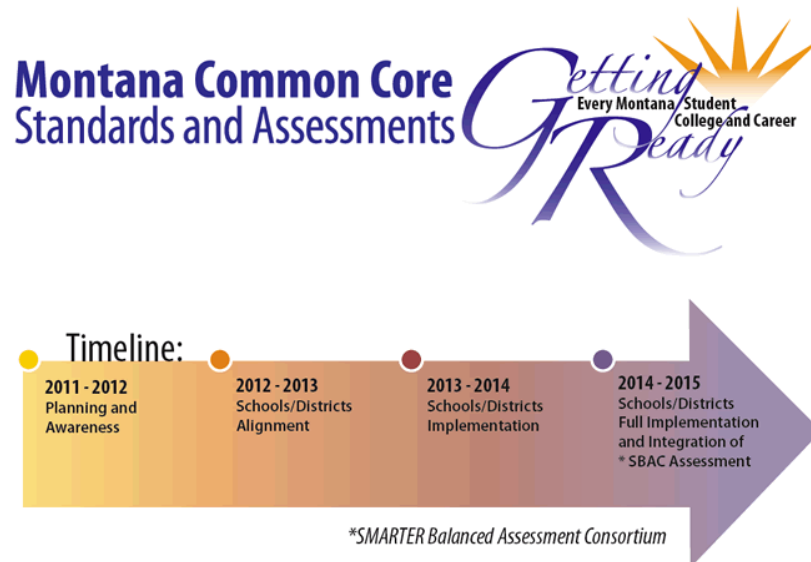


Figure 2. Montana Common Core Standards Implementation Timeline

Nationally, many organizations are creating resources to aid in the implementation of the CCSSM. At an NCTM Regional Meeting in Fall 2011, J. Michael Shaughnessy presented the efforts of the NCTM with respect to increasing awareness and providing implementation resources for the CCSSM. As a member of the Mathematics Common Core Coalition (MC³), whose mission is to ensure the successful communication, interpretation, implementation, and assessment of the CCSSM, NCTM has been working on creating a common website, www.Mathccc.org, that houses information and resources about the CCSSM. On its own, NCTM has created and made available grade band-specific slide presentations about the CCSSM. NCTM has also released a series of publications, *Making It Happen*, that showcase how NCTM's existing resources can be used for successful CCSSM implementation. Finally, a representative from NCTM is on the advisory board for the *Illustrative Mathematics Project*, a Web-based project that provides extensively documented sample tasks illustrating the CCSSM standards and practices.

The ongoing implementation and dissemination of the Common Core State Standards has given rise to related research projects all over the nation. In particular, *A Priority Research Agenda for Understanding the Influence of CCSSM* by Heck, Weiss, and Pasley (2011) highlights many research areas of particular interest during early phases of dissemination and implementation. The document recommends that research include a variety of case studies on teacher responses to the CCSSM. Recommendations of particular interest to the present study are Heck, Weiss, and Pasley's "Priority Case Study Focus #4 and #5," summarized below:

Priority Case Study Focus #4: State/district responses to the CCSSM....Ongoing Case Studies of Adopting States/Districts

1. What other policies, programs, resources, and contextual factors influence implementation of the CCSSM, and in what ways?
6. What is the depth and breadth of penetration of the CCSSM within the state/district system?
7. Within the state/district, what variations in implementation of the CCSSM are evident? What accounts for those variations? For whom do these variations have important consequences?
10. What strategies appear to be effective across a variety of state and district contexts?

Priority Case Study Focus #5: Teacher responses to the CCSSM

1. What opportunities do teachers have to learn about the CCSSM and their implementation? What messages do teachers take from these opportunities? What do teachers see as the implications for their further professional learning?
2. What implications do teachers see for their mathematics instruction? What aspects of their mathematics instruction do they see as validated by the CCSSM, and what aspects do they consider in need of change based on the CCSSM? Do teachers view these changes as positive, negative, some mixture of the two, or the latest in a long line of fleeting “reforms”? Why? (Heck et al., 2011, pp. 12-14)

Such questions can effectively be studied during the design, enactment, and follow-up of a professional development project focused on the Common Core State Standards.

Research on the CCSSM is ongoing, as are related studies of teacher understanding, effectiveness, and implementation or dissemination in states, districts, schools, and classrooms. Cogan, Schmidt, and Houang (2013) reported on results from a 2011 online national survey of over 12,000 teachers of mathematics in grades 1-12 from states that had adopted the CCSSM at that time. They found that only 55% of these teachers were aware that their state had adopted the CCSSM. Furthermore, after examining selected CCSSM standards for their grade, about 77% of teachers thought the CCSSM were the same as their former standards. Using the data from this survey,

Schmidt (2012) gave a presentation titled *The Challenge of Implementing the Common Core State Standards for Mathematics*, where he revealed that if the CCSSM placed a topic in a different grade, only about one-fourth of teachers polled said they would cease teaching that topic. He also reported that of the teachers polled about one-third have not participated in any activity preparing for the implementation of the CCSSM.

A vast majority of states are revising or creating new curriculum materials that align with the CCSSM. The Center on Education Policy (CEP) is conducting ongoing surveys of CCSS-adopting states. Their 2012 survey found that “all of the CCSS-adopting states in our survey are conducting statewide professional development and designing professional development materials” (Kober & Rentner, 2012, p. 2). In this article, the CEP shared that one major challenge, identified by 20 of the 37 responding states in the survey, is providing professional development of sufficient quality and quantity. Another challenge identified by 18 of the surveyed states is aligning content of teacher preparation programs with the CCSS. These challenges encourage a deeper understanding of how teacher learning and professional development are related to Common Core implementation. Professional development plays a large part in effectively implementing the CCSSM, and the type and design of this professional development will affect the success of implementation.

Successfully implementing CCSSM will therefore require that professional development no longer be a singular event that occurs occasionally in a teacher’s life but rather becomes teachers’ way of life as they work collaboratively in grade-level groups. (Larson, 2012, p. 112)

The dramatic shift in teaching prompted by the common core will require practical, intensive, and ongoing professional learning – not one-off ‘spray

and pray' training that exposes everyone to the same material and hopes that some of it sticks. (Hirsh, 2012, p. 1)

Montana's Office of Public Instruction continues to gather resources for professional development and has already produced a variety of webinars on the CCSSM with accompanying slide presentations and worksheets. The STREAM professional development project is a large portion of Montana's professional development plan for implementation of the CCSSM.

Teacher Learning

This exploration into the extremely deep literature on professional development begins with a consideration of teacher learning. Ball (1996) lists several areas about teacher learning that she labels as "things we think we know":

- Prior beliefs and experiences – these shape how teachers learn and can also be a hindrance towards teacher learning.
- Teacher subject-matter knowledge – this can hinder or help how or what a teacher learns.
- How teachers know students –hearing what students say involves more than accuracy, it requires experiencing the world through another's perspective.
- Importance of contexts – aspects of the context constrain and inhibit teachers' efforts.
- Reflection – this is seen as central to learning to teach.

- Follow-up – this includes long-term support, coaching in teachers’ classrooms, and ongoing interaction with colleagues.
- Teacher control – teacher learning is heightened when teachers have more control over what they are learning. “Setting off into a terrain beyond one’s current horizons is difficult, if not impossible. Yet, if the agenda is set by others, it might not be sensitive to teachers’ needs and concerns” (Ball, 1996, p. 502).
- Time – there never enough time to both learn and unlearn the amount of material that is desired. “There is as much to unlearn as there to learn, and what there is to learn is complex and underdeveloped” (Ball, 1996, p. 501).

The STREAM project attempted to expose and address at least some of these challenges in its professional development design. But Ball also discusses three more subjective challenges to teacher learning that are difficult to address from outside the school environment. First is the challenge of incomplete knowledge, described as the idea that what teachers know about their students or about teaching in general can never be certain or complete. Second are the challenges of competing commitments, which all teachers seem to confront on an almost daily basis. “When a child presents a novel approach to a problem that is imaginative – and completely nonstandard – what is the right thing for the teacher to do?” (Ball, 1996, p. 503) Third, the challenges of anticipating, interpreting, and responding to students require teachers to adapt and improvise in the face of what happens as lessons unfold. These three challenges, along

with the ongoing need to address change mathematics education standards and curriculum, affect teacher learning and make researching teacher learning a hard task.

Both Ball (1996) and Wiliam (2007) identify the need for support and reflection to help teachers learn and to help them change teaching practices. This idea of reflection as a necessary component of change is repeated throughout the professional development literature (Van Zoest & Stockero, 2008; Ball, 1996, Wiliam, 2007, Lewis & Tschuido, 1998, Mezirow, 1997). The professional development project in the current study incorporated opportunities for reflection in both face-to-face and online activities, and grouped teachers in “pods” to support collaborative change and mutual planning.

A popular vehicle for teacher learning in recent years is the establishment of professional learning communities. Wiliam (2007) identified five principles or features related to establishing and sustaining teacher learning communities: gradualism, flexibility, choice, accountability, and support. Gradualism is the idea that only small changes can be made to teaching, or else teachers tend to revert to more comfortable and familiar teaching practices. Flexibility is described as the understanding that modifications need to be allowed and expected. Choice is important because teaching is very personal, and teachers must be able to make some choices when implementing something new in their practice. Accountability to the learning communities enables change, and support requires trust and equality of power among members of the community.

Mizell (2010) also commented on the value of teacher learning communities for professional growth: “[Teachers’] professional development is more relevant when they

are able to analyze and discuss with their team members what they are learning and their experiences in using what they learned” (p. 11). He added, “A team will stay together as long as members have a mutual learning goal” (p. 12), noting that teacher teams must set goals and reassess their goals as they continue with professional learning. The example of educators continuously working together to address student learning problems and to introduce new material can lead to other teachers adopting their best practices, and “success can spread throughout the school and even from school to school” (Mizell, 2010, p. 12).

Reform Mathematics and Professional Development

Despite their own student experiences with being taught in a lecture fashion, teachers today are trying to help students make deeper connections in mathematics and engage in genuine inquiry. Teachers who were taught traditionally by memorizing facts and procedures are now being asked to change that approach – essentially to “teach” less and to ask more questions. However as Ball (1996) points out, evidence that students don’t understand is sometimes more uncomfortable and scary than it is intriguing. “When we ask students to voice their ideas, we run the risk of discovering what they do and do not know...the distance between their thinking and ours becomes visible. And the instinct to explain away the apparent misunderstandings is strong....The impulse to help and clarify, to show and tell, is deeply rooted in teachers” (Ball, 1996, p. 504).

Beyond the anxiety produced by asking students what they do and don’t know, teaching reform comes with new anxieties. “Teachers who do the things they have always assumed were helpful and then discover that the students are really not understanding the

concepts, face even more anxiety....[A teacher] embarked on changing her teaching began to doubt that she had ever helped her students ‘really’ understand. As a dedicated veteran with 20 years’ experience, she was profoundly distressed” (Ball, 1996, p. 505). Discovering new things about oneself as a teacher can be disheartening if those discoveries are negative. Another obstacle that comes with reform is trying to get people outside of the classroom to believe in the reform. “Often teachers must defend to parents and administrators things they are trying even before they themselves are convinced or confident about them” (Ball, 1996, p. 505). Huffman and Thomas (2003) acknowledge these issues when they suggest that for reform mathematics professional development to be effective “the focus should be on school-wide reform rather than on individual teachers” (p. 385).

Fortunately, most research suggests that having teachers examine their instructional practice should or does lead to changes in those teachers’ practices (Ball, 1996; Huffman & Thomas, 2003). And research has shown that mathematics teaching practices that align with the NCTM standards, which emphasize problem solving and peer collaboration, result in an increase in student motivation for learning and improved student performance, even among low-achieving urban elementary students (Bolyard & Moyer-Packenham, 2008; Ginsburg-Block & Fantuzzo, 1998). Because the Common Core State Standards for mathematics also include standards for problem solving and peer collaboration, specifically in the Standards for Mathematical Practice, similar results could be expected from the new standards.

Types of Professional Development

Content-Focused Models

Many research articles point out that professional development needs to be about the content of the discipline and how to teach that content. For example, content-focused mentoring pairs novice teachers or teachers new to teaching mathematics with accomplished veteran teachers who provide coaching and mentoring on standards and research-based teaching of the content. According to literature, this observation could easily apply to all teachers, not just new teachers, as evidenced by Mundry's comments about novice teachers:

New teachers need content-focused mentoring that supports them to teach their specific curriculum and content and inducts them into the profession of teaching....“They need opportunities to collaborate with others, reflect on practice, learn from data and results and see what does and does not work in their classrooms, recognizing that strategies that work one year with one class may need to be adjusted for new students” (2005, p. 10).

Research has shown that a positive relationship exists between teacher subject knowledge (which includes subject-specific degree(s) held by the teacher, subject-specific coursework completed, and subject-specific knowledge for teaching gained from both professional development and other sources) and student mathematics achievement (Bolyard & Moyer-Packenham, 2008; Chaney, 1995; Hill & Ball, 2009; Monk, 1994; Moyer-Packenham, Bolyard, Kitsantas, & Oh, 2008). This result has influenced

professional development in the past decade to focus more directly on content knowledge in mathematics and other disciplines.

Not only do teachers need to possess content knowledge at a deep level, they must also command specialized knowledge of how to convey subject matter to students (NBPTS, 2002). The expert teacher's content knowledge is specifically honed to teach a particular piece of material (Leinhard, 1986). "Teachers need an understanding of subject matter that is more explicit and deeper than the subject matter needed by other practitioners ... Teachers need not only to understand the content deeply, but also to know something about how that content is taught and learned," said Kennedy (1991, p. 17). With respect to teaching mathematics, Ball (2003) specifically noted, "Teachers also need to be able to use representations skillfully, choose them appropriately, and map carefully between a given representation, the numbers involved, and the operations or processes being modeled" (p. 3). She continued, "Teaching requires justifying, explaining, analyzing errors, generalizing and defining. It requires knowing ideas and procedures in detail, and knowing them well enough to represent and explain them skillfully in more than one way. This is mathematics" (p. 4).

Lesson Study

The STREAM project professional development model included opportunities for lesson study at various levels of adaptation. Lesson study helps build communities of practice characterized by teachers working together on lesson design, talking with one another about student learning, and observing teaching in classrooms. "Using strategies

such as lesson study deepens teachers' content knowledge and prepares them to work in a professional community focused on ensuring quality teaching" (Mundry, 2005, p. 11).

Lesson study may involve designing, observing, and revising research lessons that are carefully planned, usually in collaboration with one or more colleagues over several months. Research lessons are focused with a particular goal or vision of education in mind. Lewis and Tschuido (1998) studied Japanese lesson study and stated that, "The lessons are examples of a particular goal or vision in action, and individual teachers feel free to draw on them as appropriate to their own philosophy and classroom" (p. 14). Research lessons are recorded and studied through many mediums including video and audio recording, checklist observations, copies of student work, and transcriptions. Teachers may discuss the lesson in a private setting or during a public colloquium or panel discussion where strengths and weaknesses are identified.

Lesson study allows for feedback and reflection that can influence philosophy of teaching and build momentum for improvement. Japanese research lessons are influenced by national education policy, and in turn influence national policy. Teachers identify lesson study as useful for improving classroom practice. One teacher (Lewis and Tschuido, 1998) commented that when others observe you during a research lesson, "Your real profile as a teacher is revealed to you for the first time" (p. 15). Crespo and Featherstone (2006) similarly noted that because teachers have taken-for-granted assumptions about their teaching practice they do not always have the ability to raise questions that an outside observer might raise.

Designing, observing, and reflecting on lessons also helps in spreading new content and approaches. Examining teaching gives teachers a chance to talk and think about the reasons behind changes they are making in their practice as well as changes that are happening in the national curriculum (Lewis & Tschuido, 1998; Crespo & Featherstone, 2006). “Teachers also reported that research lessons connected them with teachers within their schools” (Lewis & Tschuido, 1998, p. 16). Lesson study in its many forms gives teachers a chance to bring up, discuss, and perhaps reconcile competing goals or visions of education. One unexpected advantage of studying lessons for professional development is that it allows for highly proficient teachers to stay in the classroom. These teachers continue to help others learn to teach better by modeling good teaching. “Teachers are not expected to be passive recipients of whatever new reform comes along; they help to shape and change classroom education. Japan’s national educational guidelines underscore the idea that policy is created in the classroom, not on paper” (Lewis & Tschuido, 1998, p. 50).

Video Analysis

In a 1996 article on the use of video to foster school-based reform Ball wrote that videotapes of classroom activity serve, in part, as proof that reform practice can happen in schools. She added that we know little about what people attend to and learn while watching recorded teaching. Ball posed questions about this tool for professional learning including: What is offered by polished professional-quality video? When is watching a novice teacher preferable and why? When is it helpful to observe the struggles of experienced teachers? Of course, in the years since Ball’s article was published many

others have studied the use of videos to help teachers reflect on and attend to their teaching practice (Van Zoest & Stockero, 2008; Romagnano, Evans & Gilmore, 2008; Yung, Yip, Lai, & Lo, 2010), but Ball's questions are still valid. The STREAM project used both Web-based professional video and teacher-produced local classroom videos as a medium for teacher learning.

Yung et al. (2010) displayed an enthusiasm for the use of video and offered a model for using video in professional development. Although this group did not provide any original research to back up the model, they examined previous literature and identified three effective means to engage teachers in using videos for professional development: 1) critical reflection, 2) meaningful comparison, and 3) productive discussion. They also pointed to a fairly large body of studies that involve teachers "reviewing, selecting, and editing their own videos" (Yung et al., 2010, p. 15).

Romagnano et al. (2008) noted that through the use of video for lesson analysis, a greater depth of inspection of teaching practices can be gained.

Yung et al. (2010) noted that facilitation is necessary for the effective use of videos in professional development, and suggested that the role of facilitators and the challenges they face are under-researched. Hirsch (2012) added that "emerging tools such as classroom video capture, earbud coaching (in which teachers receive real-time coaching via an earpiece while they work), virtual classroom simulations, and online tutoring" (p. 2) can be used to support professional learning. These types of innovative technologies address individual educators' needs and support the propagation of best practices to improve teaching and thus student achievement.

School-Based Professional Development/
Teacher Team Professional Development

Many schools support teacher teams, allow teachers to have common planning times, require and support professional learning communities, and consistently encourage teachers to work together to improve student performance. “A school that organizes team-based professional development and expects all teachers and administrators to consistently participate demonstrates that it is serious about all educators performing at higher levels” (Mizell, 2010, p. 18). The STREAM project incorporated the team concept by organizing participants into district-based “pods” that would study mathematics and standards as a group and collaboratively plan school-based professional learning.

DuFour, DuFour, and Eaker have published extensively about Professional Learning Communities (PLCs). In 2008 they wrote: “The most promising strategy for sustained, substantive school improvement is developing the ability of school personnel to function as professional learning communities” (p. 1). Over a decade they have promoted six characteristics of effective PLCs, including (1) shared mission (purpose), vision (clear direction), values (collective commitments) and goals (indicators, timelines, and targets) focused on student learning; (2) a collaborative culture with a focus on learning; (3) collective inquiry into best practice and current reality; (4) an action orientation of learning by doing; (5) a commitment to continuous improvement; and (6) a results orientation (p. 15-17). Research indicates that professionals learn through practice, that reflection has a valuable role in teacher learning that brings about change in practice, and that active participation in professional learning must take place for change to occur (Webster-Wright, 2009; Garet et al., 2001; Wiliam, 2007; Mizell, 2010). These findings

suggest that professional learning communities are an effective means to provide these experiences in teacher learning.

Combinations

It is worth noting that research has also been done on blending different approaches to professional development. Silver, Mills, Castro, and Ghouseini (2006) provided professional development using both lesson study and case analysis and discussion. They believed this combination allowed teachers more learning opportunities than just one particular type of professional development would allow, although they did not provide research to back this claim. McNulty and Fox (2010) used communities of learning and peer observations to empower new teachers and to create affable environments within schools. They noted that observations of new teachers are not just a one-way street; the benefits of observation are often mutual, and the professional reflection that comes from the experience of observing and being observed often results in teachers changing their classroom practices and in becoming role models for each other. According to Azer (2005), role models “inspire imitation and influence people working with them to develop new skills and achieve their potential” (p. 67).

Features of Effective Professional Development

Garet, Porter, Desimone, Birman, and Yoon (2001) studied a national sample of 1,027 mathematics and science teachers to examine the effects of different characteristics of professional development on teachers’ learning. Using program data collected as part of a national evaluation of the Eisenhower Professional Development Program, they

asked teachers to indicate the extent to which knowledge and skills had been enhanced in each of six areas: curriculum, instructional methods, approaches to assessment, use of technology in instruction, strategies for teaching diverse student populations, and deepening knowledge of mathematics. They also asked teachers to report the extent to which they made changes in their teaching practice in each of six domains: mathematics curriculum content, cognitive challenge of mathematics classroom activities, instructional methods employed, types or mix of assessments used to evaluate students, ways technology is used in instruction, and approaches taken to student diversity.

Based on their results, Garet et al. identified three core features that have significant positive effects in classroom practice: focus on content knowledge, opportunities for active learning, and coherence with other learning activities. At least four dimensions were identified within the category of “focus on content knowledge”: the relative emphasis given to the subject matter, the specificity of changes in teaching practice that were encouraged, goals for student learning that were emphasized, and emphasis given to the ways students learn particular subject matter. “The continual deepening of knowledge and skills in an integral part of any profession. Teaching is no exception” (Garet et al., 2001, p. 916). “If teachers are expected to teach to new standards, including complex thinking skills, it is essential that they have a sophisticated understanding of the content and of how students learn that content” (Birman, Desimone, Garet, & Porter, 2000, p. 30).

Garet et al. (2001) also identified four dimensions within the category of “opportunities for active learning”: observing and being observed teaching; planning for

classroom implementation; reviewing student work; and presenting, leading, and writing. In their research, Huffman & Thomas (2003) confirmed that the opportunity for planning was a significant predictor of teachers' use of standards-based curriculum and instruction.

Finally, Garet et al. (2001) identified three dimensions of professional development that is "coherent with other learning activities": the extent to which it builds on what teachers have already learned; how it emphasizes content and pedagogy aligned with national, state and local standards, frameworks, and assessments; and how it supports teachers in developing sustained, ongoing professional communication with other teachers who are trying to change their teaching in similar ways. They also found that duration, both in terms of span over time and actual contact hours, exerts a substantial influence on those core features of professional development. The authors wrote that "To improve professional development, it is more important to focus on the duration, collective participation, and the core features (i.e., content, active learning, and coherence) than type" (p. 936).

Garet et al., (2001) found that very few professional development activities from their study possessed all the desirable features of extended duration, content emphasis, use of active learning activities, coherence, and collective participation. One of their conjectures was that meeting these criteria for effective professional development requires substantial lead time and planning and that those features are expensive, possibly costing \$512 per teacher, which is more than twice what districts typically spend. Confirming this view, Birman et al. (2000) observed, "A focus on breadth in terms of the

number of teachers reached comes at the expense of depth in terms of the quality of the experience” (p. 30).

Penuel, Fishman, Yamaguchi, and Gallagher (2007) tried to extend or at least confirm the conclusions of Garet et al. (2001) through a study in science professional development. Using a sample of 454 teachers who were engaged in an inquiry science program, they examined different characteristics of professional development and their effect on teachers’ knowledge and ability to implement the program. Their findings echoed Garet et al. (2001) in the sense that there were positive impacts on teacher learning created by support for planning, total hours of professional development, content emphasis, and meaningful, ongoing and coherent professional development experiences. Other features, such as the size and source of the program, may also play a role. Penuel et al. (2007) found, during a professional development program focused on inquiry, that university-based partners did a better job supporting the use of student inquiry than school-based partners. “Small-scale interventions led by local communities, but supported by outside agencies, have been demonstrated to be highly successful, in comparison to the failure of many blanket one-size fits-all programs of aid” (Webster-Wright, 2009, p. 727).

STREAM – Standards-Based Teaching Renewing Educators Across Montana

The STREAM project is an ESEA Title II Part B Mathematics and Science Partnership Project, funded by the U.S. Department of Education through Montana’s Office of Public Instruction. The project has two primary goals: “(a) Create a statewide

systemic, research-based and sustainable approach to improve student achievement and teacher content knowledge of Montana’s Common Core Standards for Mathematics and (b) Design and deliver interactive, on-demand, high-quality learning modules...[for] statewide and regional professional development...[using] school-based and distance learning” (Luebeck & Cobbs, 2013, p. 1). These goals motivated the design of a highly structured, three-phase, eight-month professional development experience that was launched in February 2013. The project was built on a partnership model that included K-12 administrators and teachers, curriculum directors, faculty members from both of Montana’s major universities, a project manager, and an external evaluator.

Project leaders first identified fifteen partner school districts that represented variety in size, ethnicity, and location in Montana. Administrators from each district agreed to support participation in the STREAM project and identified roughly one-third of their mathematics teachers in grades 4-7 to participate in the project. An external mentor teacher was assigned to each partner district based on criteria “such as knowledge of mathematics content and pedagogy, breadth and depth of teaching experience, evidence of leadership and exemplary teaching, and demonstrated knowledge of the MCCSM” (MCCSM Proposal Narrative, 2012, 3). In the first year of the project, approximately 55 teachers and 10 mentors participated in three phases of professional development training. A Launch Workshop introduced four key content themes for the ongoing professional development: (a) Standards for Mathematical Practice and connections to STEM education (b) number systems and operations, (c) fractions, ratios and proportions, and (d) teacher learning and leadership. Following this workshop,

participants completed a series of four online modules where teachers studied these themes more deeply and practiced implementing the MCCSM through lesson design and observation. Finally, at a Summer Academy teachers brought closure to their study of the four themes and developed Strategic Plans for disseminating information about the new standards and leading school-based professional learning in their home districts.

As stated earlier, Garet et al. (2001) identified three core features that are found in effective professional development: focus on content knowledge, opportunities for active learning and coherence with other learning activities. The researchers further elaborated that support for planning, total hours of professional development, content emphasis, and meaningful, ongoing and coherent professional development experiences increased the effectiveness of professional development. The STREAM project made a deliberate effort to meet these research-based criteria in the design of its professional development model. At least half of each face-to-face event and three of the four online modules focused on mathematics content knowledge related to the Common Core State Standards. Active participation was ensured through classroom-centered tasks where teachers examined student work and created and taught standards-based lessons. The project's use of existing local and national resources for implementing the CCSSM provided a high probability of coherence with teachers' other professional learning experiences in this area. The blend of face-to-face, online, and school-based professional development activities and a three-year commitment guaranteed adequate duration with many hours of face-to-face and virtual learning that provided teachers with specialized knowledge about

the CCSSM. Finally, including a significant school-based dissemination component confirmed the extension of teacher learning to audiences beyond the STREAM project.

Summary

Answering the questions asked in the current study may help to confirm Mizell's (2010) statement that "What matters most is how the professional development is planned and implemented" (p. 15). This chapter provided an overview of current research regarding many of the professional development strategies used in the STREAM professional development project, which are foundational to this research study. However, this case study also explores a deeper dimension of professional development. Webster-Wright (2009) wrote that "the majority of this professional development literature...both research and practice based, has a focus on programs and content rather than on learning experiences" (p. 712). This study looks closely at the learning experiences of individual teachers and cohorts as they both receive and deliver professional development. The following chapter describes the research methodology that was used to examine how professional development about new standards is interpreted, processed, valued and passed on by mathematics teachers. It also offers a glimpse into how these teachers are implementing and disseminating their specialized knowledge of Common Core State Standards for Mathematics.

3. DESIGN AND METHODS

Introduction

This study took place at a critical juncture in the process of enacting the Common Core State Standards for Mathematics, as teachers and schools shift from awareness of new standards to implementation. Due to the widespread adoption of the CCSSM, this is also a period of curricular and instructional reform of mathematics education in the United States. The research goal of this study was to investigate how teachers interpret the CCSSM and how they transition from professional development and awareness to implementation and dissemination. The subjects of this study were Montana teachers and schools who participated in a highly structured and ongoing professional development project. Before discussing aspects of the research design and methodology, the research questions are repeated here.

Research Questions

How do teachers process and disseminate content knowledge and pedagogical practices learned through professional development? How do they acquire and pass on knowledge of the Montana Common Core Standards for Mathematics (MCCSM)? This study explores these questions within the context of the STREAM professional development experience which provided teachers specialized knowledge of the Common Core in the areas of the Mathematical Practices and Teacher Learning and Leadership (TLL) with specific attention to the domains of Number Systems and Operations (NSO) and Fractions, Ratios, and Proportions (FRP).

1. What elements of STREAM do teachers identify as most valuable to support dissemination of information about the MCCSM?
 - a. What structures do teachers identify as most valuable to support dissemination of specialized knowledge about the MCCSM to peers?
 - b. What messages do teachers take away from professional development about the Common Core?
2. What factors influence school-based dissemination of specialized knowledge of the MCCSM?
 - a. What supports, needs, and barriers do teachers identify as influencing their ability to disseminate the MCCSM?
 - b. How is school-based dissemination of specialized knowledge about the MCCSM hindered or enhanced by existing resources and opportunities?

Research Design

This study explored the process of standards implementation and dissemination, and attempted to thoroughly describe how teachers interpreted the MCCSM. These factors drove the choice of a qualitative research design, which is “characterized as being particularistic (focused on a particular situation, event, or phenomenon), descriptive (whose end product is a rich description of the phenomenon of the phenomenon), and heuristic (illuminate the reader’s understanding of the phenomenon under study)” (Merriam, 2009, p. 43). According to Yin (2003) a case study design should be considered when the focus of the study is to answer “how” and “why” questions. Yin continues to say that, “The case study is preferred in examining contemporary events, but

when the relevant behaviors cannot be manipulated” (p. 7). The case study design was used to answer research questions of this project, which deal with non-quantitative measures of “how” and the need for a detailed exploration of “what.” The nature of the research questions and the fact that the researcher did not manipulate participants’ behaviors made a qualitative case study methodology a good fit.

Creswell (2012) offers a more pragmatic view of case study, calling it “a qualitative approach in which the investigator explores a real-life, contemporary bounded system (case) or multiple bounded systems (cases) over time, through detailed, in-depth data collection involving multiple sources of information, and reports a case description and case themes” (p. 97). This study fit those criteria as it followed cohorts of teachers in bounded groups (their schools or districts) over time (the period of Year 2 implementation and dissemination for the STREAM project). Detailed and varied data collected at the project, district, and individual level allowed for the researcher to triangulate and confirm data: “A hallmark of a good qualitative case study is that it presents an in-depth understanding of the case” (p. 98).

In this study, a case was defined as a cohort or “pod” of teachers, generally from the same district or from two nearby rural districts. The size of a cohort ranged from 2 to 6 teachers. Each cohort was supported by one partner administrator as well as a by a STREAM project mentor. Therefore, a single “case” was made up of more than one member, and multiple cases were studied. Justification and description of the case selection process will be described in the following section. Further details about the

structure of STREAM professional development and background information about the researcher are also provided to help frame the setting for the study.

Background and Setting

Standards-based Teaching Renewing Educators Across Montana (STREAM)

The three-year STREAM professional development project was launched in Fall 2012. A core planning team representing teachers, curriculum directors, administrators, professional development coordinators, and university faculty met in October to review and approve the project's goals, intended curriculum, and anticipated products. A six-week recruitment and application process resulted in selection of approximately 50 teachers in 12 school districts.

The participants of the STREAM professional development were recruited as cohorts that represent at least 25-35% of the mathematics teachers in grades 4-7 in their school or district. In one case, teachers from a large district were split into two pods, while other small districts were combined into a single pod. In total, 10 pods collaborated throughout Year 1 of the STREAM project. The project supported these pods with an experienced mentor teacher, in most cases from an outside district, assigned to each pod. While the recruitment process was underway, four design teams made up of mathematics teachers and teacher educators created face-to-face and online curriculum materials with the goal of preparing teachers to effectively implement Montana's version of the Common Core State Standards for Mathematics.

In February 2013, a face-to-face Launch Workshop provided teachers, mentors, and administrators with two days of professional development based on the four key CCSSM themes discussed in Chapter 2. The teacher participants and mentor teachers then completed a four-month online learning experience consisting of four distinct learning modules from February through May. In July 2013, the second face-to-face professional development experience took place as a four-day retreat, called the Summer Academy. At this event, teachers revisited each of the four project themes in a series of inquiry-based workshop sessions. They also devoted substantial time to developing a Strategic Plan for school-based implementation and dissemination, described later in this chapter.

The STREAM teacher participants learned together with their pod members and their mentor teacher during the Summer Academy. At least one district or school administrator joined their pod to work on strategic planning for the last two days of the Academy. The Strategic Plans served as a road map as the teachers, mentors, and administrators disseminated their newly acquired knowledge of the MCCSM in the following year. Participants for this research project were selected from this pool of participants. The participant selection process is described below.

Participant Selection

Three *cohorts* for the case study were selected from among the ten pods of teachers who operated as teams in the STREAM project. To be clear, the term “*cohort*” refers only to classroom teacher participants in each of the cases, not to mentor teachers or administrators. The selection of cohorts was based mainly on three criteria:

preparedness, performance, and population. *Preparedness* was assessed by the quality and feasibility of the Logic Model created by the cohort administrator in conversation with the external evaluator, and on the Strategic Plan developed by the cohort teachers for implementation and dissemination of the MCCSM. *Performance* was based on engagement and completion of assignments in the four STREAM online modules. Finally, *population* ensured that the three cohorts represented district of varying size.

Due to constraints on time and resources, the researcher confirmed that selected cohorts were committed to success in the implementation and dissemination phase of the STREAM project, and were willing to commit time and effort to allowing for research data collection through observation and interviews. It was also necessary to confirm that cohort administrators were willing to support the cohort's Strategic Plan and allowed data collection in the form of interviews of themselves, their cohort and school-based observations. Funding and time constraints also required the researcher to minimize travel for interviews and observations.

Two candidates for the case study easily met the criteria stated above. After consulting the STREAM leadership team, the researcher proposed to recruit Twotown (a smaller cohort comprised of two rural districts, Smallville and Prepmont) and Ampleton, a larger cohort representing a relatively large school district in the state. The researcher deliberately selected one rural and one urban (by Montana's definition) cohort with the hope of drawing out size-related issues and differences that might contribute to answering the research questions. A third noteworthy cohort, Riverview, was proposed as a case study due to its highly motivated teachers and administrator, and for outstanding

performance in the online modules far beyond the majority of STREAM participants. Lichtman (2012) proposes that there are three types of cases worth studying through the use of case study: the typical case, the exemplary or model case, and the unusual or unique case. Ampleton and Twotown represented typical urban and rural cases while Riverview was chosen as an exemplary case. The Twotown cohort included three teachers from two rural districts, one mentor, and two administrators. The Ampleton cohort included six teachers, one mentor, and one administrator. Riverview had two teachers, one mentor, and one administrator participating in the STREAM project. The Leadership Team approved inclusion of these cohort groups in the research study, and the participants were asked to participate as research subjects at the Summer Academy in July 2013. All of these cohorts agreed to participate.

Length of Research Period

Research initially was intended to occur over five months, beginning in August 2013 and terminating in late December 2013 or early January 2014. This period began with the last phase of formal STREAM project professional development for Year 1 participants—the Summer Academy—and carried through the first semester of implementation and dissemination for participants continuing into Year 2. This research window allowed the researcher to observe an important transition period from project-led and highly structured professional development to a self-directed and school-based dissemination of teacher professional knowledge. During this time the knowledge gained during the first year of professional development was fresh in the teachers' minds and would likely influence the professional knowledge they chose to share. It was realistic to

expect observable and measurable progress during this time period as each cohort's Strategic Plan for school-based dissemination was intended to include milestones to be accomplished in Fall 2013. However, after initial school-based observations and corresponding analysis, the researcher found it necessary to extend this research period for an additional three months. The research period occurred over eight months, from August 2013 to March 2014. The cohort participants were able to draw from multiple school-based professional development events for their interview responses. Observation and documentation of their activities provided further evidence to answer the research questions.

Role and Experience of the Researcher

I earned an undergraduate degree in Mathematics with a Teaching Option in May 2007. I completed student teaching at a small rural school in Montana and taught high school mathematics for one year in Washington prior to beginning graduate studies. I earned a Masters Degree in Mathematics in May 2010 and I have been a Graduate Teaching Assistant while earning my masters degree and progressing toward a doctoral degree. I was employed as a Graduate Research Assistant and Internal Evaluator for the STREAM project and continued in those roles throughout the study period. The STREAM project director was the supervisor of my work as a Graduate Research Assistant as well as the faculty advisor for this research.

My preparation to be a high school teacher and subsequent teaching experience took place prior to the release of the CCSSM. Earning certification in Montana, a state that had only a handful of mathematics standards at the time, and then teaching in

Washington with its extensive and detailed mathematics standards, was a very difficult transition for me. This experience influenced my hope that the implementation of common standards throughout the nation would not only unify the content to be taught in the classroom but would also develop a common language for all K-12 teachers. The content in the CCSSM represents a cohesive knowledge base that can allow all students to be college and career ready. I was very hopeful that the CCSSM would unite the U.S. in the intended mathematics curriculum; however, I was concerned whether implementation of the CCSSM in schools would be undertaken in a meaningful and sustainable manner.

I attended and participated in all STREAM events including the first Core Planning Team Meeting, the Launch Workshop, and the Summer Academy; and also assisted one of the instructors of the online module sequence throughout Spring 2013. These experiences allowed me to become well-versed in the goals, purpose, and continued activities of the STREAM project. Thanks to a rural Montana upbringing and education, I was also well-versed in the circumstances and needs of Montana teachers, especially in rural areas. My experiences brought me into contact with several of the teachers in this study prior to the beginning of the STREAM project. Although I judged that these experiences, being part of the STREAM project, being raised in Montana, and having been in contact with some of the STREAM participants prior to this study, would not unduly affect data collection and analysis, they should be noted as a way of recognition and to reduce potential bias. I remained aware of the potential bias these factors presented and worked diligently to reduce its effect on this research.

Methods of Data Collection

A substantial amount of data, mostly qualitative, was gathered for the purpose of project evaluation and was available to the researcher. Although many of these sources were not used in this study except for confirmation of collected data results, a few STREAM tools were used that documented the goals schools set for moving forward with school-based implementation of the Common Core. Project evaluation alone was not enough to answer the posed research questions. So, the researcher developed a separate data collection plan, focusing on the school-based dissemination stages of professional development. The data collection plan for the research study provides information about teachers' use of new knowledge and skills and related organizational changes (Guskey, 2000). The key components of data collection and supporting project evaluation data are described below and grouped into two categories: data assessing educators' readiness for CCSSM school implementation and cohort dissemination, and data regarding dissemination. This description is followed by a timeline that help organize the process of data collection.

Educator Readiness Data

Logic Models. In collaboration with the STREAM external evaluator, administrators for each of the partner districts involved in the project created a district Logic Model to represent their vision for implementation and dissemination of the CCSSM. These were created during Spring 2013 and served as a reference and road map during Year 2 of the STREAM project. The Logic Models outlined a problem statement

for each district, priorities of the district, assumptions about what was to be gained from the STREAM professional development experience, and external variables that could potentially hinder implementation. They also included detailed descriptions of planned efforts and activities, expected outputs and products, anticipated outcomes of enacting these plans, and measures that were used to describe the initial status of each district's implementation of the Montana Common Core Standards for Mathematics. Additionally, Logic Models were used as a reference during interviews with administrators (described in more detail later in this chapter) and provided data to help answer research questions about the factors that influence the implementation and dissemination of professional knowledge about the CCSSM. An example of a Logic Model can be found in the Appendix A.

Strategic Plans. In July 2013, STREAM cohort members worked together with an administrator to create a Strategic Plan for school-based professional development and dissemination of the MCCSM in the 2013-2014 academic year. Significant time was allotted during the STREAM Summer Academy for each partner district to develop a Strategic Plan specific to the district. Each Strategic Plan included a vision or mission statement, professional development goals, the professional development audience, descriptions of activities or strategies to meet goals, a budget and timeline, and assessment milestones. The Strategic Plans were intended to be aligned with the district's Logic Model and formed the foundation for STREAM Year 2 activities in each district. Together with the Logic Models, the Strategic Plans were helpful in revealing what teachers found valuable about their CCSSM professional learning and how they proposed

sharing their knowledge with peers. The Strategic Plans, along with initial cohort interviews (described in more detail later in this chapter), also served as the outline for anticipated cohort dissemination activities. A template of a STREAM Strategic Plan can be found in Appendix B.

Dissemination Data

Observations. As described earlier in this chapter, three cohort groups were selected for the case study. A cohort group was made up of two to six STREAM teachers from a single district or cluster of rural districts that worked, learned, and planned together with support from a mentor and administrator(s). Cohort-level data collection included on-site observation events. The first set of observations occurred at the Summer Academy in July 2013. Throughout the week, the researcher participated with each cohort in professional learning to build trust as the cohorts became comfortable with the researcher's role and purpose. The researcher also rotated among the three cohorts during strategic planning sessions, which were scheduled at three different times during the week for a total of six to seven hours. During these observations, the researcher gained information about how each cohort functioned, descriptive information about the cohort members, and how the cohort planned to disseminate MCCSM knowledge within their districts in the coming year.

A confidential observer journal was kept to track cohort interactions and collaboration as well as challenges confronted and decisions made along the way. The researcher also collected copies of each cohort's initial draft of its Strategic Plan, which were posted as a Google or Word document. Finally, if the cohort did not appoint its own

recorder, the researcher asked if one voluntary member of each cohort would keep minutes of meetings and discussions and to provide a record of events related to the project that occurred in the cohort's home district(s) during the research time period. Every cohort provided a recorder who kept in touch with the researcher, and vice versa, throughout the study.

For the school-based event observations, the researcher used an observation protocol to make notes and to maintain consistent topics for observation. This observation protocol was adapted from the Horizon Research Inc.'s 2005-06 Local Systemic Change Professional Development Observation Protocol. The adaptations were made to make the protocol more appropriate for use in a teacher-led, school-based professional development setting. Along with providing clarity for topics to consider during observation, the researcher intended to use the Horizon instrument's "Capsule Rating," a holistic scoring of the entire event, for description of the quality of the professional development session. However, upon analysis of school-based events, there was no fair and consistent way to represent these capsule ratings for comparison purposes. Therefore, they will not be reported and were not considered in the analysis and results of this study. The observation protocol used for school-based events is included in Appendix C.

The second set of observation events took place during one of the cohort's first meetings in Fall 2013. The researcher traveled to each site to observe how the cohort initiated its Strategic Plan. Confidential observer notes were recorded on how cohorts renegotiated their Strategic Plan as their dissemination efforts began, how they chose to

revise or adapt their original Strategic Plan, or how they carried out the first steps of their Strategic Plan. This visit was also an opportunity to confirm that the cohort kept a record of future meetings and events and to determine if additional site visits were needed.

The third set of observations was mutually determined by the researcher and the cohort to coincide with significant events, usually identified in the Strategic Plan, that represented dissemination of MCCSM professional learning at the district, school, or grade-band level. The researcher attended and took notes as an observer and obtained copies of all materials used at the event. Anonymous feedback from attendees was also collected in the form of informal interviews during these events.

Interviews. The outcomes of this research study rely heavily on the participants' self-expressed values, perceptions, and challenges; therefore, it was essential to capture their own words and thoughts as often as possible. For this reason, four levels of interviews were conducted during the study period. Each interview followed a semi-structured protocol, which is characterized as having "partially prepared questions that are fully structured by the researcher/interviewer's concerns and initial theoretical framework" (Wengraf, 2001, p. 1). These interviews were "sometimes fairly-fully or heavily structured and sometimes very lightly structured sessions and questions" (Wengraf, 2001, p. 2). The semi-structured format assures that the research questions were adequately addressed, but also allowed for flexibility to pursue useful side avenues and to "hear what participants have to say in their own words, in their voice, with their language and narrative" (Lichtman, 2012, p. 144). Following Lichtman's notion of the "in-depth interview," each interview session began with questions to build trust,

encourage calmness, and inform participants of how data would be used. The researcher continued with a sequence of pre-determined questions that addressed the research questions, using additional prompts as needed. The five interview protocols were developed in conjunction with and approved by the STREAM project director. All interviews were videotaped and audiotaped for later transcription and analysis. Informal interview questions asked during observation visits in the form of conversation and e-mail were also be used in the data collection process. Even though these teachers had already signed consent forms due to their participation in STREAM, each interview began by first gaining signed consent from each participant.

The first set of interviews occurred after the second full day of the Summer Academy in July 2013. This timing ensured that each cohort group had completed the three major content sessions of the Summer Academy as well as a session to initiate strategic planning. Three separate focus group interviews were conducted, one for each cohort group chosen for this study; these will be referred to as the “initial cohort interviews” throughout the rest of this paper. The question protocol used in this initial cohort interview can be found in Appendix D. By essentially rephrasing the research questions, the researcher asked the participants of each cohort to discuss the value of the MCCSM professional knowledge they gained and their vision for disseminating that knowledge with others in their district. A focus group interview format was ideal for gathering this level of data and to further observe how cohorts articulated their vision and interacted with each other. Creswell (2007) notes that focus group interviews can encourage new ideas about a topic or question that result in more in-depth discussion than

with individual interviews. “Focus groups are advantageous when the interaction among interviewees will likely yield the best information, when interviewees are similar and cooperative with each other, when time to collect information is limited, and when individuals interviewed one-on-one may be hesitant to provide information” (Creswell, 2007, p. 133).

A potential drawback of focus group interviews (Creswell, 2007) is that the group discussion can be influenced or dominated by a few people: “Care must be taken to encourage all participants to talk and to monitor individuals who may dominate the conversation” (p. 133). To further accommodate this possibility, the researcher invited the members of each cohort to share their individual views via email. Within 24 hours of the focus group interview, participants received the same questions electronically along with a request to restate or expand on the views they stated (or did not state) during the interview. No member chose to take part in this accommodation. The interview protocol for the initial cohort interview can be found in Appendix D.

The third day of the Summer Academy provided an opportunity to interview a school or district administrator from each cohort group in the study. Data from this interview was used to assess the level of alignment between the STREAM teachers’ vision and the administrator’s vision of how MCCSM knowledge should be disseminated in a given district. Administrators were actively involved in the creation of a Logic Model for their districts, and they were involved in enacting the Strategic Plans in those districts. It was therefore important to determine whether their goals and the cohort’s Strategic Plan were mutually supportive. At this interview, administrators were also

asked to characterize their district's current status in terms of CCSSM implementation. This information provided an initial status of district implementation to begin the description of each cohort's dissemination process, detailed in Chapter 4. This interview is titled the "administrator's initial interviews" for the remainder of this paper. The question protocol used in this interview can be found in Appendix E.

The three mentors assigned to the cohort groups in this study were also interviewed immediately after the Summer Academy. Interviews with the mentors, experienced teachers selected to mentor the cohort members throughout the STREAM project, provided an external perspective on the progress of each cohort group and were used to confirm the focus group responses or identify areas that needed further questioning. Mentors reported on the progress and effectiveness of strategic planning within their cohort group; the feasibility and perceived strengths and weaknesses of the Strategic Plan; and the outcomes they anticipated as the cohort enacted its plan. Mentors also described their expected role in the school-based dissemination process. These interviews will be referred to as the "mentor's initial interviews" throughout this paper. The question protocol used in this interview can be found in Appendix F.

A fourth round of interviews was conducted in March 2014. Initial analysis results exposed that individual interviews of cohort members were needed. It would be inefficient if not impossible to interview all teachers in the three case study cohorts; as a compromise, all of the teachers were interviewed with the exception of three teachers in Ampleton. This resulted in interviews with three of the six teachers in Ampleton as well as both teachers in Riverview, Prepmont, and Smallville, a total of twelve individual

reflection interviews. A semi-structured protocol was used to encourage participants to reflect on the process and success of enacting their Strategic Plan. Questions focused on identifying factors that either helped or hindered the process of implementation and dissemination of professional knowledge about the CCSSM as well as description of dissemination events that occurred in each district. Although the questions were for the most part the same for all individual interviews, specific questions addressing individual statements and actions throughout the dissemination process were also included. Following these interviews, the researcher again sent each participant an electronic invitation to individually respond to or expand on the interview questions. No member chose to provide any additional comments. These interviews will be referred to as the “cohort member’s reflection interview.” The question protocol used during these interviews can be found in Appendix G.

The cohorts’ administrators were interviewed a second time in March 2014 regarding the enactment of the Strategic Plan, factors that supported or hindered their cohort’s progress, and the district’s status in implementing the MCCSM. This interview is titled the “administrator’s reflection interview” for the remainder of this paper. The question protocol used during these interviews can be found in Appendix H.

The data collected from the case study groups, the cohort groups, will be the primary source of data to answer the research questions. Data collected from all of the STREAM project teachers as a whole, (e.g., the STREAM pre/post-tests, STREAM external evaluator reports, surveys, etc.) were used to help strengthen the findings from the cohort groups and allow them to be considered in a larger population.

The timeline for data collection is outlined in Table 1 below:

Table 1. Data Collection Timeline

<u>Date</u>	<u>Procedure</u>
July 2013	• Confirm participation of cohort members (teachers) as well as cohort mentors and administrators • Observe each cohort's relationships and their planning process • Initial Cohort Interviews • Administrator Interviews • Mentor Interviews
September – December 2013	Attend and observe cohort event or planning meeting • Ampleton Launch Event – September • Riverview Event - December • Prepmont Cohort Planning Meeting – September • Smallville Cohort Planning Meeting – September
October 2013 – March 2014	Attend and observe cohort events • Ampleton Events – February and March • Riverview Event – March • Prepmont Events – October and March • Smallville Events – October and March
March 2014	• Cohort Members' Reflection Interviews • Administrators' Reflection Interviews

Analysis of Data

The researcher entered the research process with a predetermined set of questions for investigation as well as plans for data collection and analysis. However, it was expected that preliminary findings in the research process might redirect the investigation. The researcher approached data analysis using a spiral process as described by Creswell (2007). In this view, data collection, data analysis, and report writing are treated as non-distinct steps that are interrelated and often go on simultaneously. This process was cyclical in nature - research coding and initial findings influenced the next

round of data collection. Data analysis procedures are outlined in this section, loosely organized by the type and purpose of the data.

Logic Models & Strategic Plans

An administrator from each partner district in the STREAM project worked with the project's external evaluator to create a Logic Model for long-range planning about Common Core implementation. Cohorts created their own Strategic Plans for school-based dissemination during the Summer Academy in July 2013. The external evaluator used these documents for the purpose of evaluating project effectiveness, but permission was also granted for the researcher to access and analyze these data sources for this research study.

Logic Models. Because the Logic Models were created by the district administrators, they were referenced directly during the initial administrator interviews. During these interviews, administrators were encouraged to discuss and more thoroughly describe the external variables identified on the Logic Models that they anticipated supporting Common Core implementation in their district, as well as the expected outcomes identified on the Logic Models and how their district was working towards these outcomes.

Strategic Plans. The Strategic Plans created at the Summer Academy by the cohorts with assistance from their STREAM mentors were used throughout the research period. They were compared to the Logic Models to examine how the teachers' vision for district implementation compared and contrasted to the vision created by the

administrators. As an overall record of goals and activities for the cohorts, the Strategic Plans provided a record of how and what the cohorts anticipated for dissemination compared to their actual dissemination effects. Along the same lines, because the plans also included specific milestones and timelines, they were constantly referenced to see if cohorts were meeting their original objectives and allowed the researcher to ask targeted questions about supports and barriers. The actual dissemination process was both observed by the researcher and confirmed or clarified by self-reported interviews as described below. Prior to these interviews and observations, the Strategic Plans were reviewed to ensure the researcher was conscious of each cohort's expected implementation plans.

Interviews and Observations

The majority of the data used in this study came from interviews and observations of case study participants. Data analysis more or less followed the order of the data collection timeline. The analysis was ongoing and occurred as soon after the data was collected as was possible.

As discussed in the data collection methods section above, the researcher began with observations of each district in the cohort group throughout the Summer Academy in July 2013. The researcher maintained a confidential observer journal to keep track of significant interactions and decisions within the cohorts. At the end of the Summer Academy, the researcher compared her observer journal notes with the cohort's working notes and Strategic Plan. Discrepancies that existed were discussed with cohort members in informal settings as well as during formal reflection interviews. During the Summer

Academy, the first round of interviews, which included initial interviews of cohorts (in a focus group setting), mentors, and administrators took place. The researcher followed a semi-structured interview protocol to allow flexibility during each of these interviews. The researcher audio and video-recorded each of these interviews, transcribed these and reviewed them during data analysis. During the focus group interview, a discussion protocol named “Go Around One” was used. This protocol was inserted in the initial cohort interview question protocol, which is attached in Appendix D.

After the Summer Academy observation and interview data was collected, the researcher began analyzing the body of data for each cohort to develop a full picture of how the cohort functioned and its plans and preparedness for school-based dissemination. Data analysis for a cohort began by re-reading the researcher journal notes and the cohort’s Strategic Plan in their entirety, and reviewing the interviews straight through to record general impressions. The researcher then transcribed the interviews directly. The researcher then read and coded the interviews by highlighting, clustering, and synthesizing significant and repeated statements, beginning with the initial cohort interview and ending with the administrator interview. The researcher journal notes and the Strategic Plan served as a backdrop to this analysis, and significant statements from these sources were included to supplement the interview data analysis.

After developing codes for each cohort, the researcher reviewed and compared these codes with data within and across cohorts to create categories of similar codes. The researcher continued collecting data and analyzing it in the same fashion throughout the study period while remaining aware of existing categories, examining for confirmation

and considering negative case analysis (contrasting data to existing codes). As necessary, the researcher created new categories, and modified and reorganized existing categories. As a result of this analysis, the researcher identified emergent themes both within and across cohorts, accuracy of which the researcher confirmed with raw data.

Data analysis was continuous throughout the study period, but data was also considered as having two phases. The first phase was pre-implementation, when cohorts were planning and preparing to disseminate their knowledge of the MCCSM in their home districts. The second phase focused on how cohorts actually carried out those plans, and the obstacles and successes they encountered. The line between these two phases was not clearly defined. For example, the first school-based cohort meetings in the beginning of Fall Semester 2013 were related to the planning phase but also signaled the beginning of the implementation phase. Observation of these meetings resulted in new researcher observation notes that had to be analyzed with an attention to existing codes/categories but also for new emerging codes related to standards implementation. For each phase of data collection, both before and during dissemination, the researcher revisited codes and categories and compared and contrasted across the data types to validate the themes that emerged from the data.

As more information was added to a cohort's database, codes were added, removed, and regrouped to find more central and meaningful categories. The more powerful emerging patterns in the data were reformed as key concepts or themes. As data collection continued, the researcher worked with the research advisor to confirm whether

codes were being developed appropriately. Each of these coding and categorizing cycles followed the procedure outlined by Lichtman (2012):

Step 1. Initial coding. Going from the responses to a summary idea of the responses

Step 2. Revisiting initial coding

Step 3. Developing an initial list of categories

Step 4. Modifying the initial list based on additional rereading

Step 5. Revisiting the categories and subcategories

Step 6. Moving from categories to concepts (p. 198)

In discussing Step 6, Lichtman says, “As a rule of thumb...five to seven concepts should be the maximum number that you can find in a set of data” (p. 254). The coding process as described was that of a generic approach to coding. Creswell (2012) states that, “In this approach, the researcher collects qualitative data, analyzes it for themes or perspectives, and reports 4–5 themes” (p. 184).

Issues of Validity and Reliability

Generalizability to a large population, or the ability for a study to be widely replicated, is not typically the desired outcome of qualitative research. Therefore the traditional measures of reliability and validity used in quantitative research are not easily applied. Instead, qualitative research is judged and evaluated based on issues of credibility, transferability, dependability, and confirmability. A complete discussion of these concepts is beyond the scope of this chapter but a brief definition, activities

suggested in the literature to improve these issues, and how this study will maintain high standards of quality in each of these areas will be immediately discussed.

Credibility refers to the “adequate representation of the constructions of the social world under study” (Bradley, 1993, p.436). Lincoln and Guba (1985) recommended activities that would help improve credibility that are repeated throughout the literature on qualitative research analysis. These include: “prolonged engagement in the field, persistent observation, triangulation, negative case analysis, checking interpretations against raw data, peer debriefing, and member checking” (Zhang, Y. & Wildemuth, 2009, 6). This study employed many activities to improve credibility. Researcher interpretations were consistently checked against raw data. Because of the extension of the research period, the researcher conducted data collection for a sufficient period of time to fully understand each cohort’s school-based dissemination efforts and the supports and barriers they encountered. The participants’ responses to interview questions were collected and interpreted in multiple ways including: live observer notes taken during the interview, audio and video-recordings for auditory and visual record, and written record in the form of researcher transcriptions. Member checking was used throughout the study period. Participants were given an opportunity to clarify or elaborate on the initial interviews although no participant elected to do so. During reflection interviews, participants were asked directly to elaborate or clarify significant statements made or observed actions. These accounts were examined against existing research codes to ensure that the results met requirements for confirmability as well as credibility. The method of triangulation of

multiple data sources to provide corroborating evidence was also used to address dependability and confirmability of the results.

Dependability of the results was supported through extensive description of the data collection and analysis procedures and through the use of semi-structured interview protocols. Dependability refers to “the coherence of the internal process and the way the researcher accounts for changing conditions in the phenomena” (Bradley, 1993, p.437). “Dependability is determined by checking the consistency of the study processes” (Zhang, Y. & Wildemuth, 2009, 7). To further increase dependability, data from this study were analyzed by comparing participants’ verbal interview statements against analysis of participants’ actions in observation periods as well as in their written work. Any inconsistencies were examined during the analysis stage of the study.

Confirmability is “the extent to which the characteristics of the data, as posited by the researcher, can be confirmed by others who read or review the research results” (Bradley, 1993, p.437). “Confirmability is determined by checking the internal coherence of the research product, namely, the data, the findings, the interpretations, and the recommendations. The materials that could be used in these audits include raw data, field notes, theoretical notes and memos, coding manuals, process notes, and so on” (Zhang, Y. & Wildemuth, 2009, 7). All of the qualitative data collection was done by the researcher, therefore interpretations maintained uniformity throughout all periods and types of data collection. Additionally, through repeated examinations of the raw data throughout the study period, the researcher maintained a consistent analysis of the data. The researcher also maintained a detailed chain of evidence so that an external researcher

could follow the procession of evidence from research questions to any conclusions drawn from the data.

Finally, data collected from the whole group was used to strengthen the transferability of the results from the cohort group. Transferability is the extent to which the results from a study can be applied to another context. “It is not the researcher’s task to provide an index of transferability; rather, he or she is responsible for providing data sets and descriptions that are rich enough so that other researchers are able to make judgments about the findings’ transferability to different settings or contexts” (Zhang, Y. & Wildemuth, 2009, 6). Transferability in this context is the extent to which the results of data analysis regarding the subjects of the case study, the three cohort groups, can be transferred to other settings. Due to the qualitative nature of this research, any specific results may not be realistically transferable to other populations or settings. However, the results from this research should be useful in a general sense to other populations as they undergo the process of disseminating specialized knowledge of standards-based instruction in their schools, districts, and states. The determination of how transferable the results from this study might be is left to other researchers, but this decision will be aided in the thorough and rich descriptions of the data collection and analysis methods performed as well as through the vivid portrayal of the cohorts’ dissemination process given in Chapter 4.

Limitations and Delimitations

Limitations

Because this research was situated in the context of the STREAM project, an existing professional development project that the researcher did not design for the purpose of this study, the research program had to remain within the parameters set by the STREAM Leadership Team. STREAM was funded through a federal and state grant and thus maintained rigorous standards and expectations as to what research was performed; therefore the researcher filtered all research methods and data collection tools through the STREAM Leadership Team. As noted earlier, the STREAM project director was the research advisor for this study and therefore gave input that may have influenced the direction of the research. Much of the data collected was self-reported and therefore faces a limitation in both its validity and reliability. This limitation was somewhat diminished by using multiple data sources, directly comparing self-reported data to observed activities. Time was another limitation that was a major factor in both participant selection and data collection. The time frame imposed by the STREAM project calendar was enforced in this research project and set an overall limit to the data collection period.

Delimitations

To allow for an in-depth focus on the process of how teachers disseminated professional knowledge of the MCCSM, the sample size was purposefully kept small. As a qualitative case study, the results are not explicitly generalizable beyond the three cohort cases in the study and the participants within. However, steps to further

generalizability have been discussed above. The eight-month study period may also be a limitation of this study. The reasons for the choice of this time frame were discussed earlier in this chapter in the section titled *Length of Research Period*.

During observations and interviews, the researcher attempted to maintain a detachment from participation within the dissemination process. However, the presence of the researcher and the transparency of the interview questions may have created a Hawthorne effect (the stimulation to output or accomplishment that results from the mere fact of being under observation) within the cases being studied. The other cohorts in the STREAM project were not asked to participate in multiple interviews and observations. This opportunity to reflect on the progress of their dissemination efforts and on the factors that influenced this process may have indirectly impacted how dissemination was carried out.

Conclusion

This study provided an opportunity to investigate emerging issues occurring in the wake of CCSSM adoption and with the implementation and dissemination of the CCSSM. This study provided a detailed account of teacher interpretations of the CCSSM as well as valuable knowledge about factors that influenced the process of dissemination of the CCSSM in schools and districts. This research study combined the well-established research methodology of case study with reputable qualitative data collection methods including semi-structured interviews and observations. The study informs the Priority Research Agenda set forth by Heck, Weiss and Pasley (2011). Ultimately, it expands the current knowledge base about how teachers implement and disseminate their professional

knowledge about the CCSSM and the factors that hinder or help this process. It has the potential to inform how teachers interpret and use knowledge gained through professional development in general.

4. ANALYSIS & FINDINGS

Purpose of the Study

“Educators have come to realize that we are responsible for our own learning... But we usually do not move our eyes around the room – across the table – and say to ourselves, ‘I am also responsible for the learning of my colleagues’” (Lambert, 2002). More and more teachers are tasked to become leaders in their school and to provide professional learning opportunities for their peers. Some research exists on how teachers assume leadership roles when providing professional development in mathematics content for teaching (Elliot et al, 2009). However, research on teacher leadership in an entire school-based reform movement, such as the implementation of the Common Core State Standards for Mathematics, is nearly non-existent. “Educators yearn to be more fully who they are – purposeful, professional human beings. Leadership is an essential aspect of an educator’s professional life” (Lambert, 2002). But, what does that look like in action? How do teachers approach change in school-based reform?

The purpose of this research study was to describe how teachers disseminate content knowledge and pedagogical practices learned through professional development – in particular, how they pass on knowledge of the Common Core State Standards for Mathematics (CCSSM). This study explored these issues within the context of the STREAM professional development experience that provided teachers with specialized knowledge of the Common Core in the areas of Common Core content knowledge, mathematical practices and connections to STEM education, and leadership in school-based learning. The questions that guided the research are:

1. What elements of STREAM professional development do teachers identify as most valuable to support dissemination of information about the CCSSM?
 - a. What structures do teachers identify as most valuable to support dissemination of specialized knowledge about the CCSSM to peers?
 - b. What messages do teachers take away from professional development about the Common Core?
2. What factors influence school-based dissemination of specialized knowledge of the CCSSM?
 - a. What supports, needs, and barriers do teachers identify as influencing their ability to disseminate the CCSSM?
 - b. How is school-based dissemination of specialized knowledge about the CCSSM hindered or enhanced by existing resources and opportunities?

The next section offers a review of the STREAM project and its participants, followed by a brief introduction to each of the four case study cohorts examined in this case study and their members. Next, the discussion of findings begins with a description of five phases of dissemination that emerged as common to all of the cohorts as they conducted professional development with peers in their home districts. The chapter continues with an in-depth analysis of each cohort, using the five phases of dissemination as an organizing structure to allow parallel presentation of each case. The chapter concludes with findings from an analysis of the four cohorts across cases.

Review of STREAM Participants and Program

The STREAM project was deliberately designed to incorporate core features of effective professional development. These include a focus on content knowledge, opportunities for active learning, and coherence with other learning activities. In addition, effective professional development is sustained and of adequate duration, provides support for teacher planning, and creates meaningful, ongoing and coherent learning experiences (Garet et al., 2001).

Participants in the Standards-based Teaching Renewing Educators Across Montana (STREAM) project experienced three phases of professional development during Year 1 of the project. A Launch Workshop introduced four themes: mathematical practices, mathematics content in number systems and operations, and mathematics content in fractions, ratios and proportions, and teacher learning and leadership. Teachers continued to study these themes and apply them to classroom practice in a series of month-long online modules. Finally, at a four-day Summer Academy teachers added to their knowledge in these four areas and developed Strategic Plans for disseminating information in their home districts.

Although data collection did not begin until the end of the STREAM professional development cycle, the researcher was immersed in the project and experienced the professional development throughout Year 1. Besides handling many project logistics and serving as an internal evaluator, the researcher attended all STREAM professional development events in Year 1 of the project and contributed as a participant in all four online modules. During the Summer Academy, the researcher interacted both

professionally and socially with participants from all fifteen districts in the partnership. This depth of knowledge aided in deciding which district cohorts to include in the research study. Selection of cohorts for the study was based on demographic factors and issues related to preparedness and performance. Prior to the initial interviews, the researcher was well acquainted with all of the research participants and confident that the participants felt familiar and comfortable with her. The school-district cohorts themselves are described below.

Introduction to the Cohorts

Qualitative research often tells a story about a representative group of people, either by demonstrating their similarities or by displaying how every person's story is unique and has value. This case study focuses on four school districts or cohorts and the journey of teachers within these school districts through eight months of providing professional development to their peers after receiving nine months of intensive professional development in the STREAM project. The original research plan intended to follow teachers through the first semester (four months) of dissemination activity. Initial analysis and a slow start by some districts called for extending this observation period well into the second semester. To clearly illustrate the uniqueness of each cohort's experience during eight months of implementation (August 2013 – March 2014), the cohorts will be discussed separately. In the following sections, each cohort will be introduced by describing the school and district context and circumstances and the teacher audience for dissemination. This is followed by a short description of the classroom teacher participants, mentor teachers, and participating administrators from

each school district. These descriptions serve to highlight similarities and differences across the four school districts as well as the distinctive strengths and needs of each district.

The Ampleton Cohort

Ampleton School District, located in one of Montana's largest "urban" areas, includes five distinct elementary schools serving almost 2,000 students in grades K-5. The number of students enrolled at each school varies from 299 students to 569 students. Four of these schools are located within a one-mile radius in the city of Ampleton, with the fifth school about two miles from this central area. In each school at least 40% of the student population qualifies for the free and reduced lunch program with three of the five schools at over 50% free and reduced lunch. Ampleton has about 90 full time self-contained classroom teachers across the five elementary schools (about 150 FTE in grades PK-5) and a large support staff employing mathematics coaches, instructional coaches, and teacher aides. The STREAM cohort targeted all K-5 educators in the five schools, which totaled over 100 teachers. The Ampleton cohort consisted of five classroom teachers, each from a different school: Pamela, Quinn, Roxanne Robinson, Stella, and Teresa. The sixth cohort member, Una, was the district mathematics coach. Additionally a mentor teacher, Wendy, was paired with the Ampleton cohort and the Assistant Superintendent, Mr. Owens, volunteered to participate in STREAM alongside the teachers from his district. Table 2 provides a short description of each of these participants.

Table 2. Ampleton participant demographics

Participant	Age	Total Years Teaching	Years Teaching at Current School	Teaching Assignment	Education
Pamela	40-50	10	10	Elementary Coach	B.A.-Elementary Education M.S.-Education Leadership
Quinn	40-50	6.5	4.5	3 rd Grade	B.A.-Elementary Education M.S.-Curriculum & Instruction - Literacy
Roxanne	20-30	3	3	4 th Grade	B.A.-Elementary Education
Stella	30-40	6	6	4 th Grade	B.A.-Social Science M.S.-Elementary Education
Teresa	50-60	13	5	5 th Grade	B.A.-Liberal Arts K-8 Endorsement
Una	60-70	28-Teacher 3-Math Coach	NA	Elementary Mathematics Coach	B.A.-Elementary Education

The Riverview Cohort

Riverview School is a one-building K-8 school, built in 1895 and located on the edge of one of Montana’s “urban” areas. Riverview had approximately 480 students enrolled with about 16 self-contained elementary classes and four subject-specific middle school classrooms. The STREAM cohort targeted all K-8 educators in the school, an audience of 20 to 25 teachers. The school’s website claims that it “has a long tradition of excellence and has been home to many families for generations.” With almost 95% of its student population identifying as White/Non-Hispanic, approximately 50% of Riverview’s elementary students but only 16% of middle school students qualify for the free and reduced lunch program. Two Riverview teachers, Jill and Kim, were participants in the STREAM project. They were supported by their elementary principal, Mr. Iverson and a mentor teacher, Zachary. A summary of the Riverview cohort is provided in Table 3.

Table 3. Riverview participant demographics

	Age	Total Years Teaching	Years Teaching at Current School	Teaching Assignment	Education
Jill	30-40	16	16	Middle School	B.S.-Mathematics M.S.- Mathematics – Mathematics Ed. Concentration
Kim	30-40	12	2	4 th Grade	B.S.- Business Management M.S.- Elem. Ed.
Mr. Iverson	40-50	9-Teacher 7-Principal	7	Principal	B.A.-Education M.A.-Educational Leadership
Zachary	30-40	8	8	4 th Grade	B.S.- Elementary Education M.S.- K-8 Administration

TwoTown – a Temporary Cohort

The STREAM project wanted to explore combining small districts that would collaborate in completing the professional development program and developing a shared Strategic Plan for school-based implementation. TwoTown was originally identified as a single cohort representing two rural school districts, Smallville and Prepmont, within about 40 miles of each other. The teachers in the TwoTown cohort included Brad, Carol, Fay, and Zachary. Zachary played a dual role as mentor to Riverview and as a member of the Smallville cohort. Another mentor teacher, Veronica, was paired with the TwoTown cohort and their participating superintendents, Mr. Allen from Prepmont and Mr. English from Smallville,

This collaboration was successful through most of the professional development. However, the two schools decided during the third day of the Summer Academy that working together on school-based implementation would be unfeasible. Although the TwoTown teachers participated together in the initial cohort interview, it was clear that they wanted to work independently on dissemination in their home districts. Therefore

the STREAM project decided to treat them as two separate cohorts, and the researcher did the same. Therefore Prepmont and Smallville will be considered two separate cases in analysis and reporting.

The Prepmont Cohort

Prepmont School District was founded in 1935 on a Montana Indian reservation. The district is composed of three buildings serving the small town of Prepmont (population 600) and a surrounding rural area that extends over 30 miles across the reservation. Prepmont Elementary School houses roughly 270 K-6 students with about 14 teachers in self-contained classrooms and several more who are engaged in the arts, physical education, counseling or special education. The middle school serves about 70 students with one teacher responsible for mathematics. The Prepmont cohort decided to target an audience including all K-8 teachers and aides in the elementary and middle schools.

Over 70% of the Prepmont student population is eligible for the free and reduced lunch program. About two-thirds of the Prepmont student population is American Indian. The district as a whole showed pride for their American Indian culture and community, and the Prepmont STREAM cohort named Pride, Respect, Community, Cultural Awareness, and Family as core values in their Strategic Plan. Two teachers from Prepmont, Brad and Carol, were involved in the STREAM project along with their superintendent, Mr. Allen. Table 4 summarizes characteristics of each participant.

Table 4. Prepmont participant demographics

	Age (years)	Total Years Teaching	Years Teaching at Current School	Teaching Assignment	Education
Brad	30-40	12	12	4 th Grade	M.A.T- K-8 Ed. B.A.- Elementary Education B.S.- Business Marketing & Management
Carol	40-50	8	8	Middle School	B.A.-Elementary Education K-8 & Special Education P-12 M.S.-Middle School Mathematics
Mr. Allen	60-70	5 – Admin.	2	Superintendent	B.S. – Ag. & Extension Education M.S. – Ag. & Extension Education E.D. – Educational Leadership
Veronica	60-70	37- Students 21- PD	Retired 2013 after 7 years in same school	NA	B.A.- Distributive Humanities for Elementary Education MSMME-M.S.- Mathematics, Mathematics Ed. Concentration

The Smallville Cohort

Smallville School District, located on the same Indian reservation, was founded in 1922. The district is composed of an elementary, middle, and high School sharing the same city block. The district serves the small town of Smallville (population 440) and those in the surrounding rural area. Smallville and Prepmont share a population of students that go back and forth between the two schools. Smallville’s community demographics are similar to Prepmont’s, although Smallville was sometimes referred to as the “white reservation school.” Just over half of the student population is eligible for the free and reduced lunch program.

Smallville Elementary School has seven teachers working with 145 students, while the middle school enrolls about 45 students with three full time teachers and two who split their time with the high school. The target audience for the Smallville cohort included the seven K-6 teachers, one middle school mathematics teacher (Fay) and two

special education teachers. Table 5 describes the two teachers in the Smallville cohort, Fay and Zachary, as well as the Superintendent, Mr. English. Both Smallville and Prepmont worked with Veronica as a mentor.

Table 5. Smallville Participant Demographics

Participants	Age	Total Years Teaching	Years Teaching at Current School	Teaching Assignment	Education
Zachary	30-40	8	8	4 th Grade	B.S.- Elementary Education M.S.- K-8 Administration
Fay	50-60	7	7	Middle School	.
Mr. English	45-55	16 – Admin.	2	Superintendent	
Veronica	60-70	37- students 21- PD	Retired 2013 after 7 years in same school	NA	B.A.- Distributive Humanities - Elementary Education MSMME-M.S.- Mathematics, Mathematics Ed. Concentration

Context for the Cohorts

Each cohort’s journey through implementing and disseminating Common Core knowledge is described in the next sections of this chapter. Although each journey is different, a consistent set of components helps structure the descriptions. Data collection began by assessing each cohort’s status based on Montana’s “Common Core Standards Stages of Implementation” rubric (opi.mt.gov, 2012). An administrator representing each cohort estimated the district’s current stage of implementation as defined by the Montana Office of Public Instruction. The six stages are outlined in Figure 1, found on page 16 and repeated below.

Montana Common Core Standards Stages of Implementation Continuum

	Explore			Implement		Sustain
Stages	Stage 1 understand MCCS	Stage 2 Align Curriculum and Instruction	Stage 3 Align Student Progress Measures	Stage 4 Implement in classrooms	Stage 5 Implement in schools and districts	Stage 6 Evaluate Assessment Data to make school- wide systematic changes
CCR	All Students Graduate College and Career Ready					
Descriptors	The Montana Common Core Standards for each grade and subject area have been thoroughly studied and are understood.	District Curriculum has been revised or created that aligns with the MCCS at each grade level and provides a common sequencing to facilitate teacher collaboration at the school level. Educators have identified instructional materials that are coherent, consistent, and comprehensive and support effective learning of the ELA, literacy and Mathematics standards.	Educators establish measurable conceptual learning progressions and how students' understandings of ideas develop, evolve, and progress to establish measurable goals. Student assessments have been identified to measure the established goals. A foundation of understanding for formative assessment is established.	Educators design, adapt and use evidence-based best practices and guides to support effective deliver of the curriculum and assessment progress measures to support learning for all students through focused, coherent, and rigorous instruction.	Throughout the school year teachers engage in horizontal (e.g., grade level) and vertical (e.g., cross-grade level) conversations to be sure that every student has multiple learning opportunities and experiences to master standards required for student success at the next grade level.	Educators evaluate data collected from interim and summative assessments. Processes are established to make systematic changes based on data results.

Figure 1. Montana Common Core Standards Stages of Implementation Continuum

The administrator was also asked to anticipate where the district would be in the stages of implementation after two years of school-based, teacher-led professional development.

The researcher asked similar questions of an administrator (not necessarily the same person) from each cohort in the study during an initial interview. This information is reported as “initial status” and provides context prior to reporting findings from each cohort.

Five phases experienced by the cohorts as they prepared and carried out school-based professional development were identified by the researcher during initial analysis. These phases: anticipation, initiation, implementation, complication, and expectation will be described here and then used for description of analysis and findings for each cohort in the coming chapters. Although these phases were not strictly linear and were experienced

in different ways, they were evident within each cohort and provide a consistent framework for reporting and comparing findings.

During the *anticipation* phase, teachers wrote a Strategic Plan to guide their school-based implementation efforts and revised those plans based on feedback from their administrators, input from fellow teachers, and formal review by STREAM leadership staff. In general, the anticipation phase occurred during the STREAM Summer Academy and throughout the summer of 2013. The anticipation phase was resolved when initiation of the plan began in each of the cohorts. Data regarding the anticipation phase was collected in the form of each cohort's Strategic Plan for implementation and through group interviews with each cohort as well as individual interviews with administrators and mentors.

Analysis of the anticipation phase of dissemination led to the identification of five recurring themes across the cohorts: emphasis on the mathematical practices; prior leadership roles; anticipated barriers; insight about dissemination; and perceptions about the MCCSM. The first four themes will be highlighted in the discussion of the anticipation phase for each cohort. The fifth theme related to perceptions about the MCCSM will be addressed in the analysis across cases near the end of this chapter.

The *initiation* phase follows the anticipation phase. Initiation often emerged from a cohort's Strategic Plan in the form of a school-based launch event. These initial launch events tended to be quite different from the ongoing implementation that continued through the school year. The initiation phase was examined through a number of data sources including observation of the launch events, observation of planning meetings,

email correspondence between the researcher and cohort members, and through interview questions.

Initiation blended into the *implementation* phase, comprised by the collective events making up the remainder of each cohort's dissemination efforts in the home district. The cohorts' intentions for the implementation phase are most clearly expressed in their final Strategic Plans. How those intentions were and were not met is explored through researcher site visits, observations of specific events, and reflection interviews. Reports from one-on-one interviews conducted by the STREAM external evaluator with a representative from each cohort's district were used to further establish a complete picture of implementation.

Two other phases are included in this analysis, the *complication* phase and the *expectation* phase. The complication phase represents challenges to implementation. Challenges arose at very different points in the timeline for each cohort and are ongoing. Implementation of the Common Core State Standards for Mathematics is not viewed as a finite event, either by the STREAM project or by the broader mathematics education community. Because implementation of standards will continue into a third year and beyond, each cohort in the study was also asked to share their *expectation* for future dissemination activities by reflecting on needs that must be met as well as changes that may need to occur for effective dissemination to continue.

Each cohort will be situated in the stages of implementation and then described in terms of the five phases: Anticipation, Initiation, Implementation, Complication, and Expectation. In a cross-case analysis of the four cohorts, the research will compare,

contrast, and synthesize the evolution of the cohorts through all five phases. The separate and combined stories of each cohort's journey offer suggestions and imply consequences for school-based professional development of teachers that will be discussed in the final chapter of this paper.

Ampleton

The Ampleton cohort included Pamela, Quinn, Roxanne, Stella, Teresa, and Una. Pamela was a reading and mathematics coach who was always ready with a comment. Within her STREAM cohort, Pamela portrayed herself as “the member who has a lot to say and works hard to be a good listener.” She embraced change and was excited about the implementation of new standards in both reading and mathematics. Quinn was a third grade teacher who was very detail-oriented and demonstrated natural leadership within her cohort. When responding to a question, whether in print or face-to-face, Quinn was almost always concise and to the point. She ran a very tight ship in her classroom and held very high expectations of her students and colleagues.

Roxanne, a fourth grade teacher, described herself as a “baby teacher” and was the youngest study participant. She was an energetic and enthusiastic young woman who grew up in Ampleton and enjoyed working with teachers she once had as a student. While most teachers in the STREAM project were approached by their administration about joining the project, Roxanne took initiative by asking her administrator if she could be a part of a professional development project. Stella was a soft-spoken and reserved fourth grade teacher. Within her STREAM cohort, Stella considered herself the “smiley, quiet person of the group,” a description confirmed by observation. Stella spoke very few

times in the initial cohort interview. However, when she did speak, her colleagues listened and often deeply considered what she had said.

Teresa was a fifth grade teacher who titled herself the “rebel” and did not shy away from questioning administrative decisions. Teresa was also one of the only participants who identified herself as being weak in mathematics.

Finally, Una was an experienced teacher holding the title “Mathematics Common Core Specialist” in Ampleton. She also worked directly with Assistant Superintendent Owens on a regular basis. During interviews and school-based events, Una spoke slowly and precisely and made sure that everyone was heard and that no one in the group took over.

Assistant Superintendent Owens supported the cohort by attending STREAM events and agreed to participate in the research study. Wendy, a middle school mathematics teacher in Ampleton, was assigned by the STREAM project to mentor the Ampleton cohort throughout their professional development experience. The Ampleton cohort’s dissemination audience included over 100 K-5 classroom teachers.

Initial Status

The Ampleton administrator placed the district at Stage 3 in the Montana Common Core Standards Stages of Implementation Continuum. Stage 3 is described as the period of time where educators are aligning student progress measures. In this stage, educators are creating conceptual learning progressions, identifying assessments to measure established goals, and building a foundation for formative assessment. His assumption for growth was that within two years, Ampleton would be at Stage 6,

described as the stage where educators are evaluating assessment data to make school-wide systematic changes. In this stage, educators evaluate data from assessment and processes are established to make changes based on data. In his initial interview, Assistant Superintendent Owens said that Ampleton had chosen to dive into the MCCSM and had taken the approach of “embracing the chaos in many respects instead of taking a safe approach.” In his view, Ampleton had been operating under the Montana Common Core Standards for a full year: “We’ve made that adjustment last year and it’s a matter of continuing on with that implementation.”

The Ampleton Logic Model listed a variety of external variables that might help or hinder standards implementation, including a small group of resistant teachers in Ampleton. Administrators wrote that some teachers thought the MCCSM would soon be replaced by yet another movement. Another variable was that teachers were struggling with how to teach less material at a more in-depth degree. Two factors related to high school success were also named. First, Ampleton only requires students to take two credits of mathematics for high school graduation. Administrators noted that this could result in 25% of high school juniors not being in a mathematics class while being required to take a standardized mathematics assessment at the end of that school year, creating a major obstacle to high test performance. Additionally, Ampleton’s high school serves many K-8 feeder schools from outside the district that may not implement the new standards in the same way, which could result in half of the high school freshmen not having been taught from a MCCSM perspective. In terms of support for implementation of the MCCSM through the STREAM project, administrators expected “coordination of

[the Ampleton cohort's] professional development with the existing professional development plan" and added, "School district administrators (including school principals) fully support the partnership including STREAM leadership and professional development components."

Anticipation – Strategic Planning

Within their Strategic Plan, Ampleton included a vision and goal statement to guide their work. In this they wrote, "The overall vision of our Strategic Plan is to empower fourth through eighth grade teachers in Ampleton to increase student mathematics achievement by providing effective, content-focused professional development in mathematics." Their goal was to implement the MCCSM "to increase student achievement in mathematics through communication and effective teacher collaboration." They planned to disseminate information in the district in many settings including "PLCs, study groups, the [school] website, staff meetings and early release time, September launch meeting at beginning of school...mentor teacher example and modeling, [and] sharing of tools for the PLC to effectively communicate." Curriculum was a concern for them as they sought to find "effective avenues to bring in STREAM to our PLC teams as they wrestle with forging MCCSM into a newly adopted mathematics curriculum" (*Go Math*, a K-6 curriculum published by Houghton Mifflin Harcourt).

Emphasis on the Mathematical Practices. From the outset, the Ampleton cohort planned to emphasize "different ways to implement the Mathematical Practices and Common Core State Standards throughout the year." The Ampleton cohort recognized that the Mathematical Practices were statements distinct from content standards in the

MCCSM and students would need to be taught how to use them. However, they also realized that teaching the Mathematical Practices as standalone standards to their peers was both less efficient and less effective than integrating them in a specific setting or context: “It is more meaningful to introduce the Mathematical Practices while engaging in a contextual task.” They planned to use STEM activities in interactions with their peers to help other teachers integrate the Mathematical Practices within the Common Core content standards.

In the initial cohort interview, Ampleton unanimously stressed the importance and power of the Common Core Mathematical Practices. Una summed up their feelings:

I think no matter where we go mathematically in this world and whatever pendulum swing we take again, past my day when I’m in the wheelchair...is that the Mathematical Practices should never go away. They literally should be how we should think mathematically and do mathematically. Understanding the power behind them and the deeper understanding that comes....The Mathematical Practices are the verbs and the content are the nouns. And those verbs are pretty powerful.

The Ampleton cohort also identified that teachers needed help with knowing what using the Mathematical Practices in a classroom looks like, learning how to engage students in use of the practices, integrating the practices with content, and verbalizing the practices to students so that they are able to begin using them.

Prior Leadership Roles. Many of the Ampleton participants were in leadership roles within their schools or the district prior to participating in the STREAM project. For example, both Una and Teresa were identified as content coaches at the district or school level. The value placed on those roles was evident in the Ampleton cohort’s description of how they enjoyed being trained on how to be leaders and how to build trust and

collaboration during the implementation process. Roxanne described this in her reflection interview: “Going into STREAM, I originally saw myself as a leader for my building and this was a step into being a leader for the district and I was nervous.” Similar statements by other cohort members demonstrated a need to be identified by someone in an administrative role as a resource for peers.

Anticipated Barriers. The Ampleton cohort seemed very aware of the existence of barriers or obstacles to dissemination. Most issues identified by an individual were quickly agreed upon by the group. They noted that the staff was generally overwhelmed by new programs that had recently been implemented in the district. Another major concern identified by the entire Ampleton cohort was that paraprofessional and other support staff did not have adequate background knowledge in mathematics. Pamela said, “Some of the people that we go disseminate this to do not have the background knowledge to even accept it.” The cohort also recognized that since the MCCSM were brand new to the Ampleton district, they would need to work for deep understanding of the standards rather than rushing through implementation. Teresa appreciated that their mentor, Wendy, advised they should not “rush to the point where it’s not done well...it’s worth solidifying.”

More than once, Pamela expressed her feeling that the structure of their STREAM cohort was askew because their elementary mathematics coach, Una, was a teacher participant in the project while a middle school classroom teacher from their district, Wendy, was identified as their mentor. Pamela felt it was more natural for her to appeal to Una over Wendy with questions or concerns: “I end up deferring to our mathematics

coach more than I do to my mentor teacher.” The cohort did not agree with this view, and Teresa stated in opposition, “That’s what I like about [the structure]. It’s not hierarchical. I feel like it’s more of a partnership.”

In his initial interview, Assistant Superintendent Owens reiterated factors the Ampleton cohort foresaw, and expanded on additional factors that he predicted as influential in school-based dissemination. He stated that time and scheduling were “incredibly limiting” factors. He also believed that finding a balance between teacher or building autonomy and district direction or focus would be a limiting factor. Mr. Owens went on to describe issues of trust that he saw coming into play. He needed to trust that his teachers would be able to “do what you know you need to do,” and they needed to trust their administration to identify and help those teachers who “need quite the direction and others who just need to be unshackled.” Mr. Owens saw his role in the upcoming dissemination as being “a thorn in people’s sides sometimes, knowing when to push, and knowing when to back off...a leader trying to enact change and trying to push very competent people to be better.”

Insight About Dissemination. In their Strategic Plan, the Ampleton cohort discussed the need for their large district to communicate effectively. They planned to take advantage of existing structures in their district by using school websites, scheduled PIR time, and newsletters as “a simple, fresh way to keep teachers and parents informed.” They hoped to infiltrate their existing PLC group meetings as “our primary vehicles for implementing change.” As the elementary mathematics coach, Una planned to attend

elementary PLCs “on a rotating basis to help them formulate sound operational practices and maintain a focus on implementing the Mathematical Practices.”

The cohort also planned to create new structures to use during the implementation phase of the STREAM project. This included videotaping lessons to share with colleagues: “We want to identify pockets of math/science expertise in the district and encourage teachers who are seeking to improve their own practice to observe master teachers....Teachers in grades 4 through 7 will be offered two observations to view Mathematical Practices in a lesson during the 2013-2014 academic year.” They would survey teachers at the beginning and end of the school year in order to track progress and to identify what types of PIR offerings were needed.

Ampleton teachers recognized that having committed and supportive administrators would likely help with dissemination. In Quinn’s words, “I really believe we have administration who we share a trusting relationship with. We may not see eye-to-eye on a lot of issues but we have someone who listens to us and respects us and wants to hear our input, hear our expertise. I just feel like there’s a real mutual respect with...the key leadership.” The cohort felt they needed to have a similar relationship with the other teachers in their district, stressing the need to have all teachers invested in a “unified front” for MCCSM implementation. They saw strength in the fact that Ampleton was currently focusing on mathematics over English and language arts in the elementary grades. Stella stated, “I think the whole idea that we have a mathematics coach in the elementary schools just proves that there is a lot of support, a lot of focus on getting that mathematics Common Core going.”

Initiation – the Launch Event

Ampleton’s STREAM launch event aligned closely with what they proposed in their Strategic Plan: “The goal of the launch is to ensure that teachers have a shared vision of why this is a better way to deliver quality mathematics instruction so that they are committed to making sure this change occurs.” The workshop began with an inspirational video used by the STREAM project and a “number talk” presentation. The participants then divided into grade-level breakout sessions, each led by an Ampleton cohort member, to engage in grade-specific activities with the primary goal of “heavy focus on the Mathematical Practices.” These sessions focused on using STREAM activities along with resources from the newly adopted *Go Math* textbook series to “model how to find and teach the Mathematical Practices in the lesson/activity.”

All K-5 teachers in Ampleton (over 100 teachers) were expected to come to the launch event as it was a scheduled early release professional development activity. The researcher attended the Ampleton workshop and recorded notes using the event observation protocol described in Chapter 3. The Assistant Superintendent and Curriculum Director attended as well and introduced the Ampleton cohort as a “unique situation of great teachers ready to make necessary changes.” They described the cohort as a resource for the other teachers in the district.

Most Ampleton cohort members described the launch event as successful and positive learning activity for the district. However, Roxanne had a more negative experience with her fourth grade teacher peers. As she expected, there was some anxiety about the MCCSM and in particular, frustration with the newly adopted curriculum.

Roxanne explained that it's "been a tough thing with our district this year. People assume that us with STREAM were tied to this new curriculum and I just, over and over, had to explain that we are not *Go Math*, we are STREAM and that is different." Reflecting on the launch event, Roxanne said:

I had some pretty upset fourth grade teachers saying, "You're really going to talk to us about Mathematics Practices when we have this brand new curriculum that we have only been teaching for about a month, and we don't even understand the standards and the curriculum itself?" I hate to say it wasn't a good experience but it wasn't...since then, it's been a lot better but within that first month of school starting, I think we were just overwhelming our teachers in some grade levels.

While Teresa described the launch event as successful, she did remark that the Ampleton cohort "didn't want to make it too intense because we had just gotten the mathematics program the day before school started and there was still a lot of anxiety and frustration from the staff regarding that program." Teresa did not use the *Go Math* lessons during her session, choosing to use a STEM lesson that she had used in the past because "I didn't feel like I could field questions [about *Go Math*]. I didn't know the program any better than anyone else. So I wanted to avoid getting into the nuts and bolts about the program itself." While Roxanne did use a *Go Math* lesson in her session, she attempted to deal with the frustration issue by emailing her plan for the session to her fourth grade peers in advance to "set up that connection with those teachers and ... keep it from being a negative thing."

The Ampleton launch event attempted to introduce and use many resources and ideas in a very short time period. While some teachers were not fully engaged during the whole group activities, all teachers participated in the breakout sessions led by one of

their colleagues. There was evidence of teachers' resistance towards the *Go Math* text, but also a receptive attitude towards learning from their Ampleton cohort peers.

Implementation – School-Based Efforts

Throughout the fall and early spring semesters, the cohort members tasked each other with advancing implementation within their own schools. Some decided they could most effectively reach their colleagues through existing PLCs and tried to focus a least a portion of those meetings on mathematics, with specific attention to the Mathematical Practices. Others chose to present at staff meetings. Assistant Superintendent Owens stated that “increasingly [the Ampleton cohort] are being seen as leaders in their buildings so people are coming to them for support as needed, kind of the informal approach to that.”

Some of these activities were reported to be more successful than others. Roxanne used a 90-minute early out period to engage her colleagues in the Mathematical Practices, stating “It was well received and people wanted to start trying it out right away.” Using problem solving as the vehicle, she allowed teachers to dive into using the Mathematical Practices, reflect on how they were using those practices, and display how the practices could be employed by students in the classroom. On the other hand, Pamela described that while she had informally discussed the MCCSM with her colleagues and always tried to be an available resource for her teachers, she couldn't “wrap my mind around what concepts to present” at events with larger groups.

In her role as district mathematics coach, Una took the role of disseminating the MCCSM to her entire K-5 faculty. She was invited to many PLC group meetings

throughout the district, during which she shared information about the MCCSM. She also made herself available to teach lessons in classrooms for peer observation or to observe teachers and provide constructive feedback. She constantly referenced the Mathematical Practices in professional development activity and even in informal setting like the copy room, earning her the middle name “Mathematics Practices.”

Early in the spring semester, the Ampleton cohort initiated Learning Cadres focused on mathematics. They began by bringing a group of K-5 “master teachers” to a half-day workshop on the MCCSM where the cohort used STREAM-created activities to engage them with Common Core mathematics content, the Mathematical Practices, and the integration of the content into STEM activities. Roxanne said, “Many of them wanted to get involved in STREAM afterwards.” In late February and early March, other K-5 teachers were provided a full day substitute and spent a day with Una and Quinn learning about the MCCSM, observing the master teachers in the classroom, and reflecting on their observations. Most cadres observed at least three different master teachers and after each observation, they met with Una and Quinn to reflect on the observed lesson and to discuss how the Mathematical Practices contributed to the lesson. At the end of the day, the teachers were encouraged to describe one “ah-ha” moment and to brainstorm how to tie the Mathematical Practices to the content they were currently teaching.

The researcher attended two of the Learning Cadres. Even those participants who reported resistance towards change during the launch event left the Learning Cadre meetings with observed intention and urgency to use the knowledge they learned during the event and to make substantial changes to their instructional practices. Pamela viewed

the cadres as an opportunity to expand the cohort. She stated, “I feel like we have several teachers [not just in the original cohort] that I think are seeded that can help spread this.”

Assistant Superintendent Owens shared this assessment:

The model that they’re working now, with the Learning Cadres and those observations and the reflective discussions on the back end of those things are, well frankly, way more valuable than the launch that was done in the fall. The launch was helpful in terms of framing up for our teachers, [but] the cadre model is far more effective in helping those thing to get implemented and to move.

Complications Affecting Dissemination

The Ampleton cohort recognized that their colleagues were extremely overloaded, a perception that was reinforced in interviews and during observation of school-based professional development activities. The Assistant Superintendent agreed, noting a “general overwhelmedness because of the shifts, not just in mathematics but also in English Language Arts.” The adoption of the new *Go Math* curriculum and the fact that textbooks did not arrive until the day before school started was a major frustration and an impediment to the Ampleton cohort’s efforts. Teresa stated in an interview that the teachers often were “just lumping everything together, the *Go Math*, the Common Core, and the Mathematical Practices,” which resulted in negative feelings towards standards implementation. “They just want to get through this big thing that they were just given....So, because of that level of frustration, we’ve had to be pretty sensitive.” Teresa, who started the year with fairly realistic expectations of the difficulty of the dissemination process stated that she was still “amazed by the levels of resistance.”

Expectations for the Future

Mr. Owen's expectation going forward was "that we continue the cadre model and that that forms the basis for how we go about this in the future....I hope [the] cadre model continues to build and that we continue to model and support teachers as we're looking at the implementation of the new standards." He expressed hope that the Ampleton cohort would stay involved with the STREAM project and that "our other teachers begin to increasingly see our STREAM teachers as teacher leaders....I just hope that our STREAM teachers are increasingly seen as the people that know and that can help."

Some of the Ampleton cohort members had new ideas for future dissemination efforts. Roxanne stated:

I would like to take our focus back into the [content] standards....I would like to get progressions out there a little bit more and that goes along the same lines of pacing. Kind of bringing those two things together...And also, I would really like to bring more of the middle school into what we're doing and get rid of that communication barrier between fifth and sixth grade teachers where they change schools.

Roxanne thought that the next year's dissemination process would be much easier than it was during the 2013-2014 school year. She expected the *Go Math* textbook adoption to be more established and hoped for a lessening of time commitments made by the district for other trainings such as writing and reading.

In contrast to Roxanne's ideas for change, Teresa and Pamela both pointed to small adjustments and minor tweaking. Teresa felt that "maybe all of our ideas were bigger than what is going to be palatable to the mix of people." She suggested minor adjustments such as sharing "a small tiny thing at early outs" and continuing with those professional development activities that were currently working within the district.

Pamela wanted to meet more routinely with her STREAM cohort and continue with the activities they had planned but hadn't accomplished yet, such as adding resources to the school district website.

Una and Quinn wanted to continue the Learning Cadres and start them even earlier in the next school year. They sought help in measuring the effectiveness of their efforts as well as guidance for reflection and discussion during the Learning Cadre experiences. They also wanted to push into the middle school, and planned to work with their mentor Wendy to recruit middle school teachers into the Learning Cadres and help make the transition from elementary to middle school more natural for students. Assistant Superintendent Owens pointed out further advantages of Una's participation. "As our K-5 mathematics coach...she, in just her day-to-day life and work that she's doing from site to site, has been able to provide a lot of on-the-fly training to folks."

The entire Ampleton cohort expected to remain part of the STREAM project, and some anticipated taking on a larger role in the dissemination process going forward. Each cohort member felt they had personally benefited from their involvement. Roxanne went as far as to say,

Overall, it's been very positive, in fact, it's made me want to just teach mathematics full time....Personally, my confidence in teaching mathematics is over and beyond what it was before I started STREAM and I feel very lucky that I get to do this. And the modules....I like the feeling that I was challenged in those, that it wasn't just "skim the surface." I felt like as an individual, I went really deep into my capabilities. So overall, STREAM has done a lot for me personally and I just want to continue to disseminate that.

Riverview

The Riverview cohort consisted of two classroom teachers, Jill and Kim. Jill was a middle school mathematics teacher in her sixteenth year at Riverview. She described herself as having a thick skin and as being an over-achiever. She was aware that her strong content knowledge and her reputation for being assertive sometimes had a negative effect on relationships, noting that if some of her teacher peers “found out I was going to come watch them, they would flat out refuse.” Being in the STREAM project had a profound effect on Jill, who said, “I like this so much that I want to, when I change careers, go into something professional development related because of being part of STREAM. I have loved being in front of my peers and teaching them.” Kim was a fourth grade teacher with twelve years of experience but only two at Riverview. She had a bubbly and infectious personality, and her interviews were filled with laughter and self-criticism. Kim described herself as “a wussy” when asked to speak in front of her peers and found being put into that position very intimidating and overwhelming.

Principal Iverson was an administrator from Riverview who attended the STREAM events and agreed to participate in this research. He had been involved in the STREAM project from its very early stages as a member of the advisory team. Zachary, a teacher in the Smallville cohort, played a dual role as the Riverview mentor. The Riverview cohort worked primarily with all K-8 teachers who taught mathematics, totaling about 18 individuals.

Initial Status

Principal Iverson identified Riverview as being in Stage 2 of the Montana Common Core Standards Stages of Implementation Continuum. Stage 2 is described as the period of time where schools are aligning curriculum and instruction to meet the expectations of the MCCSM. In this stage, district curriculum is created or revised to align with the MCCSM at each grade level, and educators have identified instructional materials consistent with and supportive of the MCCSM. His assumption was that within two years, Riverview would be at Stage 6. In this stage, educators evaluate data from assessment and processes are established to make school-wide systematic changes based on data results.

In his initial interview, Principal Iverson reported on standards implementation by grade band. He explained that grades K-2 had standards-based report cards based on the MCCSM and that teachers were aligning their instructional materials and instruction accordingly. Grades 3-5 were “in the process of creating common formative assessments based on the standards, but haven’t created report cards to do any measurement of those.” Regarding grades 6-8, Principal Iverson noted that “those two people have done a lot in terms of making sure that they’re using the eight Mathematical Practices in their instructional strategies.” Based on these descriptions, the researcher placed Riverview in Stage 3 on the Montana Common Core Standards Stages of Implementation Continuum, where educators are aligning student progress measures to goals aligning with the MCCSM.

The Riverview Logic Model listed several external variables that might hinder implementation efforts: teacher inability to create and facilitate problem solving at the depth implied in the Common Core; discomfort among community members with the change from “normal” grade level expectations; and possible lack of community support for the move to the MCCSM. Principal Iverson added that he expected this movement would “miss some initially who are going to wait and see what the excitement of the others looks like.” He followed with a reminder that many teachers were already held accountable thanks to standards-based report cards. He noticed a “sense of urgency because they are excited about doing well” and observed that this led to teachers actively seeking to make themselves better “rather than sitting back and waiting passively for administrative directive.”

Anticipation – Strategic Planning

The Riverview Strategic Plan stated a vision that “All teachers will have the ability to increase student learning through the Common Core Standards in Mathematics.” The mission “to use the knowledge gained through the STREAM project to grow our colleagues towards the realizations of the vision” was to be accomplished by gaining competency in three areas:

1. Understand the mathematical content within the curriculum and how learning progressions are built. (Curriculum)
2. Understand what the eight Mathematical Practices are and effectively implement them into their teaching. (Instruction)

3. Understand how to develop an effective assessment for a given standards and know how to use the results to improve student learning. (Assessment)

Riverview's Strategic Plan was planned in two phases. The first phase, "Launch," was described in detail, including a specific date for professional development with all K-8 mathematics teachers. The launch was intended to "get teachers excited about the eight Mathematical Practices and in turn, excited about the potential of the Common Core." They wanted their mentor to join them for the launch event and planned to introduce the Mathematical Practices through "a variety of activities" and to create grade-level team lessons based on the MCCSM. The second phase, "Mathematics Focus Groups," involved teachers meeting in differentiated groups to concentrate on either curriculum, Mathematical Practices, or assessment. The focus groups would "meet formally once per quarter...each group meeting with the cohort members for 2-3 hours during a school day." The plan also included peer observations where "in partners or in small groups, teachers need to watch each other teach Common Core lessons."

Emphasis on the Mathematical Practices. The eight Common Core Standards for Mathematical Practice had a significant role in the Riverview Strategic Plan. Jill and Kim credited STREAM for increasing their awareness of the Mathematical Practices. In Jill's words:

I was content driven. I was "What do I need to teach, what order, what grade, etc." And the Mathematics Practices were kind of like, "Yeah, I'll get to those later." I think that this has made me realize that the practices are more important than the content. It helped me to see that I've got to make sure that I'm doing those Mathematical Practices all the time.

Kim added, “It’s not only just teaching it – me knowing ‘Okay, I’m going to work on precision today’ or ‘I’m going to work on perseverance’ or whatever it may be, but then verbalizing that to the kids.” Jill’s final comment was, “I think that if you don’t pull the practices off correctly, then you’re not teaching Common Core. Even if you do the right curriculum, you’re not getting at what you need.”

Prior Leadership Roles. Jill and Kim were both already involved in leadership roles in Riverview, but they did not want to assume a leadership role for STREAM dissemination. They preferred to be seen as a resource for their peers, as “one of them,” undergoing the same change process. Principal Iverson knew he needed to provide support and credence to what Jill and Kim were trying to do in Riverview from the outset. “It’s not just two people that are out there excited about something, it is two people that are the liaisons to a bigger idea.” He wanted to make sure that Jill and Kim had the confidence and the venue to be able to spread what they knew.

Anticipated Barriers. Both Jill and Kim said the designation of “leader” was a potential barrier to school-based dissemination. Jill’s apprehension to be seen as a leader came from her understanding that she intimidated some colleagues. Principal Iverson qualified that perception as being “not because of her personality but because of her prowess.” Kim’s apprehension came from a personal lack of comfort with her peers, partly because she had taught in Riverview for only two years. She said, “I just don’t want to come in and have people thinking ‘Psh, who are you? Who made you the queen of Common Core?’ I am so afraid of that.” Jill acknowledged “it’s a different experience to teach your peers” and admitted that the Riverview staff was intimidating when all

together, but felt she had developed a “pretty thick skin” over the years. She added that Principal Iverson was already very aware of their apprehension and did not plan to put Jill or Kim in an awkward position.

The cohort was also concerned about staff buy-in. One of the most important messages Kim received from her STREAM professional development was that “it truly has to be all or none” whether that meant getting buy-in from all teachers or “doing the depth, the rigor, the mathematics practices. Meshing it all together.” Both cohort members knew there was a pocket of very resistant teachers in Riverview, and Jill asked, “How are we going to convince them that this is a whole new way of teaching?....It’s an exciting new way to teach but it’s also my biggest fear.”

Jill and Kim identified three other barriers in their initial cohort interview: too many big ideas with little follow-thru, time for dissemination, and a mismatch of school vision versus teacher needs. Jill stated, “We have a lot of ideas. We have a lot of motivation. We want to do it but we [brainstorm ideas] and then we never actually do any of them because we spend all of our time talking about all these great things that we could do.” With help from STREAM leadership, they were able to pare down many of their ideas to a more realistic plan. Even so, Jill was still concerned about how much time would be devoted to their school-based activities.

The third of these barriers was a mismatch between school vision and teacher needs. Jill stated, “The school has been real ‘big picture’ and I think a couple of our people would just like us to show them something or tell them what to do or kind of just get them going.” The Riverview mentor, Zachary, added that “the support they get from

their administrator can go either way. Sometimes I think he's very strong behind them and other times I think he has his own agenda. So we'll see how that plays out."

Insight About Dissemination. The cohort members felt a majority of the teachers in Riverview were excited to learn about the MCCSM. In Jill's view, "They're hungry for more.... Eighty percent of our school wants to know a ton about it, but doesn't even know where to get started." The administration was described as "very knowledgeable in the theory and what Common Core is" and very supportive of the dissemination efforts to come.

Much of Riverview's desire for more information was driven by not having a district-mandated textbook. Kim seemed to welcome this: "I mean we have a textbook, but it's going to stay, for the most part, on the shelf.... It really wouldn't cover, definitely to the depth or the rigor, that I would want to have for the kids." Jill agreed: "Books don't work. Nothing is in the book, you find [material] on your own, you copy it on your own, and you give it to your kids on your own." The cohort viewed this shift as a huge undertaking but a large step forward for Riverview. However, Jill acknowledged that it might become a barrier for teachers who needed more support to move beyond being overwhelmed and towards actual change.

Initiation- the Launch Event

Riverview's full-day launch event took place before the school year began. The researcher was unable to attend this event but obtained a summary from the cohort, which concluded with "Kickoff was great! It was killer." At their request, the Riverview mentor, Zachary, assisted Jill and Kim with the launch event. All K-8 teachers who taught

mathematics were expected to attend this event as a part of the district's professional development calendar. Riverview's launch event closely matched what they described on their Strategic Plan. Jill, Kim and Zachary agreed on which activities and materials they were going to use.

The launch event started in the morning with Jill, Kim and Zachary leading the entire group through a pendulum activity paying special attention to the Mathematical Practices and STEM connections. The whole group was then introduced to the MCCSM, to the STREAM project, and to Jill and Kim's intended purpose of sharing with peers. After this, the teachers split into three smaller groups and Jill, Kim and Zachary each led one group each through an activity, rotating throughout the morning so teachers would be able to experience all three activities. The activities included estimating a wildlife population with the use of statistics, playing a mathematics addition game aligned to primary grade level expectations, and creating 10-minute videos displaying mathematics in real life. Reflections at the end of each activity emphasized which Mathematical Practices were embedded in each activity.

The afternoon included engaging teachers in examining grade-level standards to determine which standards they were already teaching and for which they needed to find additional resources. Each grade-level group then created a standards-based lesson integrating at least one Mathematical Practice, to be used in the first two weeks of school. They finished by presenting and reflecting on each other's proposed lessons.

Implementation – School-Based Efforts

Mathematics Focus Groups and peer observations began in mid-December. Teachers were divided into six groups of about three teachers each, with Jill and Kim monitoring three groups each. Principal Iverson approached one person in each group to teach first while the others in the group observed. Only the mathematics lesson was observed. The Mathematics Focus Groups were repeated twice during the semester, until each teacher had been observed by his or her group.

After each observation, the group had a 45-minute roundtable discussion with Jill or Kim to debrief and reflect on what they had observed. The session began with the observed teacher describing what Common Core Mathematics Content Standards and Mathematical Practices they felt they had emphasized during the lesson. Each teacher at the table was then asked to state one “ah-ha” from the lesson, describe what types of questions were most often used during the lesson, and offer questions, comments or feedback for the observed teacher.

The researcher did not attend the Mathematics Focus Group lesson observations, but did attend the first and third debriefing sessions in mid-December and late March, and obtained notes about the second debriefing session. During the first Mathematics Focus Group debriefing, many teachers noted that they were nervous and uncomfortable, at least for the first few minutes of the lesson. Kim and Jill recognized that true constructive feedback during this meeting was limited and identified a lack of comfort and trust within the staff as the limiting factors.

At the second Mathematics Focus Group meeting, each teacher in the school was required to share a success story and how they were implementing the Mathematical Practices in their classrooms. During the third Mathematics Focus Group debriefing, teachers seemed much more comfortable discussing their practice with their peers and very receptive to feedback from their colleagues. When Jill and Kim asked what type of professional development they would like to have in the future, each group said they wanted to continue observing and reflecting on instruction, possibly even at different grade levels or with different teacher groupings.

Comments by teachers during Mathematics Focus Group debriefing meetings helped explain the success of this approach. Teachers said “I love watching others teach;” “I’m really excited for these Mathematics Focus Groups. Getting to watch each other, sharing;” and “It’s more meaningful if you’re sharing with people you work with.” The researcher also observed teachers using vocabulary related to the Mathematical Practices such as, “I don’t want students to get stuck in an algorithm. I would rather they make sense of the problem and truly understand.”

Riverview was involved in other standards implementation efforts not related to the STREAM project. Principal Iverson had established that every “early out” throughout the 2013-2014 school year would be focused on the MCCSM. Riverview also dedicated a week of each school year to mathematical thinking where students used mathematics in every subject. The current year’s theme of “Investigation” encouraged some teachers to emphasize the Mathematical Practices, particularly reasoning and problem solving.

Complications Affecting Dissemination

Communication between Principal Iverson and the Riverview created complications more than once. In an email Jill noted, “[Principal Iverson] has put most of this together and we are still trying to understand the schedule and our role.” During Mathematics Focus Group meetings, Jill repeatedly mentioned that Principal Iverson was supposed to provide a discussion outline so she and Kim would not need to lead the discussions, but he had not provided that tool.

Lack of communication between the Riverview cohort and their administration was also evident between the launch event and the beginning of the Mathematics Focus Group meetings. Jill felt the STREAM cohort could have done more during that time, but Principal Iverson explained that the time between events was intentional as “a formative assessment time for me to look at what we’re both capable of and need.... Those things had to be determined before we could just move forward with the STREAM concepts if they were going to be successful.” While Kim agreed that the time between events, in the end, did help keep the staff from feeling overwhelmed, she also felt that they unintentionally allowed time to get away from them during Fall 2014.

As the school district’s goal for the year, Principal Iverson had tasked his teachers to pay better attention to their questioning techniques. He stressed this focus on questioning during the first meeting of the Mathematics Focus Groups and provided teachers with a protocol for keeping track of the type of questions asked throughout a lesson. Kim and Jill had also created a protocol, for tracking teacher and student engagement using the Mathematical Practices. It was not made clear how Principal

Iverson's vision connected to Jill and Kim's mission. During her reflection interview Jill reflected on this mismatch:

[Principal Iverson's] goal for the year is to work on the staff's level of questioning and I'm not sure where this came from but that's his big focus....We spent some time trying to figure out how our STREAM goals matched up with that because...we felt like we were carrying out his goal, which was hard that first time...we were like 'how are we going to get the Common Core in here?'

By the second and third Mathematics Focus Group meetings, this issue seemed to be fairly resolved:

In some ways they're two totally different ideas, and in other ways they are the same idea, it depends on how you look at it....And when you look at the practices, you cannot do a good job of teaching the practices if you're not asking good questions so it's a perfect blend.

Both Jill and Kim had expressed apprehension at the STREAM Summer Academy that some of their colleagues would not be open to change. Both resistance towards change and ignorance of the standards was observed during the Mathematics Focus Group meetings. One teacher stated, "I don't pay attention to the standards" and added that she had not time for the MCCSM. When asked what Mathematical Practices she was trying to address in her observed lesson, she stated, "No practices." Another teacher consistently referred to the Mathematical Practices when asked about content standards and had no understanding of the difference. Others plan their observed lessons around page numbers or section numbers from the textbook with little knowledge of what standards they were addressing.

The Riverview cohort did not feel a need to push the resistant teachers to accept the new standards. Those who showed the most resistance were retiring at the end of the

2013-2014 school year and Kim believed “the teachers who are [staying] here, they are on board.” Even though some teachers contested implementation of the new standards, Kim said, “It’s been so much better [than anticipated] and they have been so much more open than I thought they would be.” Jill agreed: “The response from the teachers has been better than I thought it would be. I thought we would deal with more resistance.” They felt that even the unwilling teachers had made changes in their instructional practice, even if only slightly, and that others were “on board.” Jill added, “It became everyday language for them to talk about the practices....I wanted to create [a feeling] that, if you choose not to, that’s fine. But, this is what we do at Riverview....We teach Common Core. That’s just what we do.”

Kim and Jill had different views about complications due to time. Kim’s initial response was, “Time hasn’t been an issue” while Jill immediately identified “Time” as a complicating factor. Jill would have preferred a more consistent time to share information with her peers, such as early outs, that didn’t necessarily pull teachers out of their classrooms, such as early outs. She added, “I think there is guilt that I don’t think we’ve done as much as we could have. So that’s been frustrating....I wished we could do more.” She later commented, “Could Principal Iverson have given us more time and more things to do? Probably, but maybe he feels what we’ve done is exactly the balance that he wanted.”

Principal Iverson identified “basic mathematics competency” of staff members as a challenge for school-based dissemination at Riverview. He stated, “Mathematics is hard and intimidating to some folks and that makes implementation of good teaching

difficult.” He added that many teachers don’t understand the content standards were meant to “supplant rather than supplement.” Principal Iverson credited his staff’s desire to improve their mathematics competency to the overall “enthusiasm and ability of the [STREAM] teachers [Jill and Kim]” and to:

The increased sense of urgency around the implementation of the Common Core as it relates to the assessment with Smarter Balanced. That sense of urgency has created a camaraderie among staff that says “We’re in this together and we’re learning these things for a real reason.” There’s a connection to a purpose that is important.

Overall, Jill, Kim, and Principal Iverson stated that the challenges they faced were minor, and felt they would be able to manage these hurdles in future dissemination efforts.

Expectations for the Future

In his reflection interview, Principal Iverson described the current stage of implementation in Riverview by spontaneously referring to the Montana Office of Public Instruction framework of Montana Common Core Standards Stages of Implementation Continuum:

Assessment practices characterized in Level Five are emerging; instructional pedagogy and basic understanding and awareness of the standards as characterized in One and Two are pretty strong. Level Six is sort of institutionalized behavior – exists in pockets and is more subjective based on the teacher.

In future dissemination efforts, Principal Iverson hoped for “An increased focus on assessment...both in the formative and summative side and in terms of preparation for the constructs of the Smarter Balanced assessment.” Principal Iverson saw an eventual need for remediation in altering established cultural norms related to the MCCSM, but his

main goal for the immediate future lay in assessment. Both Jill and Kim agreed and wondered if the STREAM project could create the capacity to become “assessment ninjas.” During the next year, they expected professional development focused on strengthening instruction would continue, with an additional focus on teachers’ capacity to measure and analyze student performance through assessment. The cohort and their administrator also expected to continue focusing on “formulating and posing questions that allow students to demonstrate their ability to think mathematically as defined within the eight Mathematical Practices.”

Both Kim and Jill emphasized that the getting buy-in from colleagues who wanted to learn more about teaching with the MCCSM would be easier in the coming years because of retirements, but also because new teachers would accept the MCCSM more readily. However, when the conversation turned to creation and analysis of assessment, both Kim and Jill stated that they expect sharing to be more difficult than sharing the Mathematical Practices as they had done in the 2013-2014 school year. Kim said “It’s going to be hard” and Jill added that they would need more training on assessment before they could be good resources for their peers.

While she knew the value of observing other teacher’s classrooms, Jill felt that future dissemination “needs to be totally different from what we did this year.” She had reservations about removing teachers from their classrooms for training and leaving students with a substitute teacher. Jill confidently stated she would like to either dive into assessment writing and analysis or investigate learning progressions more deeply. She wanted “more work in terms of ‘Where am I in the pie’ ... understanding of what you’re

teaching, knowing where it came from and where it's going that most of [my colleagues] don't have." Jill reiterated that the cohort's "level of dissemination was up to Principal Iverson....The administration makes the decision how much you're going to do or not do." While the content of Riverview's future school-based dissemination efforts was decided, the structure of that dissemination seemed far from certain.

Prepmont School District

The Prepmont cohort consisted of two classroom teachers, Brad and Carol. Brad was a 4th grade teacher who had been teaching for 12 years. He was an ambitious and outgoing instructor who described himself as "the team member that rallies everybody together." Brad was very involved in the school and community as a coach, but also in roles such as coordinator for community Math Games nights. Brad made sure everything got done and recognized "that everyone seems to think is the leader." His cohort partner, Carol, remarked that while Brad gave his whole life to being a teacher, she, on the other hand, had a life outside of school as a rancher. Carol was the only middle school math teacher in Prepmont and was in her 8th year teaching. She was much quieter than Brad and often assisted as a listener and recorder during school-based professional development. Superintendent Allen attended the STREAM events and agreed to be a part of this research. Veronica, a retired teacher, was the STREAM mentor assigned to assist Prepmont as well as Smallville. The Prepmont cohort worked with the entire K-6 teaching staff (about 15) as well as paraprofessional aides.

Initial Status

Prepmont's administration described them as being in Stage 2 and Stage 3 simultaneously in the Montana Common Core Standards Stages of Implementation Continuum. In Stage 2, district curriculum is created or revised to align with the MCCSM at each grade level and a common sequencing is established to facilitate teacher collaboration at the school level. In Stage 3, educators are creating conceptual learning progressions, identifying assessments to measure the established goals, and establishing a foundation for formative assessment. The assumption was that within two years, Prepmont would be at Stage 5 at a minimum and optimally at Stage 6. Stage 5 about implementation, where teachers engage in horizontal and vertical conversations to ensure that opportunities for mastery are established for every student through "focused, coherent, and rigorous instruction." In Stage 6, educators evaluate data from assessment and processes are established to make changes based on data results. In his initial interview, Superintendent Allen stated that he felt Prepmont was "at least on par, if not ahead" of the other districts in STREAM. He attributed this to the Prepmont cohort's early start with school-based professional development in Spring 2013, one semester prior to other cohorts' formal efforts.

Different from the other cohorts, the Prepmont administrator identified multiple external variables that were expected to help implementation efforts, but listed no factors that might hinder the process. In particular, Prepmont noted "monthly professional development events, parent friendly materials communicated to the community in the spring of 2013, and working with an OPI [math expert] to support pacing guides" as

supports for dissemination.

Anticipation – Strategic Planning

The Prepmont Strategic Plan stated that the purpose of school-based professional development was “to improve student performance in math by constructing a solid foundation of common knowledge on the MCCS for our K-6 staff.” They had already hosted two school-wide professional development days Spring 2013 and planned another ½-day whole group session before the 2013-2014 school year began. During the school year, they planned six 2.5-hour sessions to work with their peers. They developed a system to divide their K-6 staff into three groups and then work with each group on a rotating schedule in one day.

Brad and Carol planned to lead each of these professional development events with the help of an external consultant (referred to hereafter as Consultant Carlene). The Prepmont cohort also planned on having each K-6 teacher “complete two video lesson reflections and provide feedback to colleagues on their video reflections” once in January 2014 and once in May 2014.

Emphasis on the Mathematical Practices. Brad and Carol planned to begin their professional development activities with attention to the eight Common Core Standards for Mathematical Practice and to continue emphasizing them throughout their school-based efforts. Carol emphasized the importance of the Mathematical Practices in the initial cohort interview: “the Mathematical Practices are very important across the board, so all teachers are going to need to know those very well.” Brad confirmed that he felt the Mathematical Practices were very important and expressed concern about helping his

staff understand their importance: “It’s going to take dozens of times to go over the Math Practices before everybody fully understands the tremendous undertaking that they are.”

Prior Leadership Roles. The Prepmont cohorts’ leadership skills were evident during the Summer Academy. Brad was exceedingly committed to leadership and service to his school. During the initial cohort interview, Brad described work with the Montana Office of Public Instruction on mathematics and said he “gave up coaching (athletics) so that I could do more committee duties.” Brad’s attitude was epitomized by a statement he made after being asked to describe his primary “take-away” message from STREAM professional development:

The most important thing for me from this whole experience is to spread the wealth and spread the knowledge in as positive and as thorough way as possible to the rest of our district....The most important thing I can do is share my knowledge with everyone at my school. We can’t rely on anybody else. I have to just step up to the plate with my partner teacher here and we have to share as much as we can in the best way possible....I don’t know everything but I’m going to share what I know.

Carol, on the other hand, made it clear that she could not commit as much time because she had another job as a rancher after the school day ended. Although Carol had other obligations, she was the only middle school math teacher in Prepmont and was seen as a school leader by Superintendent Allen. Brad also named Consultant Carlene as “a major resource that we have for the dissemination,” even though she was in the district through another grant. Brad said they would most likely expect Carlene to help set up professional development agendas, to provide discussion protocols and, due to her established familiarity and rapport with the Prepmont staff, to “really keep the ball rolling.”

Anticipated Barriers. Brad and Carol expected a few obstacles to school-based dissemination. They were aware that if something was going to happen in Prepmont related to helping teachers implement the MCCSM, Brad and Carol would be responsible for it. Brad stated, “We’re it right now.” They also recognized that although their administrators were completely behind them, “They are not active by any means.” While he did not expect administrators to assist with facilitation, Brad believed “If we need this day every month, we’re going to get that day every month.”

Even though they had already provided two days of professional development for their peers, Carol still expected resistance towards MCCSM implementation. “There’s going to be resistance because it’s hard to change what you’re doing and it’s hard to make that step. And Common Core is a big step.” But she felt that because of Brad, Consultant Carlene and her own rapport with staff, resistance was a small concern for them. Brad agreed:

We’ve gotten the ball rolling in a really positive direction and we have pretty good ground rules. As long as we keep it somewhat, somehow logical and simple and planned in advance so teachers have a heads up...I don’t foresee a lot of barriers coming into play.

Superintendent Allen, however, did cite “the number of resistant teachers...who resist it on the grounds of resisting, not because they’re nervous that some kind of change is coming,” as the greatest factor likely to influence the school-based dissemination process.

Insight About Dissemination. Carol stated that many of the teachers in Prepmont “think it’s a two hour process to realign the whole curriculum.” She said her colleagues needed exposure and a uniform understanding of how much is changing before they could actually make that change. Brad added that because of “superficial administrator

support” this change would be “completely teacher-led,” and routinely commented that he felt like it was his responsibility “to take the lead.”

Brad discussed a desire to change how teachers work together at Prepmont. Using student data as a driving force, Brad wanted to make teaching “a business practice instead of ‘I’m offended because you’re saying that I’m not teaching this the way I should’....take that emotional aspect out of it and focus on the kids.” He planned to give teachers ample notice of planned events in the form of an agenda weeks in advance. He had tried this communication style with his peers during the Spring 2013 professional development days and felt it seemed to be working.

Initiation – the Launch Event

The researcher did not attend Prepmont’s launch events, but obtained a description from the Prepmont cohort and Superintendent Allen. Brad described the two early professional development in Spring 2013 as an introduction to the Common Core with specific attention to the Mathematical Practices. In Brad’s view this event “overall just warmed the staff up to the idea of increasing their knowledge and ability to teach the MCCSM. We just went through the practices, learned them inside and out.” Carol added that they chose to share the Mathematical Practices first to get all of the Prepmont teachers on board. After the event, teachers were expected to create classroom “Math Practice Posters” with their students so that students could interpret the Mathematical Practices for themselves, what they mean and how to use them in daily classroom work.

The second Prepmont launch event was held in mid-August prior to the beginning of the 2013-2014 school year. All K-8 teachers and paraprofessional staff who assisted

with math were expected to attend. The original plan for this event was for an expert from the Office of Public Instruction to help the Prepmont teachers create a pacing guide for the district. However, this expert was unable to come so Brad, Carol, and Consultant Carlene revamped the day's activities. Brad focused on alignment: "So, I kind of took the staff through unpacking and matching up our core program, which is Envisions, with the Common Core." The day included time for grade-level team planning for the first month of school. Each part of the event ended with reflection and by asking what resources and information peers needed for future professional development days.

Implementation – School-Based Efforts

The Prepmont cohort originally planned six professional development days. Three occurred in mid-October, mid-November, and mid-January. The mid-February day was cancelled, while the mid-March event was rescheduled for late March and another event was tentatively planned for mid-April. All K-5 teachers were invited to each of these events, along with Brad, Carol (the only 6-8 math teacher) and Consultant Carlene. Brad noted that it "just wasn't feasible with the administrators" to include the paraprofessional staff. Each day include 2.5-hour rotations with three groups of teachers, usually combined by grade band. For one event, teachers were grouped by their choice of Mathematical Practices to investigate more thoroughly.

The researcher attended a planning meeting in mid-September, the first school-year meeting in mid-October, and the meeting in mid-March. At the planning meeting, the three Fall events were planned in greater detail and supporting documents were created. Each agenda included goals, a list of planned activities, who would lead each of

these activities and the length of time devoted to each. Because the agenda for each meeting was shared with the staff in advance, it represented the actual activities very well. The mid-November meeting agenda can be found in Appendix I.

The teachers in each of these meetings seemed very receptive to Brad, Carol, and Consultant Carlene. The teachers seemed very willing to share their own experiences and to get feedback and help from each other. On one occasion a couple of the teachers diverted the discussion to a criticism of the chosen textbook. While he allowed a few minutes of such conversations, when he felt it was no longer a productive discussion Brad firmly stated, “Let’s close up that observation and move on.” Brad prided himself on remaining very professional with his colleagues and in modeling that behavior for them.

Throughout the year, alignment of the Prepmont school curriculum with the MCCSM was a major focus along with a continual focus on the Mathematical Practices. Teachers read and investigated the content and practice standards and planned grade-level lessons. Brad described some of the activities used in professional development as STEM activities, readily implementable classroom activities, pacing, and unpacking the Common Core with attention to the Mathematical Practices. He preferred to use STEM activities because “They appeal to me, they appeal to the staff and they directly show how the Math Practices can be incorporated.”

Brad took the lead in school-based dissemination and Consultant Carlene assumed an assistant role. For the most part, Carol fielded questions from the teachers and took care of logistics. Brad preferred these meetings to run very similarly to how he taught

class. “You have a warm up, an admit ticket, and you end with an exit ticket, a reflection. We collect and type up and send out these reflections to the staff and what our next steps are.” Immediately following each event, Brad, Carol and Consultant Carlene met to reflect on the day’s activities, read the exit tickets, type up those ideas and begin to create an agenda for the next meeting based on the feedback they received.

Brad explained that during the school year events, the cohort deviated from their Strategic Plan with respect to the content they introduced according to “what the teachers were ready for, what they wanted, and what they had requested they would learn.” Brad and Carol had originally planned to have teachers video their own instruction and reflect on that video with peers, an activity they enjoyed during the STREAM Summer Academy. However, Brad soon decided this would be unrealistic because his colleagues “just weren’t ready for the Common Core.” Instead, the cohort decided to more deeply examine the Common Core learning progressions, investigating “what areas to go deeper in, what areas do we not even touch on in your grade level, and understanding the progression...where are they coming from and where do I need to get them to during my year in my class.”

The Prepmont cohort and Superintendent Allen viewed their school-based dissemination as a success. According to Brad, “You can definitely tell that math has become...we’re aware of it and the staff is more conscious of their math teaching.” He added, “People come up to me and talk about how their implementing the math vocabulary or the Math Practices and I can go in teacher’s rooms and see Math Practice posters and teachers are referring to those.” Brad described an incident where teachers’

expectations of students were challenged when one teacher said to another: “Can you believe they expect Kindergarteners to know the Math Practices and not change how they are? A Kindergartener is not going to know what ‘persevere’ is.” Later, the Kindergarten teachers stated, “I’m so glad that we’ve been teaching those Math Practices because those kids know exactly. If they see them modeled and hear the word, they know exactly what the word means.”

This type of change motivated Brad to continue sharing with his peers. He found it “really cool to hear and cool to see that people’s views can be changed about what kids can do.” He felt Prepmont’s school-based efforts gained legitimacy when some staff attended a state-level mathematics workshop and returned saying, “We were light years ahead of where [other schools] were at.” Superintendent Allen added, “Compared to most other schools in Montana, I would say that we’re probably in the lead.” And Carol noted the uniqueness of the cohort’s efforts:

I don’t think our staff would have any idea of what’s going on if we weren’t doing this. I wouldn’t have any idea if I wasn’t in the STREAM program because our school district isn’t jumping on board with really anything...this math professional development is the only thing we have. They don’t offer us anything else so I think it’s very beneficial for the staff.

Complications Affecting Dissemination

The major complication for Prepmont was one they had not fully anticipated – in Brad’s words, “the lack of priority from the administration.” He described how even though the cohort was told they would be given one day each month to share with their peers, those meetings were not a priority for the school district. “The challenge has been keeping our dates available for our professional development days because they’ll plan

something else after we already had our professional development planned, so then we have to move our professional development because we're only going to get half the staff there." Brad expressed his frustration in his reflection interview: "I would just like that visible support....I want their buy-in, and I don't want their buy-in because I tell them I want their buy-in. I just want them to care."

Brad described a phone call with the STREAM External Evaluator where both administrators had called him in at the last minute. He ended up assuming the lead speaking role during the call:

Both administrators had no idea what was going on and so I talked the entire time, and thank goodness I was there...Maybe that was my fault that I didn't rely on them but they didn't know what was going on, and I wanted her to know what happened and what went on. I was proud of the work that we had done so far and I'm proud of what we've accomplished so far.

Brad affirmed that 100% of the Prepmont K-8 teachers were on board – they attended the professional development, seemed to value them, and provided useful feedback on exit tickets. But he was concerned that without reinforcement by the administration, many teachers may not actually change. Carol indirectly affirmed these sentiments in her interview by stating that the largest challenge towards dissemination was a lack of teachers feeling the need to truly change their instructional habits. She said, "they'll come to development and participate for the day, but then when they go back to the classrooms it's like 'Whatever, I'm doing what I'm going to do.'"

One additional challenge identified by Carol was that teachers began without a good understanding of the magnitude of change required by the MCCSM. Carol described how one teacher brought in her textbook and notebook and was prepared to

realign her instructional materials and be finished with MCCSM implementation in just one sitting. “She firmly believed that when we had our first professional development day that we were just going to align everything – everything was going to be ready to go.” More than a year after that first meeting, Carol believed “they are on the same page now and they are aware of a lot of the big things...going on.” She added that in mid-March, the same teacher was working hard to find necessary outside materials to supplement the textbook to meet the MCCSM standards.

Expectations for the Future

Both Carol and Superintendent Allen had vague expectations for future dissemination efforts in Prepmont. Carol said, “Truthfully, I don’t know yet....We will continue on but I don’t know what we might want to tweak or change out yet.” Superintendent Allen offered very broad assertion that Prepmont would “remain on track in terms of preparation so that when teachers are expected to begin teaching the Common Core and doing the appropriate connected assessments that we’ll be ready.”

Only Brad stated concrete expectations for moving forward, saying he would like to have his colleagues take one or two STREAM online modules each semester. While he felt the format needed to change for the coming year, the full-day professional development meetings “worked well for us in the short term, and it saved us some money and we were able to disseminate to many more staff members that way.” He added he would like “the administration to say ‘This is what we’re going to do. This is our plan because we still need some math improvement.’” Driven by the challenge of making MCCSM implementation a priority for Prepmont, Brad foresaw doing more individual

coaching with his colleagues. He planned to work with teachers in their classrooms:

I was thinking about giving them a list of menu items that they could choose from. Like I could go in their classroom and teach their classroom and they could watch. Or, I could teach their class and we could get another substitute and we could teach their [grade-level] classes while they could work together as grade-level partners....More individual coach instruction.

Smallville

The Smallville cohort consisted of two teachers, Zachary and Fay. Zachary was a fourth grade teacher in his eighth year at Smallville. He held a unique position as both a cohort member for Smallville and a mentor for Riverview. Zachary described himself as a leader in his school and enjoyed discussing education with anyone who would listen. He was very involved in his community and was an assistant coach for many sports at the secondary level. Zachary began his tenure with the STREAM project as an advisory board member. He was then recruited to be a mentor for the Riverview cohort, but he also viewed himself as a member of the Smallville cohort. Fay was also very conversational and often talked about her students and the successes or challenges she was facing in the classroom. In addition to teaching middle school mathematics, Fay taught a career course for middle school students and physical education at the elementary level. She identified herself as an American Indian and a Montana native. Superintendent English was the administrator that attended STREAM events and agreed to be part of this research. And Veronica, a retired teacher, was the STREAM mentor assigned to both Smallville and Prepmont. The Smallville cohort worked with all K-5 classroom teachers in the school district as well as the special education teachers, for a total of ten teachers.

Initial Status

The administration described Smallville as past Stage 2 and progressing through Stage 3 in the Montana Common Core Standards Stages of Implementation Continuum. In Stage 2, district curriculum is created or revised to align with the MCCSM at each grade level and a common sequencing is established to facilitate teacher collaboration at the school level. Stage 3 focuses on aligning student progress as educators are creating conceptual learning progressions, identifying assessments to measure the established goals, and a foundation for formative assessment is established.

Superintendent English noted, “We’re more in our infancy stage as far as mathematics.” He explained the district had adopted textbooks aligned with the Common Core Mathematics Standards but due to their involvement in a reading grant, they had pushed to “accelerate our transition to Common Core with the reading and language arts [more] than with the math.” His assumption was that within two years Smallville would be at Stage 5. Implementation is key in Stage 5, where teachers engage in horizontal and vertical conversations to ensure opportunities for mastery are established for every student through “focused, coherent, and rigorous instruction.”

Smallville’s Logic Model listed their reading grant as an external variable that would affect STREAM program implementation because it “aligned with and will support STREAM strategies and content.” Smallville began the reading project in Fall 2011. This project was intended to improve school-wide literacy achievement with special attention to disadvantaged students through providing teacher professional development and school-wide technology. The professional development component of

this project included at least one workshop per week for a majority of the staff.

Anticipation – Strategic Planning

The mission statement for the Smallville Strategic Plan was “Teachers will communicate and continually improve to make their classrooms a more productive learning environment so students can succeed in math driven by the Montana Common Core.” The Smallville cohort stated in their Strategic Plan that they had administrative approval for monthly two-hour professional development sessions. During these meetings, they planned to meet with the entire K-6 staff or in leveled learning teams to discuss and plan Common Core mathematics lessons. Their calendar of events listed specific activities for each monthly workshop, including Common Core explorations, work with the Mathematical Practices, STEM activities, article discussions, and video analysis. The Smallville cohort described each event in detail, often including “Time has already been approved by administration.”

Emphasis on the Mathematical Practices. The most important “take-away” for Fay took from the STREAM professional development was increased awareness and use of the eight Common Core Standards for Mathematical Practice. She stated, “They’re cross-curriculum. There’s some of these practices that are good no matter what you teach.” Smallville planned to begin school-based dissemination with attention to the Mathematical Practices.

Prior Leadership Roles. Zachary considered himself a leader in his school and was making an effort to be a leader for elementary teachers outside his school district.

This was the case in the STREAM project, where Zachary was also a mentor for the Riverview cohort and a member of the project's advisory team. In contrast, Fay did not consider herself a leader in her school. She stated, "I guess maybe I'm old enough that I don't feel the need to run the show anymore." Because Fay was the only middle school math teacher and worked closely with the only high school math teacher, she viewed herself as a resource for peers in mathematics.

Anticipated Barriers. Fay expected the cohort to be challenged by resistance from a staff that was overwhelmed by new information and program implementation. Smallville had been working on implementation of the Common Core State Standards for English/Language Arts since Fall 2011. Reading experts and other external education consultants were routinely in Smallville to provide professional development to the staff there. Fay stated, "We've got so many consultants coming in. Sometimes in a week, we've got three consultants in our school and lots of professional development with them. So to try and do more professional development for teachers, I think we're going to run into a little bit of resistance there."

Another concern raised in the initial cohort interview was the adoption of a "curriculum," as Fay put it. She was referencing textbook series, *Go Math*, which was marketed as aligned to the Common Core State Standards. Fay believed that because of this adoption, implementation of the MCCSM would be pretty easy in Smallville. She said simply, "our math curriculum is a huge support because it tells us...it has the Math Practices listed that you're using, it has the essential questions listed, it has the Common Core."

In his initial interview, Superintendent English described a challenge for the Smallville cohort to “build that trust so that other staff members believe in [the MCCSM].” He said his role in helping with this was to “make sure that I come across that this is something that I do support and that I do believe that is important for our kids.”

Insight About Dissemination. Fay often demonstrated a hesitancy towards sharing with her peers. She reiterated there were already a lot of professional development requirements established in the school with respect to the reading grant. She also frequently mentioned that she was the only middle school math teacher in the district and that she worked in the middle and high school building. Fay was considered part of the K-8 district, but worked officially under the supervision of the high school administrator. When asked to speculate about future school-based dissemination, Fay almost always deferred to her future plans in her own classroom. She did note that she “talked some with the fifth grade teacher [but] not as much as I hope to start doing” and that she did “collaborate with the high school [math] teacher.”

Initiation – the Launch Event

The Smallville launch event was planned as a two-hour session in August 2013, but was reduced to a very short introduction to the MCCSM. Zachary seemed to anticipate this by telling the researcher, “I hope you don't show up on Monday...in Smallville because I feel we will be cut short due to other meetings and teachers needs and wants to work in their classroom before school starts.” Despite the shortened schedule, Zachary introduced the Mathematical Practices and helped his staff create short

real-life math videos, an activity Zachary found helpful from the STREAM professional development. The K-6 teachers were tasked with putting Mathematical Practice posters up in each of their rooms before the next professional development day. Zachary documented this by taking pictures of each classroom poster.

Because of the shortened August time frame, Zachary and Fay decided to alter their plan and do more introductory work at the September meeting. However, this workshop was cancelled by the administration to accommodate CPR and First Aid training for the athletic coaches, which included about three-fourths of the staff. The professional development was rescheduled to a 45-minute span over a lunch period later in September.

Ten teachers attended the September workshop, including all K-6 teachers, a K-12 special education teacher, a K-5 Title 1 teacher, and the researcher. To begin, Zachary handed out a spiral bound copy of the MCCSM to the K-6 staff, referring to it as the “Math Bible.” While performing this task, he asked each teacher if they had their Mathematical Practice posters on their walls, and all of the teachers said they had them up in some form or another. Zachary then facilitated an examination of the content standards. The group began first by discussing how the standards were structured, with attention to domains, clusters, and standards and with a short explanation of learning progressions. The teachers then identified which grade-level standards they were already teaching and which they would need to supplement with additional resources to teach fully. Zachary closed the discussion by discussing the Smallville cohort’s professional development plans for the rest of the year. Finally, he had each teacher share a standard

that they would address by finding additional resources along with a teacher above grade-level and below grade-level.

Implementation – School-Based Efforts

Zachary and Fay met after the September workshop to reflect on the day's activities and to discuss the next professional development day, which would be led by Fay in October. They planned to have Fay introduce the video lesson reflection to the staff, show Zachary's example video done for the STREAM project the previous year, and then discuss their expectations for completion of this task. The researcher attended this workshop, which drew only six of the original nine teachers, possibly because some had attended previous professional development and were on personal leave.

Fay began by handing out her own Common Core lesson plan using a STREAM-produced lesson plan outline. She then described the video lesson that was expected and how it would be used for reflection. Because recording and reflecting on lessons was required for evaluation each trimester in Smallville, Fay noted that a lesson focusing on the MCCSM could serve as double duty. She showed a version of Zachary's video lesson and self-reflection, then shared a blank copy of the STREAM lesson plan template and a copy of Zachary's completed lesson plan.

Fay led a debriefing of Zachary's lesson, with specific attention to the Common Core Mathematics Content and Practice Standards. She then gave the teachers the remaining hour to work in their respective classrooms, stating "I'll be in my room if you want any help." During this meeting, most of the teachers remained very passive, and Fay seemed to have difficulty facilitating discussion. In her reflection interview she

explained, “I felt like, for a couple of [the other teachers], that they just weren’t into it at all....[We have] such a separation.”

Smallville’s next professional development day, scheduled in November, was cancelled. At the cohort’s January workshop, teachers paired up and spent one hour watching their video lessons together and providing feedback for each other. Zachary described this as time well spent, even though video-recording instruction and watching other teachers’ videos was routine in Smallville. He noted that “We do videos all the time at Smallville and we are supposed to watch them but...it’s usually ‘Here watch mine, here watch yours’ – you watch for five to ten minutes. Here’s a comment about something you can work on.” However, deliberately sitting down with other teachers, watching the entire lesson and providing feedback face-to-face was a rare occurrence. In his reflection interview, Zachary said “that was probably the most meaningful thing we’ve done so far.”

In February the Smallville cohort had planned to have their mentor Veronica come and present, but she was not able to join them. Instead, Zachary led his colleagues through an activity from a STREAM workshop. He provided copies of lesson plans that were intended to address specific Common Core content standards, and the teachers worked in groups to try to determine which standards the lessons intended to cover. After a discussion of the lessons and standards, the K-6 teachers took the SBAC practice test at their grade level. For many, Zachary said, it was an insight into how difficult the exam was and how much higher student expectations would be.

The researcher attended the March workshop, where Smallville's mentor Veronica led the staff through a presentation about "Number Talks," a method of engaging students in mental math. Number Talks were presented by Veronica in the STREAM professional development. Zachary and Fay chose to introduce this instructional tool, also demonstrated in STREAM professional development, because of its ability to showcase students engaging in the Mathematical Practices.

Veronica presented Number Talks as a sequence of posing a mental math problem followed by student discussion and presentation of possible solutions. She explained that students were expected to not only provide answers but full solution paths, using justification and possibly visuals such as a number line to help describe their mathematical thinking. Veronica spent much of her presentation engaging the teachers in Number Talks with special attention to how she was presenting the information, writing students' solutions without editing, and moving the discussion forward with careful selection of problems. She ended by sharing resources for Number Talks and fielding questions from teachers about the Smarter Balanced assessment. Veronica also employed an exit ticket protocol, asking teachers to reflect on one thing they learned about leading classroom discussions.

Complications Affecting Dissemination

A major complication that arose early for the Smallville cohort involved getting the time for professional development they were promised. Zachary stated, "We had a very simple plan this year....We didn't try to reinvent the wheel. We didn't try to throw a

ton at them. The only downfall really has been the time allotted from our administration.”

Zachary had a plan for improving administrator support:

Be prepared ahead of time. Let them know weeks in advance what your plan is to do that day so that before they even align their schedule of what’s going to happen on that professional development day, you’ve already told them what you’re doing. That’s what it has come down to. I just make sure that I’m ahead of them.

Superintendent English agreed that the Smallville cohort was not given enough time. He said, “I think we should’ve emphasized it more in the fall and given them more time instead of an hour or two hours once a month....I think we need to have more grade-level meetings and I think we need to give them more time.”

The Smallville cohort was also concerned that their administrators were not on board or perhaps had different expectations for Zachary and Fay’s activities. Fay said, “I don’t know if they are really even very aware.” Zachary went a step further:

[The administrators] came to me and asked if we ‘need to be involved’ in [the next year of STREAM]...so that right there is they’re not sold on it. They thought it was going to be something different...as far as the teaching to the other teachers, I would bet that they almost have no comment.

Zachary expressed frustration about comparisons made by the administrators between an extensive district reading grant and his modest work through STREAM with his colleagues: “I think the math is compared to the reading grant from our administration standpoint. Well obviously you’re getting way more out of your reading grant than you are the STREAM grant, way more.”

Zachary also found it challenging for the cohort to interact with two different administrators. Superintendent English had originally agreed to be part of the STREAM

project and attended several STREAM events, but the school principal worked more directly with the teachers, including Zachary. In his reflection interview, Superintendent English was quick to say that “they’ve fulfilled my expectations.” He had expected that “emphasis on math and those teaching strategies would be stepped up,” and he felt that was the case. He added that he was not sure Zachary and Fay believed they had met their goals for MCCSM dissemination.

Fay found it challenging to work in a different building than the teachers she was supposed to be working with: “I feel like my communication with the elementary isn’t good because I just don’t get over there...and we really, really need that open communication.” Because of this, Fay often deferred to Zachary to facilitate meetings and workshops.

I’m more the support. You know, like I’ll make copies and [communicate with the mentor]....Part of it is because he is in the building with them and I’m not....I mean, I’m friends with all of them but we don’t talk every day or anywhere close to that.

Superintendent English also addressed communication and trust in his reflection interview: “[It] was a good reality check. It takes more than just a matter of disseminating information and allowing time and that kind of thing. I think there is a whole, it’s a trust thing.” He thought the peer-to-peer professional development structure was a good idea, but that it “really depends on your staff. The collegiality can be kind of a sacred thing and some of that can be destroyed when [teachers] are put in a different role.”

A final obstacle that may be true in other schools was Smallville’s treatment of their textbook series, *GoMath*, as a solution to implementing the Common Core. In the reflection interview Fay stated, “Our books are Common Core. We’re confident in the

information in them and we've gone through [the textbook] and so the content we're not so worried about, because we know it's there." She later added, "We've got the book that has it all in it ... as far as doing the Common Core. We handed it to [the staff]."

Whenever Fay discussed the Mathematical Practices, she talked about really wanting her colleagues to understand them, use them and have students use them. But when talking about content standards, she deferred to the textbook or simply mentioned the need for teachers to make students aware of what standard they were covering. Zachary also exhibited a similar view. During STREAM professional development, he often shared with peers that they should get their school district to get *Go Math* because it was so well aligned with the MCCSM, at least in terms of content standards. In his reflection interview, he explained that "The *Go Math* curriculum follows the Common Core really well, but the Math Practices, it doesn't necessarily state them."

Expectations for the Future

"Hopefully we'll have a little bit better luck with the things that we planned going through instead of getting interrupted," said Fay about the future of school-based dissemination in Smallville. She had two hopes for future professional development; first "Meetings not getting canceled and everybody being there," and second "To go and be able to see Brad and Carol or the Riverview ladies and see something that they're doing."

Zachary wanted to get his teachers excited about integration of mathematics in STEM lessons. Teachers in the STREAM project explored the MCCSM content and practice standards through STEM activities. Zachary firmly stated, "That's how I want to go next year, is teaching those lessons." Zachary said he would initially like to do more

STEM activities with his students, as a sort of trial run, then engage his colleagues in doing the same STEM activities. “Because that’s how I learned....That’s how I got excited about [the MCCSM].” Superintendent English hoped to see emphasis placed on “specific teacher strategies, the relevancy of math, and more hands-on activities” in future dissemination efforts.

Zachary believed that an ideal scenario, to “get everybody to buy in, would be a day of math activities.” In his mentor role he had seen Riverview structured their launch event as a full day of math activities and saw the benefits in terms of staff buy-in. But he added, “When that day would be appropriate, I don’t know....My biggest question is here, for our staff....Everyone thinks we’re doing great, which I think we all are but everyone wants to go their own way.” He showed great concern that the timing of such an event would need to be spot-on to have the desired effect.

Because the 2013-2014 school year was the last year for the reading grant, both Zachary and Fay thought that for the most part future dissemination would be easier in Smallville. Fay added that because her teaching peers were used to the Smallville cohort sharing information with them, the discussion would be easier. Zachary thought future dissemination would be “Harder to plan, easier to implement.” He ended his reflection interview by saying, “We all make a valiant effort to know what we’re teaching, why we’re teaching it, and how we’re teaching it.... Everyone is on the same page and understanding what we are talking about.”

Cross Case Analysis

The previous sections presented findings for each cohort in four key areas: Emphasis on Mathematical Practices, Leadership Roles, Anticipated Barriers, and Insight about Dissemination. These themes are briefly reviewed below, followed by a more detailed analysis and discussion of the fifth theme, “Shared Perceptions of the MCCSM.”

Every cohort emphasized the Mathematical Practices and included staff awareness and understanding of the Mathematical Practices as one of their school-based dissemination goals. Many individual teachers in the cohorts also described that they would be emphasizing the Mathematical Practices in their own instruction, which included encouraging and expecting students to use the Mathematical Practices.

All cohort teachers, with the exception of Carol and Fay, stated that they considered themselves leaders in their districts. Many held leadership roles in and out of the classroom prior to beginning the STREAM project, although those roles were not always related to mathematics. During the reflection interview, cohort teachers stated that they were now considered mathematics leaders in their schools by other teachers. It is interesting that not all of the teachers were comfortable naming themselves as leaders, but they had no problem viewing themselves as resources on the MCCSM for their peers. Administrators in each of the districts confirmed the perception that the cohort members were considered both leaders and resources; in fact, the word “resources” was used often in describing the cohorts.

All four cohorts anticipated specific barriers to their dissemination efforts. Many of these barriers were actually encountered during the school year, but each cohort also

anticipated barriers that upon reflection did not interfere with dissemination. Two cohorts in particular, Smallville and Prepmont, encountered a variety of unanticipated barriers, which proved to be some of the biggest challenges they faced during dissemination. These barriers are discussed in more detail later in this chapter.

Cohorts demonstrated insight about their role in school-based dissemination, often directly related to a challenge they encountered. Administrative support, whether passive or active, was identified by all four cohorts as necessary for effective dissemination. Guaranteed or pre-established time for teacher learning was also identified as an important factor in the dissemination process. In the focus groups and initial interviews, no cohort mentioned the possibility of needing to change their Strategic Plans, perhaps showing a lack of insight. However, upon execution of the Strategic Plans, they discovered many changes that had to be made. Almost all cohorts had to alter content expectations for their events or greatly simplify their plan to stay within time constraints and meet teacher needs.

Shared Perceptions About the MCCSM

Depth and Rigor of Standards. Teachers across all four cohorts expected adoption of the rigorous MCCSM would require teachers to more deeply understand mathematical content. In their initial cohort interview, Jill and Kim in Riverview stated that they were very aware of the “depth and rigor” of the MCCSM. Ampleton wrote in their Strategic Plan, “The implementation will require a paradigm shift from ‘covering’ standards to developing a deeper mathematical understanding of key concepts....The focus of the STREAM project is to develop mathematical knowledge in teachers so that they can

competently teach the new standards with more depth and rigor.” Additionally, cohort members came to realize that teachers were expected to integrate the Mathematical Practices into daily instruction as well.

Role of Learning Progressions. Along with the increased depth and rigor of the MCCSM, the design structure of the standards was not lost on the Riverview cohort. In their initial cohort interview, Riverview routinely described the Common Core State Standards, especially with respect to the learning progressions, as “beautifully designed.” Jill described the standards as “like one of those domino things, you have to have every single piece” and added, “If you’re going to do it, do it right.” Kim elaborated that not only are the standards an all-or-nothing phenomenon that builds from year to year, but that those teaching it had to work together: “It has to be all or none.”

The other three cohorts repeatedly referenced the value of the learning progressions associated with the Common Core State Standards. The Ampleton cohort valued the learning progressions as a concrete reference for help with remediation in mathematics. Pamela described how they applied this view when talking with fellow teachers:

When I talk to someone, I can confidently tell them “If you just back up a grade level or two when something is wrong in a child’s learning and you can’t quite figure it out, back up a little bit in that progression”... [progressions are] that solid.

Representing Prepmont, Carol stated that learning progressions allowed her to look forward and back in terms of content expectations, and also provided “a set of expectations” that would ultimately help the students as well as the teachers with more consistent education. She saw this as being especially beneficial for those students who

regularly moved between multiple schools in the area, a trait often associated with the Native American students in her area. Fay from Smallville added, “You’re not responsible for everything. [There are] things you need to focus on and [there] are the things that you can expect students to [have been] well introduced to when you get them.”

Coherence of Mathematical Practices. All of the teachers in the four cohorts and many administrators emphasized the global nature of the eight Common Core Standards for Mathematical Practice. Jill and Kim rarely discussed the content portions of the MCCSM without making specific reference to incorporating the Mathematical Practices. In his initial interview, Principal Iverson hoped the Mathematical Practices would provide for “longitudinal consistency” by “making sure that we’re using similar programming, using similar vocabulary, making sure that the language and the vocabulary of the Common Core State Standards is something that students have heard for a long time.” Brad went further to say that not only are the content and practice standards important, they were not something that would be implemented and done, that “you’re never going to stop working on them and trying to improve on them.”

Focus on Students. Throughout the year of dissemination, even though the cohorts were working with their colleagues on implementing the MCCSM, their focus remained on students’ increased achievement in mathematics. Every cohort’s Strategic Plan purpose or vision statement included a statement related to student achievement: “Increase student learning through the Common Core State Standards for Mathematics;” “Empower teachers to increase student mathematics achievement;” “To improve student

performance in math;” or “So students can succeed in math.” Rarely was a statement of success not associated with improvement in student performance.

“That’s probably the most motivating part of all of this – to first understand it myself, or begin to, and then communicate that and help my students understand it,” stated Fay during her initial interview. When cohort members described the Mathematical Practices, they often spoke of the necessity for students to know and use the vocabulary within them. Stella stated, “It’s not only just teaching it...but also verbalizing that to the kids because they need to have that vocabulary and that knowledge – that ‘Yeah dude, I can do this.’ I think that that’s going to help them take more ownership.” After discussing the deep and cultural changes that need to occur for the implementation of the MCCSM to be effective, Ampleton teachers concluded, “when we do all of those things, what we do is create students that really believe they can do mathematics better.”

Importance of Context. Most cohorts alluded to the value of using mathematics in real-world contextual settings. In his initial interview, Zachary from Smallville stated that he planned on using real-world STEM activities for the coming year. Carol from Prepmont stated that those real-world, hands-on activities allowed her “to focus and think of how it’s applying and where it fits.” Ampleton cohort members not only mentioned the value of using mathematics in more contextual settings, they stated that this was one of the most important messages they learned from the STREAM project. When discussing messages taken away from STREAM professional development Stella stated “deep thinking based on real world application” and Una reiterated “real life application – looking at mathematics in a contextual environment.” Quinn hypothesized that by

“[applying math] to a real life situation that made sense to them, that they were interested in and excited about, [students] began to have those ah-ha moments of ‘Oh, that’s what this is.’”

Unique Perceptions About the MCCSM

A few unique but notable perceptions of the MCCSM were voiced by one or two individuals. In the initial cohort interview, two of the teachers stated that they enjoyed the reduced burden or the freedom that the MCCSM allowed. Roxanne stated that rather than just teaching lesson by lesson from the beginning to the end of a textbook, “It was nice being told that I have the freedom to halt content and have discussions about math.” Fay felt more comfortable about required content: “This is my responsibility for seventh graders, this is my responsibility for eighth graders. I don’t need to go all the way across the board [in terms of content] every year.”

When asked in the initial interview about her primary “take-away” message from STREAM professional development, Roxanne simply said, “Collaboration.” In her later reflection interview, Roxanne clarified that she had previously felt like a “lonely island” in her building as the only fourth grade teacher. When she joined the STREAM project, she was allowed the “opportunity to share” with others and realized that sharing was “so important.” She added that additionally, in Ampleton, the administration was making their PLC time a “huge priority...for us to have that collaboration time and to share what we’re doing.” The results was that she now associated peer collaboration with the MCCSM.

Factors Affecting Dissemination

Logistics and Timeline. Although the STREAM project concentrated on grades 4-7, each of the cohorts decided to include additional grade levels in their school-based dissemination efforts. Ampleton had anticipated focusing on grades 4-6 more closely but due to pressure and additional monetary support from the district, they included all of their K-6 teachers. The other schools, due to their relatively small size, decided that they would undertake to include all K-8 teachers. Each cohort also decided independently to put on an event very similar to the STREAM Launch Event to launch their own school-based dissemination. The cohort launch events imitated the STREAM launch by providing information about the MCCSM and engaging teachers in activities focusing on the Mathematical Practices and STEM. However, often connections made in the STREAM Launch Event across content and activities were lost due to cohorts choosing to use only those activities they enjoyed during their own launch.

Each cohort's launch event took place either late in the summer or within the first few weeks of the 2013-2014 school year. After that, no cohort engaged in any formal school-based professional development activities for over six weeks. This waiting period was built into the Strategic Plan for three of the cohorts. Smallville had planned to engage their peers in professional learning once every month, but cancellation of multiple events in Fall 2013 made this impossible. Riverview waited almost four months before continuing with dissemination, because Principal Iverson used that time period to evaluate his staff's needs and readiness for the school-based professional development school year events.

During dissemination events, the Ampleton, Riverview, and Prepmont cohorts spent a full day leading professional development, although they did not necessarily meet with all of their audience at once. The exception, Smallville, typically used only 30-45 minutes to share information, with the exception of an outside presenter's two-hour presentation. When asked if this short time frame was adequate to strengthen teachers' knowledge of the MCCSM, Zachary stated that he felt as long as the goal for the time period was simple, the short time frame was not an issue. In contrast, both Fay and Superintendent English simply stated "No" and emphasized that the time frame was far from adequate.

Anticipated Difficulties. During the reflection interview, cohort members were asked if sharing their knowledge of the Common Core State Standards was harder or easier than expected. There was no consensus among the teachers. Both members of the Smallville cohort stated that dissemination was harder than they had expected. They attributed this difficulty to "getting teachers to buy in." No other cohort agreed on how accurately they anticipated the difficulty of school-based dissemination. A couple teachers said it was easier because teachers were more receptive than anticipated, while others felt they had anticipated the difficulty level accurately. Two other teachers answered both easier and harder, saying "At first harder, but now a lot easier" or that certain aspects were harder (e.g., not completing all of the intended activities as stated on the Strategic Plan) and others were easier (e.g., teacher buy-in). Most cohort members did agree when asked about the anticipated difficulty of future school-based dissemination. All but one stated that the next year would be easier. They attributed this to teachers

being more comfortable with adopted curriculum, less involved with other school district trainings, or because the teachers were “on the same page” and were “on board” with the effort being made. Jill, who did not state it would be easier, added “It depends on what we do with it.”

Barriers – Anticipated and Encountered

Table 6 summarizes the barriers to dissemination that each of the four cohorts either identified or encountered or both. These were addressed within the analysis of each cohort, but are revisited and discussed collectively below. Blue items indicate barriers that were both anticipated and encountered by a given cohort during dissemination. The black items specify barriers that were anticipated but were not observed during site visits or referenced in the reflection interviews. Items in red represent barriers to dissemination that a cohort encountered, but had not anticipated. (In this table PD stands for “professional development.”) As shown, Ampleton and Riverview anticipated far more barriers to dissemination than they actually encountered, while Smallville and Prepmont underestimated the challenges they would confront.

Table 6. Barriers to cohort dissemination

	Ampleton	Riverview	Prepmont	Smallville
Shared Barriers	Teacher resistance	Teacher resistance	Teacher resistance	Teacher resistance
		Communication issue with administrators	Communication issue with administrators	Communication issue with administrators
	Overwhelmed teaching staff	Instructional shift from following a textbook to finding the best materials		Overwhelmed teaching staff
	Time – a limiting factor	Time for dissemination	Receiving guaranteed PD time	Receiving guaranteed PD time
	Effective communication with district teachers and community		Building separation	Building separation
	Teachers’ struggling with content depth; Lack of adequate knowledge in support staff	Teachers’ struggling with content depth		
	Trust	Cohort members’ apprehension to lead		Trust
Unique Barriers	Balance between teacher autonomy and district vision	Lack of community support in MCCSM implementation	No additional PD on MCCSM planned in district	
	Cohort structure	Teacher buy-in/”All or none”	Staff perception of quick “alignment”	
		Lack of follow-through		
Note: Blue - Anticipated & Encountered Barriers , Black - Anticipated but not Encountered Barriers, Red - Unanticipated & Encountered Barriers				

Some barriers were identified by multiple cohorts. For example, all four cohorts identified some form of teacher resistance as an anticipated barrier to dissemination, although only two cohorts reflected that they were actually challenged by teacher resistance. Riverview encountered three teachers who blatantly refused to alter their instruction or to adopt the MCCSM in their classroom. Although they attended and participated in all professional development events and reportedly made small changes to instruction, these teachers often stated firmly that they just didn't have time or desire to change. All three were in their last year of teaching and would retire after the 2013-2014 school year. While Jill described this as "very frustrating," both of the Riverview cohort members stated that they anticipate almost no resistance in the future because their colleagues "want to learn" more about the MCCSM.

Ampleton stated that they did face teacher resistance; however, much of this was attributed to the abrupt introduction of the new *Go Math* curriculum and the inaccurate association teachers made between that series, the MCCSM, and the Ampleton cohort's efforts. Cohort members repeatedly felt the need to explain to their peers that these three things were not part of a package. Additionally, in 2013-14 Ampleton was finishing a reading grant and had many additional responsibilities that would not be present in the future. The cohort felt these factors contributed to the staff's sense of being overwhelmed, and as Roxanne put it, "We're working on it." Adoption of new curriculum and engagement in a reading grant were mentioned as limiting factors by Smallville as well.

Smallville and Prepmont shared many barriers to dissemination. As middle school mathematics teachers in small districts, Fay at Smallville and Carol at Prepmont felt like they had no direct peers to share information with. Carol emphasized, “I have nobody to work with and nobody to bounce ideas off of.” Additionally, they were located in different buildings than the elementary teachers. Each felt their cohort partners, (Zachary and Brad, respectively) had a more direct relationship with the main audience for dissemination. Fay stated, “Zachary is much more in contact with the elementary [than I am].” As a result, Fay and Carol tended to assist with school-based events rather than taking a lead role.

Both Prepmont and Smallville struggled to negotiate the professional development time they had been guaranteed over the summer. During the Summer Academy, these two cohorts were guaranteed very specific dates and times for their school-based events. However, both ultimately had planned events cancelled by administration. Zachary, from Smallville, and Brad, from Prepmont, attributed these cancellations to administration being unaware of the importance of their efforts. This “passive” and “superficial” support from administration was also evidenced in lack of awareness and unspoken expectations.

Prepmont and Smallville also agreed that they wanted and encouraged their administrators to attend professional development events but they rarely, if ever, participated. The Riverview and Ampleton administrators were directly involved in planning for events and were very aware of the actions taken by the STREAM cohorts, but reflection interviews with the administrators of Prepmont and Smallville showcased

how little they knew of their cohort's dissemination efforts. While the Riverview and Ampleton administrators were able to give fully detailed descriptions of events that occurred in their district, Superintendent Allen described Prepmont's work in broad terms; "I can't remember the total number of days but we've had several full day trainings." Superintendent English of Smallville stated, "We have professional development days where we've designated one day each month and we have orientation days at the beginning of the year." No detail of the meeting's content was given and no reference was made to cancellation of two of the three events scheduled for Fall 2013. Additionally, administrator expectations in Smallville did not align with the cohort's plan. Zachary stated, "I don't know what [the administrators] were expecting. They didn't know what they were getting....Obviously, STREAM is a different expectation than what [administrators] had."

Riverview experienced and dealt with two unique barriers. First was the cohort members' apprehension to assuming leadership. Both cohort members stated that they did not want to be seen by their peers as leaders in implementing the MCCSM; they instead wanted to be seen as colleagues who were undergoing the same change process. When asked by their peers when it would be "the experts'" turn to be observed, they quickly and assertively stated that they were not the experts nor were they the leaders; they were merely part of the group. This attitude was one that the Riverview cohort was still trying to deal with.

Another challenge appeared because Riverview had no identified textbook, opting instead to use other available materials including previous textbooks used and online

resources. As a result, teachers were tasked with finding the best materials available to address each of grade-level standard in the MCCSM. Many Riverview teachers had expressed frustration and an unawareness of where to begin to find these materials. At their school-based events, the Riverview cohort provided online resources that they were using and others that the STREAM project had identified. By the third round of meetings, it seemed this was no longer a major issue and that the majority of teachers had found materials.

Riverview further identified a mismatch between the school's focus on questioning techniques and the Riverview cohort's focus on Mathematical Practices. This conflict arose during the first cohort-led meeting but seemed to be resolved by the third meeting. For Jill, it became apparent that the two visions, while seemingly different, worked very well together. She believed that students cannot truly engage in the Mathematical Practices without the teacher engaging in effective questioning techniques.

During the school year, all cohorts but Ampleton encountered a complication to effective dissemination that was directly linked to communication issues with the administration. Because of communication problems between Principal Iverson and the Riverview cohort, links between his expectation of a focus on questioning techniques and the MCCSM were not communicated clearly. According to Brad, the biggest complication that Prepmont encountered during dissemination was "the lack of priority from the administration." Brad described that he would have been satisfied with verbal confirmation that his efforts were a priority and of importance to the administration, but he had not received that affirmation. Smallville also sensed a lack of importance and

stated that their biggest challenge was to get the time they were guaranteed. Zachary stated, “I just make sure that I’m ahead of them.”

Take-away Messages

The messages teachers took away from STREAM’s professional development about the Common Core State Standards often differed significantly from the messages they were trying to convey to their peers during school-based professional development. Table 7 displays some of the individual take-away messages, which are synthesized in the discussion that follows.

The primary messages taken by cohort members about the MCCSM from STREAM professional development were that the staff needed to be unified and willing to collaborate for the implementation of the MCCSM to be effective; that the standards emphasized depth over breadth of content; and that the standards required the staff to have a uniform understanding of the change that was happening before they would be able to alter their instruction accordingly. These messages were oftentimes about the “big picture” of the MCCSM and many were in relation to their coming work towards school-based dissemination of MCCSM knowledge. On the other hand, during their dissemination efforts, they attempted to convey to colleagues that the Mathematical Practices were a large part of the MCCSM; that the standards made sense and were doable in the classroom; and that again that a uniform understanding of the importance of the MCCSM and the need for integration of all of the parts of the MCCSM. These messages conveyed were less about dissemination practices and the overall vision of the MCCSM and more about actual use of the MCCSM in the classroom.

Table 7. Primary messages about the MCCSM

Primary message taken by cohort members from STREAM professional development about the MCCSM.		Primary message tried to convey to colleagues during professional development about the MCCSM	
The MCCSM requires a unified staff willing to collaborate.	“It has to be all or none. ... We all have to be on board.”	The Mathematical Practices are an integral part of the MCCSM	“The mathematics practices and how key those are to make sure that you’re weaving through lessons... and the learning progressions... what they do in that younger grade is so key to build up.”
	“The most important thing I can do is share my knowledge with everyone at my school.”		“Especially the practices, we use them all the time.”
	“Collaboration; More teacher to teacher collaboration.”		“Our main target is to incorporate the Mathematics Practices.”
The standards emphasize depth not breadth	“Less is more. To me, that’s Common Core.”	The MCCSM are doable.	“Get the Mathematics Practices up in everybody’s room and make sure that we are talking about them more.”
	“Depth not breadth.”		“That you can do it, that it can be fun and kids are going to learn more and you’re going to have more fun teaching it.”
	“We’re not trying to get in so many concepts but the concepts are deeper and the expectations are higher.”		“It is common sense. It’s very doable. They’re not that dissimilar to what we had before.”
The MCCSM require a uniform understanding of the change.	“We need to have a uniform understanding.”	The MCCSM requires a uniform understanding of the importance and the need for integration of content and practice standards.	“The correlation between the standards on paper to the standards in action and how it relates to what we do.”
	“Before we can really get going, we need to really know what’s going on.”		“It’s important to implement ... understand the importance of it.”
	“It’s a culture change. It’s a cultural shift.”		“How do we tie this all together?”

Conclusion

This research endeavored to describe how teachers disseminate content knowledge and pedagogical practices learned in professional development to their school-based peers. The analysis of the data in this study depicts four different cohorts' journeys through teacher-led school-based professional development. Each cohort went through five phases of dissemination: Anticipation, Initiation, Implementation, Complication, and Expectation. Factors that supported and hindered cohorts' school-based professional development efforts have been described throughout. The data analysis has concluded with a discussion of the messages teachers in each cohort found important and those they shared with their peers. Overall, the cohorts made progress towards implementation of the Montana Common Core Standards for Mathematics in their school districts. The analysis of cohort data resulted in multiple findings and implications along with recommendations for research and practice that will be discussed in the following chapter.

5. CONCLUSIONS

Introduction

“For the first time in U.S. history, a set of standards is established that will be taught in nearly every state” (Dacey & Polly, 2012, p. 379). The Common Core State Standards for Mathematics are currently being implemented to varying degrees with various levels of support in each of the 44 states, including Montana, that have adopted them. Montana is in the process of enabling implementation of the Montana Common Core Standards for Mathematics (MCCSM) in classrooms and schools across the state, and professional development is a fundamental tool for providing these teachers with the knowledge to do so. Providing effective professional development to a critical mass of teachers and preparing them to share their specialized knowledge with school-based peers has the potential to expand the influence of professional development from just a few teachers to a substantial portion of the schools and districts undergoing this change.

The Standards-based Teaching Renewing Educators Across Montana (STREAM) professional development project is one of the primary professional development vehicles for teachers who are implementing the MCCSM. The STREAM curriculum focuses on developing teachers’ specialized knowledge of MCCSM content standards, the Standards for Mathematical Practice, and leadership skills. STREAM professional development is based on a unique blended design that provides access to teachers across the state of Montana while incorporating the characteristics of effective professional development described by Garet et al. (2001) and others. Those characteristics include a focus on content knowledge; active participation by teachers; coherence with other learning

opportunities; duration in both time span and number of contact hours; collective participation; and routine opportunities for reflection and feedback

This chapter begins by revisiting and answering the original research questions. The researcher then introduces a new framework for supporting school-based, teacher-led professional development. After providing a synthesis of findings and implications that arose from the study, the researcher offers recommendations for research and practice.

Research Questions

This research study examined how teachers disseminate content knowledge and pedagogical practices learned through professional development. The study was set in the context of the STREAM professional development project which provided teachers with specialized knowledge for implementing Montana's Common Core Standards for Mathematics (MCCSM). The research questions are restated below and are addressed collectively.

1. What elements of STREAM do teachers identify as most valuable to support dissemination of information about the MCCSM?
 - a. What structures do teachers identify as most valuable to support dissemination of specialized knowledge about the MCCSM to peers?
 - b. What messages do teachers take away from professional development about the Common Core?
2. What factors influence school-based dissemination of specialized knowledge of the MCCSM?
 - a. What supports, needs, and barriers do teachers identify as influencing their

ability to disseminate the MCCSM?

- b. How is school-based dissemination of specialized knowledge about the MCCSM hindered or enhanced by existing resources and opportunities?

Every teacher participant in this study, after facilitating eight months of school-based professional development, stated that the STREAM project prepared them with specialized knowledge of the MCCSM and with skills for disseminating this information to school-based peers. Several teachers elaborated on the growth of their personal knowledge. Jill from Riverview stated, “I think STREAM has made me more well-rounded in my understanding of the [MCCSM]. I understand the big picture. I understand why and where it came from.”

The teachers appreciated their experience with the well-designed face-to-face workshops and well-formatted activities provided by STREAM. Many cohort members used those activities directly in school-based professional development, replicating them for peers. Although they would have liked to “use their mentor more” during school-based events, the cohorts all appreciated the mentor teacher structure that was built into the STREAM project and used their mentors regularly for feedback, advice, and support. Cohort members also stated that the content focus of STREAM’s professional development, in both the face-to-face workshops and the online modules, was extremely valuable to increase their own mathematical competency as well as to provide confidence in the accuracy of information they were sharing with their peers.

The primary messages teachers took from the STREAM professional development was first and foremost that content is important, and that the Common Core

demands a far greater depth of understanding about content than previous standards. Additionally, they realized that the Common Core requires connections to be made across grades in order for the standards to be implemented effectively. The cohorts recognized that because the Common Core Standards for Mathematical Practice were intended to apply to all grade levels, they would be an excellent springboard to launch school-based professional development.

Along with these global messages about design and structure, a number of less tangible “take-away” messages emerged: that everyone needs to be on board with the standards in order to implement them; that the new standards require a cultural shift; that implementation of the MCCSM requires more teacher collaboration; and finally that the most important thing cohort members can do is to share their knowledge of the MCCSM with their peers.

The factors that influenced school-based dissemination of specialized knowledge of the MCCSM differed widely between cohorts, but some broad and recurring themes were identified across cohorts. These factors include existing school structures, external support, cohort collaboration, and personal motivation and perseverance. A variety of existing resources and opportunities (e.g., structured professional learning communities, embedded grade-level planning time) enhanced the effectiveness of the cohorts’ school-based efforts. At the same time, some existing conditions (e.g., new curriculum adoption, administrative priorities) hindered effective dissemination. Each of these concepts will be discussed in detail later in this chapter.

Qualitative research begins with a road map, but the research process often leads to new avenues of research and unanticipated findings. In the process of seeking answers to the research questions, a more revealing and interesting result was exposed. Mathematics educators are familiar with the “trainer-of-trainers” model where a subset of trainers work through a precisely defined set of materials and instructions and are then expected to replicate the process with a new audience. A more fluid and open model, named here the “teach the teachers” model, better describes the STREAM professional development project. In the following sections, the researcher presents and describes a framework supporting this model. The discussion of the model also expands conclusions that can be drawn from the original research questions.

A “Teach the Teachers” Framework

The study findings suggest that the STREAM project’s “teach the teachers” professional development model enabled teachers to lead school-based professional development that reached far more teachers than the STREAM project could have done alone. All four cohorts in the study successfully facilitated professional development for peers in their home districts, although the information that was transferred varied widely in topic, emphasis, nature, and quality. In several instances, the STREAM curriculum was somewhat “diluted” in the process of passing it from the project designers through the cohorts and on into their home districts. Later in this chapter, recommendations are provided for improving the professional development model to strengthen the effectiveness of teacher-led and school-based professional development. Despite room for improvement in the model, the findings of this study provide encouraging results

regarding teachers' increased knowledge of standards, their efforts to implement standards in the classroom, and their school-based outreach to peers.

The researcher offers the framework shown in Figure 3, which represents the transmission of knowledge through a “teach the teachers” professional development model and highlights contributing factors and filters that influence delivery and receipt of information.

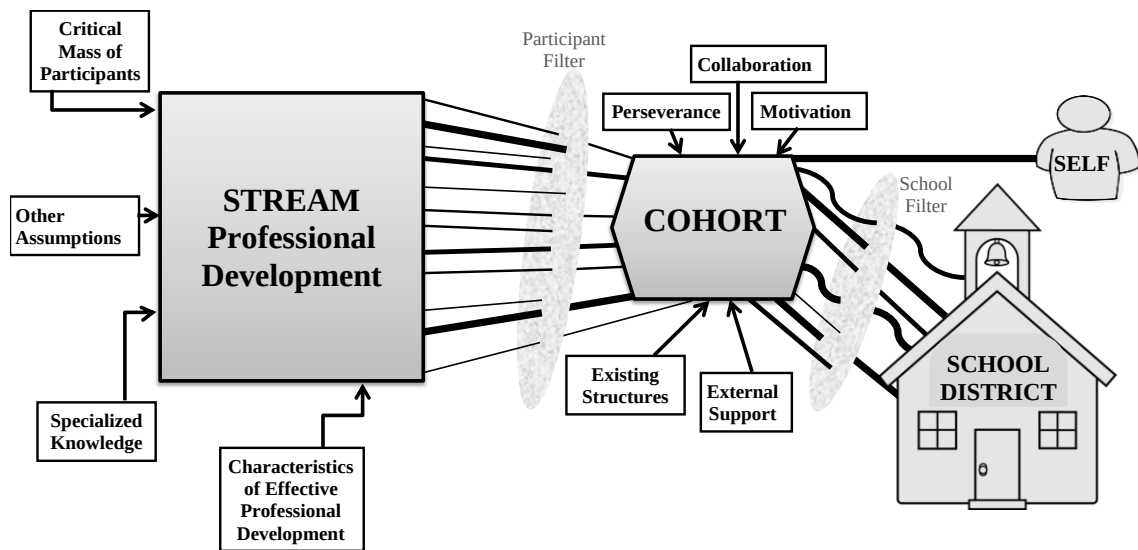


Figure 3. Framework for “Teach the Teachers” Transmission Model

In this study, specialized knowledge of Montana’s Common Core Standards for Mathematics was transmitted during STREAM professional development as well as in school-based professional development. In addition, cohort members received specialized knowledge about teacher learning and leadership. Receipt and delivery of professional development potentially occurred at three stages in the framework: the STREAM Professional Development (delivery only), the Cohort (receipt and delivery), and the

School District (receipt only). Specialized knowledge was transmitted through STREAM professional development to teachers in each cohort, and those cohorts then transmitted their specialized knowledge from STREAM to other teachers in their school district.

Arrows are used to highlight factors and inputs that influenced effective transmission of knowledge at each stage. Lines represent how at each stage, much like in the game of “telephone,” information can potentially be lost or altered as it passes through “filters” between the original intent of the STREAM curriculum, how that intent is received and interpreted by cohort members, and how it is passed on and received at the school level.

The framework also represents the fact that cohort members reportedly made significant changes to their own instruction to better teach to the depth and rigor of the MCCSM. This is illustrated at the level of “Self” use of STREAM information. Each factor influencing the transmission process is described in detail below, followed by a discussion of how the STREAM professional development content was replicated, diluted, or transformed by filters of understanding within the particular cases of this study.

STREAM Professional Development Factors and Influences

Along with the effort to meet criteria for effective professional development, a series of assumptions influenced the design of the STREAM project. The first assumption was that participating districts needed to enroll a “critical mass” of fourth through seventh grade teachers (25% - 35%). Another assumption made by the STREAM leadership was that high-quality teacher learning must be supported with adequate time

and funding. The project provided stipends for cohort members and substitute pay for districts to encourage sufficient time for school-based dissemination. A third assumption that school leaders must be involved in teacher learning led to the requirement for each district to identify an administrator who would commit to attending most of the STREAM workshops and pledge to assist in the cohort's school-based efforts. Finally, assumptions about successful dissemination led the STREAM project to recruit participants who demonstrated evidence of prior success as a teacher leader.

Specialized knowledge of Montana's Common Core Standards for Mathematics was acquired through study and application of the Mathematical Practices, specific domains of content knowledge and their related learning progressions, and knowledge of school change, collaboration, and leadership. Design teams were created to develop the four themes of STREAM professional development that were part of this study. Each design team included two veteran K-8 mathematic teachers, a university mathematics teacher educator, and a professional development consultant with years of experience working in Montana. Each design team developed a six-month sequence of workshop sessions and online modules on an assigned theme, drawing from high-quality national resources, their own expertise, and field tests.

STREAM Cohort Factors and Influences

A variety of factors outside the control of either the STREAM project or the cohort members were identified as influential to successful dissemination. In particular, existing school structures were routinely cited as having a significant effect on the cohort members' ability to work with peers. Collaboration time embedded in the school

schedule played a significant role in the Riverview cohort's ability to routinely communicate and prepare for upcoming school-based events. Professional development time was also embedded in Ampleton's elementary schools, but organized in ways that prevented Pamela from being able to consistently work with her peers while enabling Roxanne to do just that. One existing school structure proved to be a disabling factor for both Carol from Prepmont and Fay from Smallville, who cited being in a different building as the main reason they did not engage more with their elementary teacher audience.

The existence of functioning professional learning communities (PLCs) in Ampleton became one of the primary tools for dissemination, as did the existence of an elementary mathematics coach with a flexible schedule who could facilitate PLC meetings. Other cohorts described that having common planning periods with their grade-level peers was very useful for informal dissemination. Those schools without common grade-level planning periods were committed to implementing that model in the coming school year.

Individual characteristics of the cohort members played a large role in the dissemination process. Internal attributes such as willingness to persevere, ability to collaborate, and motivation for change contributed to the cohort's ability to effectively facilitate school-based professional development. For example, cohort members who described dissemination as much harder than expected were still motivated to persevere, and almost all of these individuals stated that they expected their future school-based efforts to be easier. Additionally, a subtle relationship seemed to exist between

collaboration and motivation. In some cases, a lack of motivation by one or more cohort partner led to the need for extra motivation and perseverance by the other.

External support, while not absolutely necessary, was another factor directly influencing school-based professional development. External support came from multiple sources including STREAM mentors, outside education consultants, and administrators. The cohorts, for the most part, successfully provided professional learning opportunities for their peers regardless of whether STREAM mentors or outside education consultants were available for support. Administrative support, however, had a much greater effect on cohort members' efforts. Communication between the Riverview cohort and Principal Iverson lagged for a short time period and resulted in a misunderstanding about the purpose of their school-based professional development. Once that issue was resolved, the cohort greatly appreciated ongoing guidance from the principal throughout their school-based efforts.

An absence of administrative support was influential in both Smallville and Prepmont. Smallville, although not unsuccessful in its school-based dissemination efforts, encountered many barriers resulting from the fact that the school principal was not adequately informed. Superintendent English, who was involved with the STREAM project, had guaranteed the cohort seven 2.5-hour time periods, one per month, from August 2013 to March 2014. Of these seven, two events were completely cancelled, two others were moved to a 45-minute time slot and one was shortened to a one-hour time frame, due in part to the principal's lack of understanding about the cohort's role and purpose.

Unlike Smallville, the Prepmont administrator did not cancel entire events but often double-booked these events and failed to convey the importance of the cohort's efforts. Brad stated that the largest obstacle to his school-based dissemination efforts was the lack of support from his administration, but he overcame this deficiency through self-reliance, perseverance and motivation. He said, "There are some advantages to having nobody around. If you hold yourself accountable, you're able to pretty much do some amazing things....It's not hard for me to keep enthusiasm for it because [implementation of the MCCSM] is so worthwhile." Brad's unique attitude is examined later in this chapter.

School District Factors and Influences

In the framework, "School District" represents the audience for any school-based professional development delivered by STREAM cohort members. Without doubt, the recipients of this knowledge, and the internal and external factors that influence how they receive it, impact the effectiveness of school-based professional development. However, the school district audience was not examined in this study except in terms of the STREAM cohorts' perceptions of how their school-based professional development was received.

Stages of Content Filtering

Content from STREAM professional development passed through two filters in its journey between design and dissemination. The first stage of content filtering occurred while the cohort members received and reflected on knowledge about the MCCSM. As

with all knowledge, this was processed, placed in context, and reconstructed by the participants into their own understanding of the information. This stage was not examined in this research study, but it can be assumed that while some information was comprehended as expected, other content was altered and some content was forgotten. The second stage of content filtering occurred during school-based professional development. This filtering of information was observable as cohort members transmitted STREAM knowledge, materials, and resources through replication, dilution or transformation. For clarification, an example of each form of transmission will be provided.

An example of *replication* would be that of cohort members completing a mathematical problem solving task during a STREAM online module, then later printing the task and asking their colleagues to complete the task in the same way and with the same instructions. When no alteration or adaptation of the task takes place, it is considered a replication from STREAM, through a cohort member, to a classroom teacher.

Dilution occurs when content from STREAM professional development is transmitted in a way that results in the loss of information or purpose. An example of *dilution* would be if a cohort looked at the Mathematical Practices as a school-based activity but treated them far more shallowly than in the original professional development. Another example of *dilution* would be if a cohort tried to replicate a STREAM workshop or component of a workshop but decided to only present those pieces that they liked, resulting in the loss of connections made between topics.

Transformation of STREAM content, the preferred mode of transmission, occurs when changes are made that allow for increased impact on the audience based on their grade level, knowledge base, and other factors. An example of a transformation would be if a cohort took the same task described in replication above, made specific grade-level alterations to the task and then asked teachers at that level to complete the appropriate task. Transformation does not only apply to grade-level adjustments and could also occur if STREAM content was altered to give more emphasis to specific mathematical content, practices, or learning progressions; to integrate more smoothly with an existing program; or to apply to a specific audience (e.g., an existing PLC).

A third stage of content filtering could be considered at the “School District” level where the school-based audience receives knowledge through professional development, reconstructs a personal understanding of this content, and applies it in classrooms. However, the “School District” teacher audience and their potential filters were not examined in this research study.

Replicated Content

It would be natural to expect that mathematics content was replicated in school-based dissemination, since the STREAM project focused more than half its professional development on content standards and on “doing mathematics.” STREAM workshops and online modules routinely engaged participants in mathematical problem solving, and participants were asked to complete mathematical tasks, analyze student solutions of tasks, and identify the content standards that supported tasks. Cohort members were also asked to build and teach lessons based on specific Common Core content standards.

Surprisingly, mathematics content was almost never the primary content of school-based professional development led by STREAM cohort members. When it appeared at all, mathematics content was usually introduced in the form of problem solving tasks as a warm-up to the rest of the day's activities, which focused more on examining and understanding the standards. Riverview was an exception to this rule as they replicated a "problem of the month" activity they had used during a STREAM online module in geometry. The Riverview cohort asked their peers to complete the problem, then shared solutions and discussed some of the teacher reflections posted in the online module.

Each cohort explained in interviews that they planned to focus more on mathematics content in the future, but for the first year of school-based dissemination they had decided an emphasis on the Mathematical Practices would be more appropriate. Because STREAM content focused on grades four through seven and they were working with primary grades as well, cohort members felt the content they had learned was inappropriate for their peers. There was no discussion of transforming the content to make it accessible to primary grade teachers.

It is also possible that at least some of the STREAM cohort members struggled with their own "deep and rigorous" knowledge of the mathematics content. Recruitment for STREAM was based more on evidence of teacher leadership and perseverance than on mathematics competence. As evidenced by pre- and post-tests used for project evaluation, most participants did increase their content knowledge in specific domains. However, lack of confidence with respect to their mathematical ability or a fragile grasp

of the mathematics they learned may have influenced their choices for school-based professional development.

Diluted Content

The Mathematical Practices were the main focus of all four cohorts' school-based professional development. This mirrors the emphasis that the STREAM project consistently placed on understanding and appreciating the Mathematical Practices and their fundamental relationship with content. A mid-year assessment used for project evaluation showed that STREAM participants were attending to the Mathematical Practices, integrating them with content, and introducing the eight practices to their students. The cohorts similarly emphasized the Mathematical Practices in school-based professional development, but diluted the depth of understanding in transmitting this knowledge. Every cohort cited their colleagues' attention to the Mathematical Practices as evidence that they were implementing the MCCSM. However, most of these statements were in reference to visual displays rather than application: "They all have the mathematical practices up;" "They have the practices posted;" "I can go in teachers' rooms and see mathematics practice posters, and teachers are referring to those." Making the Mathematical Practices part of the scenery supports a concern stated by Russell (2012):

Already the place of the Practice Standards in the classroom is being undermined by superficial approaches that boil down to "we are doing all the Practices all the time." ... But if students are to learn about *how* to engage in these Practices, actual instruction must be devoted to them. ... If these Practices are happening "all the time," the result will be that none of them are happening with any attention or depth. If they are only listed on the wall, they will soon be treated like wallpaper and ignored. (p. 52)

Although the cohorts advocated for the importance of the Mathematical Practices, concrete strategies for integrating them with content and engaging students in their use were ineffectively presented to the school-based audience. Fortunately, some teachers, like Jill from Riverview, acknowledged and planned to remediate this issue with future school-based professional development:

I don't think people understand the practices. I really don't. "Reason abstractly" doesn't mean "reason through the problem."... [Teachers think] "attend to precision" is "get it right, check your work." Is that part of it? Absolutely. Is there more to it? Yeah...it's still very surface to me and I think it would take a while, but I'm waiting to hear more depth in those responses.

Transformed Content

The most effective transformation of STREAM content was seen in how cohorts used lesson design and analysis in their school-based efforts. When they participated in online modules in Spring 2013, the cohort members were tasked with creating a sequence of lessons built on specific standards for content and practice as well as learning progressions. All four cohorts engaged their peers in lesson planning activities similar to what they experienced in STREAM, but adapted them to match current content needs and school context. Teachers were asked to write standards-based lessons, teach standards-based lessons, and either observe or reflect on standards-based lessons. In two of the four cohorts observed, this was a collaborative process resembling a condensed lesson study. In another cohort, teachers completed the lesson tasks alone and then watched and reflected on videos of each other's lessons. In the fourth cohort, teachers did not observe actual instruction but met together for reflection on their lessons, which often led to reflection about the school vision and goals.

Another portion of STREAM's professional development that was effectively transformed at the school district level was the use of student work for teacher learning. Several STREAM activities employed analysis of student work with a focus on how students learn content knowledge. In Prepmont, the cohort members combined analysis of student work with analysis of data as a driving force for improving student understanding of mathematics. In addition to looking at student work in its raw form, the Prepmont cohort studied MAP test scores to analyze specific content areas that needed attention or remediation.

A Model of Teacher Leadership – the Story of Brad

From early in the STREAM project, a unique teacher leader stepped forward and took school-based professional development to heights that no other subject in this study was able to reach. Brad, one of the two cohort members in Prepmont, embodies the personal attributes of perseverance and motivation, and his story deserves special attention.

Inspired by the STREAM Launch Workshop and long before his personal professional learning was completed, Brad organized his own school-based professional development. In his words, “[The administration] trusted me to implement and I just said ‘this is what we have to do, please help support me.’” The administration responded to his enthusiasm by arranging for substitute teachers and setting aside time and funds for Brad's proposed event – two professional development days for his entire K-8 mathematics staff in Spring 2013. When asked about his motivation for organizing this

event, he said simply, “Why wait? We have some good information already.” Brad became the center of communication for his staff about professional development on the MCCSM, offering immediate distribution of what he was learning through the STREAM project.

I would talk about the stuff that I was doing. I would make copies of some of the problems that we had to work out and I’d put them in [my staff’s] mailbox with a little note that said, “check this problem out, do it yourself, and then see what your kids think.” You know, just little things like that go a long way towards motivating teachers.

During his initial interview Brad declared, “We can’t rely on anybody else. I have to just step up to the plate, with my partner teacher here, and we have to share as much as we can in the best way possible.” He carried this mantra throughout school-based dissemination.

Implications for Teacher-Led Professional Development

The results from a qualitative case study are not sufficient to support broad generalizations. However, the findings from this study indicate that professional development can equip teacher leaders with specialized knowledge and tools to facilitate school-based learning for a broader teacher audience. Each cohort in this study overcame challenges and barriers to develop and deliver effective professional development programs in their districts. Their experiences translate into implications that inform the design and execution of future professional development related to standards implementation, especially in situations where groups of teachers are expected to facilitate professional learning in their home schools and districts.

Barth (2007) claims that “In our society, as in our schools, we are clearly uncomfortable claiming to be a leader. We are even more uncomfortable with those who claim to be leaders” (p. 10). In this study, almost all cohort members found being a leader in their school easier than expected. Even those who viewed themselves only as “resources” to peers were perceived and appreciated as leaders and were told that “somebody has to drive the bus.” Barth further notes that “The teacher leaders who succeed, in addition to being purposeful and persistent, seem to be able to settle for, and to even celebrate, small, partial success.... Teachers who define success as an increment of change in the desirable direction, rather than as accomplishing everything they set out to, experience success, feel “it was still work the effort,” and are likely to engage in subsequent initiatives” (2007, pp. 25-26). The cohorts in this study celebrated “increments of change” and did, indeed, look forward to continuing their efforts. This study illuminated the power of creating even small opportunities for success in teacher leadership and the importance of sharing those successes with colleagues outside the school context.

This study also confirmed that lack of communication between teacher leaders and administrators creates a barrier to school-based dissemination. This finding supports Hart’s (1994) view that “Principals should not underestimate the need for their diligent, supportive, visible, and frequent reinforcement of the real power of teacher leaders” (p. 495). Carol in Prepmont noted that administrators “don’t really pop in much to see what we’re doing and how we’re doing it, which I would like to see more.... I think they should be more involved and have their nose into it a little more.” Her colleague Brad

wholeheartedly agreed: “What about an administrator saying like, ‘Hey first grade teacher, how was the PD today? What did you guys go over?’ Or how crazy would that be if they actually went to the PDs!” Occasionally the administrator actually became the barrier, as in Riverview where Jill noted, “Our level of dissemination was up to Principal Iverson....Unfortunately I think it’s the administration that makes the decision how much you’re going to do or not do.” Smallville’s school-based professional development was paused for a period of months more than once due to lack of administrator support. Communication of goals, expectations, schedules, and strategies among cohort members, between the cohort and administrators, and to the teacher audience is essential for effective transmission of knowledge.

Finally, the quality and conceptual depth about mathematics standards, practices, and content was often diluted in school-based professional development as compared to how cohort members owned and understood the same information for themselves. This effect is due in part to cohorts’ choices of what knowledge to transmit, and also to a preference for replicating professional development rather than transforming it to suit a new audience. Cohorts using a “teach the teachers” model may need more guidance in selecting and transforming professional development materials that match the spirit and content of the original professional development.

Recommendations for Practice

Although the STREAM project provided a unique opportunity for school-based professional development, it employed many widely accepted features of effective professional development and used established materials for professional learning about

the Common Core State Standards for Mathematics. While not widely generalizable, these recommendations may be found helpful in professional development of teachers who plan to facilitate school-based learning about the CCSS or a similar initiative. In the least, these recommendations are pertinent to professional development programs that enable teachers to facilitate school-based professional development in mathematics.

Develop Skills in Facilitating Adult Learning

Professional development programs that incorporate a “teach the teachers” model, or anticipate teachers facilitating school-based professional development in their home districts, must prepare those teachers to work with adult learners. While leadership skills and knowledge of adult learning were part of the STREAM curriculum, they may have been overlooked by participants who were more interested in strategies to improve student learning. For example, differentiation in the classroom may be second nature to experienced cohort members, but when providing professional learning to their peers, differentiation and its benefits were all but lost. As they began the process of school-based dissemination, cohort members were beginning to recognize this deficit. “[We need] something more teacher-focused and less student-focused,” stated an Ampleton teacher. A “teach the teachers” curriculum should prepare cohort members to lead effective professional development. Recommendation: include instruction and opportunities for practice that address traits of effective professional development such as maintaining a focus on content knowledge, active participation, and coherence.

Design Lesson Plans for Professional Development

Standards-based lesson planning, design, and instruction was highlighted in the STREAM project; however, the participants spent little, if any, time actually planning for professional development. The strategic planning that did occur produced only general statements about the purpose of anticipated events even though the Strategic Plan template shared many features of a good lesson plan. For example, cohorts were expected to write milestones for school-based professional development but they struggled to write measureable goals and reasonable ways of assessing them. Future “teach the teachers” designs should ensure that cohort members are able to create effective goals, assessments, and curriculum for school-based professional development. Recommendation: provide instruction and practice in writing goals, assessing goals, and planning “lessons” for professional development events and activities.

Be Sensitive to Content Competence

STREAM participants were not selected based on their mathematics content competence. That said, cohorts with one or more members possessing elevated mathematics content knowledge were more successful at disseminating knowledge based on mathematics content than those without. Even after professional development, some teachers’ specialized knowledge may be too fragile to ensure effective transmission. Requiring all participants in a “teach the teachers” model to have a high level of mathematics content competency, along with leadership skills, perseverance, and other attributes, may not be feasible. However, pre-assessing such attributes would allow designers to fine-tune and maximize results from a “teach the teachers” curriculum.

Recommendation: pre-assess “teach the teachers” cohort members to address and remediate variations in participant mathematics competency and other attributes.

Strengthen Administrator Support Requirements

Administrators play an important role in school-based professional development. “Principals’ attention and contribution strongly [affect] the importance that teachers [attach] to the new leadership roles” (Barth, 2007, p. 495). Administrators assigned to STREAM partner districts might be superintendents, building principals, and curriculum directors. This variation in position and an underdetermined role for the administrator contributed to communication breakdowns that affected school-based efforts. The Smallville cohort feared that their principal “was expecting something else,” and Prepmont felt their administration wasn’t “really even aware” of what was happening. Recommendation: participation in a “teach the teachers” professional development model should ensure strong and active administrative support and require clearly defined roles and assignments for both district and building administrators.

Engage Teachers in the Mathematical Practices

Instruction in how to meaningfully engage teachers with the Mathematical Practices is necessary in a “teach the teachers” model in order to avoid, as Russell (2012) said, using them as classroom wallpaper. The STREAM project’s professional development showed cohort members how to model the Mathematical Practices effectively while embedding them in content, and most were able to emulate this type of

instruction in their own classrooms – but not in school-based professional development. The school-based audience understood that the Mathematical Practices are important, but did not truly understand how to teach the practices to students or integrate the practices into content instruction. Russell (2012) warns that “we do not want [the Mathematical Practices] relegated to special sessions apart from core mathematical content” and that if taught well, “once introduced, the Standards of Practice will certainly continue to come up” (p. 52). Consequently, a “teach the teachers” model must “[focus] on how to meaningfully incorporate the Mathematical Practice Standards” (Davis, Choppin, Roth McDuffie, and Drake, 2013, p. 2). Recommendation: Professional development for implementation of the CCSSM should include strategies for choosing mathematics content and activities that support purposeful instruction of the Mathematical Practices.

Recommendations for Future Research

The following recommendations describe potential areas of study related to professional development in mathematics as it was examined in this study. As a relatively new construct, the “teach the teachers” model also serves as a rich focus for future research.

Cohort Collaboration

Future case study research should be aimed at discovering how attitudes, beliefs and abilities are related and contribute to cohort collaboration. How cohort members work together – whether passively assisting the cohort, collaborating within the cohort, or leading the cohort – and how those relationships affect school-based professional

development is not well understood. What levels of collaboration within a cohort are necessary to provide effective school-based professional development? If collaboration is weak within a cohort, what other factors are necessary to ensure the success of school-based professional development?

The Role of Leadership

The researcher entered this study with an assumption that cohort members would possess characteristics of teacher leaders and would have been in leadership roles previously. However, a few participants had never been leaders in their school or district, and many showed great apprehension at being given that role. How does a lack of previous leadership experience affect a teacher's school-based professional development role? Is it leadership experience or personal attributes that allow teachers to effectively provide professional development to peers? A study of cohort members in pre-established teacher leader roles compared to those with no previous leadership experience could be useful in answering these questions.

Transformation of Knowledge

If cohort members are able to transform professional development knowledge for delivery to a school-based audience, learning opportunities are created that might otherwise be impossible to achieve. However, when information is merely replicated at the cohort level, passing through the cohort is an unnecessary step in the "teach the teachers" model. Further research should examine what enables the transformation of knowledge in this model. What kinds of knowledge are better suited for transformation

vs. replication? What characteristics of a cohort improve the likelihood that knowledge will be transformed as it is passed on to a school-based audience?

Use of CCSSM Materials

Cohort teachers often referred to their classroom curriculum, their Common Core-aligned textbook, and the Montana Common Core Standards for Mathematics as if these three resources were interchangeable. As the Common Core Standards and related assessments are implemented in states, districts, and schools, curriculum developers and textbook companies will surely introduce additional materials to the market. What happens when teachers use such materials as a replacement for the actual standards document? Will they know how to transform textbook materials for their students, or will they dilute the fundamental messages of the Common Core standards and practices? Further research should explore how professional development can help teachers appreciate the differences between curriculum, textbook, and standards.

Effects on the School-based Audience

The teachers who received school-based professional development from their peers were not examined in this study. What effect did the professional development provided by the cohort have on their practice? What kinds of knowledge (e.g., knowledge of content, pedagogy, standards) were most effectively transmitted and received? How does receiving school-based professional development translate into classroom practice? Gathering data on the knowledge acquired and used by the school-based audience is the next step in establishing the effectiveness of the “teach the teachers” model. Without this

investigation, research on the transmission of knowledge, whether replicated, diluted, or transformed, may be of little consequence.

Longitudinal Study of the “Teach the Teachers” Model

The initiation and first stages of implementation of a “teach the teachers” model of school-based professional development was examined in this study. Ongoing research should continue beyond the life of the formal professional development of cohort members to better examine the longevity of school-based efforts. After formal professional development ends, does school-based professional development and school change continue, or is there a return to the familiar? Factors such as motivation, perseverance and continued collaboration should be considered in this study.

Lessons Learned

An important lesson learned during this research dealt with the use of Horizon Research Inc.’s “Local Systemic Change Professional Development Observation Protocol” (see Appendix C). The researcher had become familiar with the protocol while evaluating the STREAM project’s Launch Workshop. At this event, the observation protocol was used exactly as designed; the researcher collected observation data throughout the two-day event and confirmed the results of data analysis and interpretation by the STREAM external evaluator. In particular, the instrument’s holistic “capsule ratings” of specific professional development segments were useful for evaluating the STREAM Launch Workshop and for comparing each segment’s effectiveness.

The Horizon protocol was also used at each of the school-based events observed in this research study. The early sections of the protocol were used to effectively describe each event. The lists of “key indicators,” each of which received a rating on the observation protocol, were also very useful for focusing on particular aspects of observed activities. The researcher originally intended to use the full scope of the Horizon observation protocol but as school-based events unfolded, she found the holistic “capsule ratings” to be an ineffective means for fair comparison of school-based events. For example, a workshop event in one school district earned a capsule rating of three based on the protocol criteria and another school district earned a capsule rating of four, but because these events were so dissimilar a direct comparison could not be made. The use of holistic scoring for comparing teacher-led school-based professional development is problematic, as the nature of “teach the teacher” events varies widely based on context. Further research using this protocol could establish what adaptations are needed for its effective use in comparing different sites employing a “teach the teachers” professional development model.

Concluding Statements

The study findings suggest that the STREAM professional development project enabled teachers to facilitate school-based professional development that reached far more teachers than the STREAM project could have done alone. Cohort teachers successfully facilitated professional development for peers in their home districts. However, the nature and quality of knowledge transmitted to this audience varied across cohorts, and the school-based professional development offered by the cohorts was often

diluted in comparison to how the information was originally presented. The findings of this study suggest that the “teach the teachers” model can be improved to maintain the quality and depth of professional development as it is filtered through a school-based cohort. Professional developers should also identify constructs that avoid dilution and allow for more transformation of knowledge in school-based professional development. Although this study was conducted in the particular context of the STREAM professional development project and the Common Core State Standards for Mathematics, it provides encouraging results to support future use of a “teach the teacher” model for professional development.

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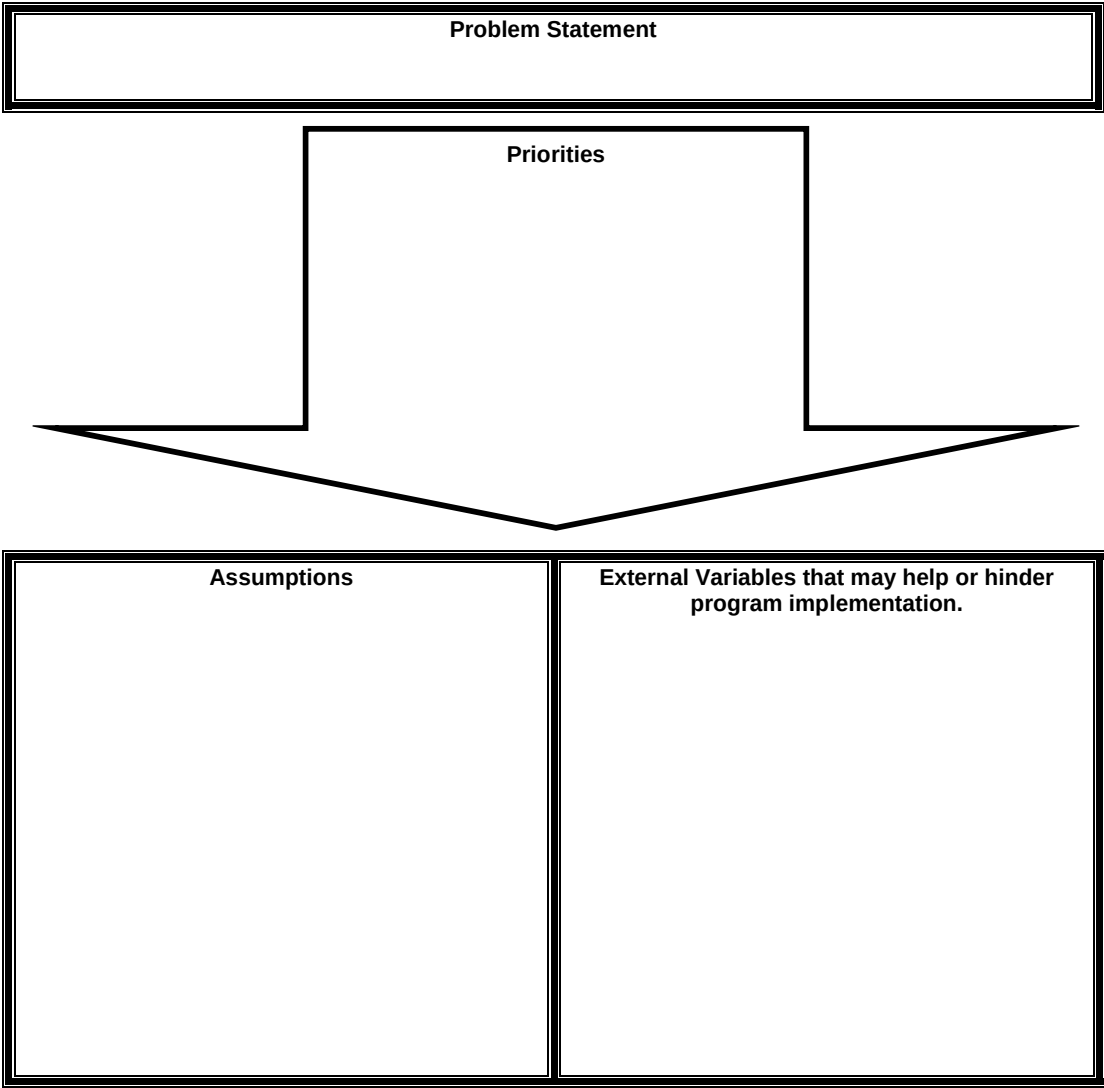
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APPENDICES

APPENDIX A

STREAM COHORT LOGIC MODEL TEMPLATE

Logic Model for *Cohort* STREAM Program



Logic Model Template for *Cohort* SD STREAM Project

Efforts & Activities ▶	Outputs/Products ▶	Outcomes ▶	Measures
Efforts & Activities ▶	Outputs/Products ▶	Outcomes ▶	Measures

APPENDIX B

STREAM COHORT STRATEGIC PLAN TEMPLATE

TEMPLATE: District X STREAM Project

Mission Statement:

Overview:

Timeline:

Budget:

Learning Designs: (One for each planned event)

WHY is this learning design worthwhile? HOW does it support dissemination?	HOW (and WHEN) will this learning design be implemented?	WHAT support is needed? (mentors, administrators, STREAM)	WHAT milestones have we set for success with this learning design? (measurable goals for evaluation)

APPENDIX C

OBSERVATION PROTOCOL

Cohort School-Based Event Observation Protocol

BACKGROUND INFORMATION

School/Pod: _____

Location: _____

Date of Observation: _____

Approximate Duration of Observation:

- ☐ 0-15 minutes
- ☐ 15-30 Minutes
- ☐ 30 minutes-1 hour
- ☐ 1-2 hours
- ☐ 2-3 hours
- ☐ Half day

Attendees: _____

SECTION ONE: CONTEXTUAL BACKGROUND AND ACTIVITIES

I. Event Demographics

- A. Describe the targeted grade level(s)/audience for this professional development event.
- i. This session was intended to improve the teaching of: (select all that apply)
 - ☐ Lower Elementary (K-2)
 - ☐ Upper Elementary (3-5)
 - ☐ Middle (6-8)

II. Other: _____ Event Context

Describe the session observed.

- ☐ This session is part of the district's professional development calendar.
- ☐ This session was during a pre-scheduled event.
- ☐ This session was specifically a STREAM-related event.
- ☐ There were multiple break-out sessions.
- ☐ Other (Please specify): _____

III. Session Focus

- A. Indicate the *primary intended purpose(s)* of this session based on the information provided by the cohort.
- ☐ 1. Increasing mathematics content knowledge of attendees.
 - ☐ a. Assessing participants' knowledge/skills
 - ☐ 2. Attention to classroom pedagogy
 - ☐ a. Learning about the CC Mathematics Practices

- b. Learning other pedagogical strategies
- c. Learning how to use technology in the classroom.
- 3. Addressing student learning
 - a. Understanding student thinking about mathematics content
 - b. Designing or scoring student assessments
 - c. Examining or scoring student work
- 4. Attention to curriculum.
 - a. Learning how to use specific instructional materials in the classroom
 - b. Learning about or how to use the CC learning progressions.
 - b. Considering issues of scope and sequence
- 5. Broad issues
 - a. Creating a vision of effective mathematics instruction
 - b. Considering issues of access, equity, and diversity
- 6. STREAM-related issues/ideas
 - a. Promoting/exploring the MCCSM
 - b. Promoting/exploring the CC Mathematical Practices
 - c. Involving administrators and personnel in CCSSM implementation
 - d. Attention to strategies/issues/roles of teacher leaders
 - e. Building collaboration among educators

7.. Other (please specify): _____ **Professional Development Activities**

A. Indicate the *major activities* of participants in this event

- 1. Listened to a formal presentation by:
 - a. Outside presenter (e.g. STREAM Mentor): _____
 - b. STREAM pod members: _____
 - c. Other: _____
- 2. Engaged in discussions/seminars/reporting out structured as:
 - a. Entire group led by presenter/facilitator
 - b. Entire group led by participant(s)
 - c. Subsets of the group discussed different issues.

Describe: _____

- 3. Engaged in problem solving or investigation activities focusing on content and/or pedagogy
- 4. Read articles about content and/or pedagogical issues
- 5. Watched videos about content and/or pedagogical issues

- 6. Analyzed teacher work or assessment from previous professional development session.
- 7. Discussed the content of the next professional development session
- 8. Other (Please specify): _____

SECTION TWO: OBSERVATION NARRATIVE

A. Describe the Event

B. Describe the mathematics being discussed.

C. Describe the pedagogy being discussed.

D. Describe the Professional Development Strategic Plan ideas being discussed.

E. Describe the broader issues being discussed.

F. Describe the STREAM-related materials being used or discussed (activities, protocols, readings, etc.).

G. Describe the STREAM-related content being discussed.

Theme 1 (MP & STEM):

Theme 2 (NSO):

Theme 3 (FRP):

Theme 4 (TLL):

Comments/Notes

Please provide any information you consider necessary to capture the activities or context of this event. Include comment on any feature of the meeting that is so salient that you need to get it “on the table” right away to help explain your ratings.

SECTION TWO: RATINGS

The key indicators in each section are rated from 1 (not at all) to 5 (to a great extent) with a category of “non-applicable” or “don’t know.” The key indicators are used to inform the Overall rating (1 to 5).

I. Design

		Not at all					To a great extent					Don't Know N/A	
		1	2	3	4	5						6	7
1.	The design of the session incorporated tasks, roles, and interactions consistent with a spirit of investigation.	1	2	3	4	5						6	7
2.	The instructional strategies and activities used in this session reflected attention to participants’ experience, preparedness, and/or learning styles.	1	2	3	4	5						6	7
3.	The session effectively built on participants’ knowledge of content, teaching, learning, and/or the reform process	1	2	3	4	5						6	7
4.	The strategies in this session were appropriate for accomplishing the purposes of the STREAM P.D.	1	2	3	4	5						6	7
5.	The design of the session reflected careful planning and organization.	1	2	3	4	5						6	7
6.	The design of the session included “framing” the activity to help participants understand the purpose of the session and where it fits into the larger staff development picture.	1	2	3	4	5						6	7
7.	The design of the session encouraged a collaborative approach to learning.	1	2	3	4	5						6	7
8.	The design of the session provided opportunities for teachers to consider classroom applications of resources, strategies, and techniques.	1	2	3	4	5						6	7
9.	Adequate time and structure were provided for “sense-making,” including reflection about concepts, strategies, issues, etc.	1	2	3	4	5						6	7
10.	Adequate time and structure were provided for participants to share experiences and insights.	1	2	3	4	5						6	7
11.	Adequate time and structure were provided for wrap-up.	1	2	3	4	5						6	7
12.	Ongoing assessment, formal/informal/summative/formative were embedded and informed the presentation.	1	2	3	4	5						6	7
13.	_____	1	2	3	4	5						6	7
OVERALL RATING: Design of the session reflected best practice for professional development		1	2	3	4	5							

Comments:

II. Implementation

		Not at all					To a great extent					Don't Know	
		1	2	3	4	5	6	7	N/A				
1.	Formal presentation(s) included in the session were carried out effectively.	1	2	3	4	5	6	7					
2.	The presenter(s)' contributions during the course of the session enhanced the quality of the session.	1	2	3	4	5	6	7					
3.	The presenter(s) effectively modeled exemplary instruction.	1	2	3	4	5	6	7					
4.	The presenter(s)' background, experience, and/or expertise enhanced the quality of the session.	1	2	3	4	5	6	7					
5.	The presenter(s) used formative assessment for flexible, adaptive design of the presentation.	1	2	3	4	5	6	7					
6.	The pace of the session was appropriate for the purposes of the professional development and the needs of adult learners.	1	2	3	4	5	6	7					
7.	The session modeled effective assessment strategies.	1	2	3	4	5	6	7					
8.	The participant interactions with each other and with presenter(s) enhanced the participants' understanding of the staff development topic.	1	2	3	4	5	6	7					
9.	The objectives were reasonable in the time frame.	1	2	3	4	5	6	7					
10.	Participants were actively participating in the session.	1	2	3	4	5	6	7					
11.	The participants were involved in collaborative learning and skill development.	1	2	3	4	5	6	7					
12.	The session effectively deepened participants' knowledge.	1	2	3	4	5	6	7					
13.	_____	1	2	3	4	5	6	7					
OVERALL RATING: Design of the session reflected best practice for professional development		1	2	3	4	5							
Comments:													

III. Content

		Not at all					To a great extent		Don't Know	N/A
1.	Content was appropriate for the purposes of the session and the backgrounds of the participants.	1	2	3	4	5	6	7		
2.	Content was sound and appropriately presented/explored.	1	2	3	4	5	6	7		
3.	Participants were intellectually engaged with important ideas relevant to the focus of the session.	1	2	3	4	5	6	7		
4.	Facilitator(s) displayed an understanding of the concepts being covered.	1	2	3	4	5	6	7		
5.	Depth and breadth of the content was appropriate for the purposes of the session and participants' needs.	1	2	3	4	5	6	7		
6.	Content was relevant and current.	1	2	3	4	5	6	7		
7.	Interactive learning opportunities were appropriately used to deepen participants' understanding.	1	2	3	4	5	6	7		
8.	Participants were provided opportunities to explore and discuss content.	1	2	3	4	5	6	7		
9.	Extent of "sense-making" of content was appropriate for the purposes of the session and the needs of adult learners.	1	2	3	4	5	6	7		
10.	The learning objectives were clearly stated and attained.	1	2	3	4	5	6	7		
11.	Participants left the session feeling more confident about using the MCCSM.	1	2	3	4	5	6	7		
12.	_____	1	2	3	4	5	6	7		
OVERALL RATING: Content was research-based and met rigorous academic standards.		1	2	3	4	5				

Comments:

IV. Exploring Pedagogy/Instructional Materials/Classroom Practice

		Not at all					To a great extent					Don't Know	
		1	2	3	4	5	6	7	8	9	10	11	12
1.	Depth and breadth of attention to student thinking/learning were appropriate for the purposes of the session and participants' needs.	1	2	3	4	5	6	7					
2.	Depth and breadth of attention to classroom strategies were appropriate for the purposes of the session and participants' needs	1	2	3	4	5	6	7					
3.	Depth and breadth of attention to instructional materials intended for classroom use were appropriate for the purposes of the session and participants' needs.	1	2	3	4	5	6	7					
4.	Facilitator(s) displayed an understanding of pedagogical concepts.	1	2	3	4	5	6	7					
5.	Facilitator(s) displayed an understanding of the Mathematics Practices.	1	2	3	4	5	6	7					
6.	Participants were intellectually engaged with important ideas relevant to classroom practice.	1	2	3	4	5	6	7					
7.	Extent of "sense-making" about classroom practice was appropriate for the purposes of the session and the needs of adult learners.	1	2	3	4	5	6	7					
8.	Participants left the session feeling more confident about using the instructional materials and Mathematics Practices.	1	2	3	4	5	6	7					
9.	Participants left the session with instructional strategies they could use in their classroom.	1	2	3	4	5	6	7					
10.		1	2	3	4	5	6	7					
OVERALL RATING: Exploration of pedagogy/instructional materials/classroom practice were reflective of standards for staff development and in accordance with the MCCSM.		1	2	3	4	5							

Comments:

V. Culture of the Professional Development Session

		Not at all					To a great extent					Don't Know N/A	
1.	Active participation of all was encouraged and valued	1	2	3	4	5						6	7
2.	There was a climate of respect for participants' experiences, ideas, and contributions.	1	2	3	4	5						6	7
3.	Interactions reflected collegial working relationships among participants	1	2	3	4	5						6	7
4.	Interactions reflected collaborative working relationships between facilitator(s) and participants.	1	2	3	4	5						6	7
5.	Participants were encouraged to generate ideas, questions, conjectures, and propositions that enhanced the learning of participants.	1	2	3	4	5						6	7
6.	Participants demonstrated a willingness to share ideas and take risks.	1	2	3	4	5						6	7
7.	Intellectual rigor was evident.	1	2	3	4	5						6	7
8.	Presenter(s) were comfortable interacting with the participants.	1	2	3	4	5						6	7
9.	The atmosphere was supportive.	1	2	3	4	5						6	7
10.	Respect for cultural and racial diversity was evident.	1	2	3	4	5						6	7
	Example observed:	1	2	3	4	5						6	7
11.		1	2	3	4	5						6	7
OVERALL RATING: Culture of the session facilitated engagement of participants as members of a professional learning community.		1	2	3	4	5							

Comments:

VI. Capsule Ratings of the Session

In this final rating of the session, consider all available information about the session, its context and purpose, and your own judgment of the relative importance of the ratings you have made. Select the capsule description that best characterizes the session you observed. Keep in mind that this rating is not intended to be an average of all the previous ratings, but should encapsulate your overall assessment of the quality and likely impact of the session. Please provide a brief rationale for your final capsule description of the session in the space provided.

- **Level 1: Ineffective Professional Development**

There is little or no evidence of participant thinking or engagement with important ideas of mathematics education. Session is *highly unlikely* to enhance the capacity of participants to provide high quality mathematics education or to be effective leaders of mathematics education in the district(s). Professional development appears to be either (select one below):

- **Passive “Learning”**

Session is pedantic and uninspiring. Participants are passive recipients of information; material is presented in a way that is inaccessible to or inappropriate for many of the participants.

- **Activity for Activity’s Sake**

Participants are involved in hands-on activities or other individual or group work, but it appears to be activity for activity’s sake. Session lacks a clear sense of purpose and/or a clear link to the conceptual development of participants.

- **Level 2: Elements of Effective Professional Development**

Session contains some elements of effective practice in professional development, but there are *serious problems* in the design, content, and/or implementation given the purposes of the session. For example, the content is presented in a way that would reinforce misconceptions or the pace is clearly too rapid for meaningful participant engagement. Overall, the session is *very limited* in its likelihood to enhance the capacity of most participants to provide high quality mathematics education or to be effective leaders of mathematics education in the district(s).

- **Level 3: Beginning Stages of Effective Professional Development** (Select one below.)

Professional development is purposeful and at times effective, but there are *weaknesses*, ranging from substantial to fairly minor, in the design, content, or implementation of the session. For example, participants’ expertise is not well-utilized; or participants are not given sufficient opportunity to reflect on what they are learning. Overall, the session is *somewhat limited* in its likelihood to enhance the capacity of participants to provide high quality mathematics education or to be effective leaders of mathematics education in the district(s).

- **Level 4: Accomplished, Effective Professional Development**

Facilitation is skillful and participants are engaged in purposeful work (e.g., investigations, discussions, presentations, reading) designed to deepen their understanding of important mathematics concepts; enhance their pedagogical skills and knowledge; increase their ability to use the designated instructional materials; or to enhance their leadership skills. The presenter(s) implement the professional development session well and participants’ contributions are valued, but adaptation of content or format in response to participants’ needs and interests may be somewhat limited. The session is *quite likely* to enhance the capacity of most participants to provide high quality mathematics education or to be effective leaders of mathematics education in the district(s).

- **Level 5: Exemplary Professional Development**

Facilitation is skillful, and participants are highly engaged in purposeful work (e.g., investigations, discussions, presentations, reading) designed to deepen their understanding of important mathematics concepts; enhance their pedagogical skills and knowledge; increase their ability to use the designated instructional materials; or to enhance their leadership skills. The session is artfully implemented, with flexibility and responsiveness to participant needs/interests. The session is *highly likely* to enhance the capacity of participants to provide high quality mathematics education or to be effective leaders of mathematics education in the district(s).

Please provide your rationale for the capsule rating:

APPENDIX D

INITIAL COHORT INTERVIEW QUESTION PROTOCOL

OPENING DIALOGUE TO THE PARTICIPANT:

I'm going to read through this dialogue to make sure that everything I need to say is said upfront.

Introduction:

Hi and thank you for allowing me to interview you today. Just to remind you, I am Kacey Diemert. I am a Doctoral student at MSU-Bozeman and am doing my dissertation research on how teachers process, share, and disseminate content knowledge and pedagogical practices learned through professional development. I'm specifically interested in how this is done when teachers (you) are provided with specialized knowledge of the Common Core State Standards for Mathematics in the areas of the Mathematical Practices and Teacher Learning and Leadership with specific attention to the domains of Number Systems and Operations and Fractions, Ratios, and Proportions. I am a facilitator of this discussion and will try to keep us on task and moving forward within this interview.

I will be taking notes during the interview but I don't want to miss, misinterpret, or misquote anything said, so with permission, the interview will be tape recorded as well as video taped so that I can assure that I'm transcribing what each person is saying correctly. (i.e. I want to make sure I know "who" said what as well as "what" is said) Hand out Consent The recorder can be turned off at any time if necessary. Because I am recording this conversation and will be transcribing it later, I ask that you speak up and that only one person talks at a time.

Everything said here is confidential. No personal identification of you, your students, or your school will be made public. None of your comments will be shared with your administrators or colleagues outside of this group. Transcripts of each interview will be made available to you if you request them. Additions, deletions, corrections, and clarifications of these transcripts are encouraged. Please be as candid and honest as possible and I will make sure that you have time to reflect before answering. If any questions are not clear, please stop and ask me to repeat, rephrase or elaborate on the question.

This is not part of the STREAM formal evaluation. General findings may be shared with the STREAM project and used in future presentations and publications.

NAME: _____ DATE: / / TIME: :

Focus Group Interview 1 (Around One Norm)

Ampleton: You represent a relatively large school district in the STREAM project in a larger area of Montana. The logic model created by your administrator and your performance on the online modules showed your motivation with respect to the STREAM project as well as towards the implementation of the CCSSM in your school district. For these reasons you were selected to be a part of this research project. Again, I'd like to thank you for being a part of it.

TwoTown: You represent a small cohort across two schools in two school district in the STREAM project in a rural area of Montana. The logic model created by your administrator and your performance on the online modules showed your motivation with respect to the STREAM project as well as towards the implementation of the CCSSM in your school district. For these reasons you were selected to be a part of this research project. Again, I'd like to thank you for being a part of it.

Riverview: You represent a cohesive unit within one school. The logic model created by your administrator and your performance on the online modules showed your motivation with respect to the STREAM project as well as towards the implementation of the CCSSM in your school district. For these reasons you were selected to be a part of this research project. Again, I'd like to thank you for being a part of it.

Discussion Protocol: Go Around One

We will be using the Go Around One discussion protocol. I will begin by asking you a prompt or question. Then each of you will have one minute to respond individually, working in a clock-wise fashion starting with the person on my left to respond. (We will change this direction mid-way through the interview so that the same individuals are not always speaking first and last.) After each of you has a chance to respond individually, I encourage you to respond to each other and to add to or clarify your own response. You have used this norm within the STREAM project before.

Purpose: Introductory prompts

1. To begin, could each of you tell me your name, what grade level and at what school you teach? Feel free to share some specifics about your classes and your students? *Look at person on left to begin.*

- Would you please share a little more about any special or unique duties or situations you have in your school?

2. I'd like to better understand the setting where you teach. What resources and structures in your district support your mathematics teaching?

- available resources, facilities, aides, team-teaching, common-planning time
- Tell me more about the existing support from other teachers, administrators, and parents within your school/district.

Purpose: Prompts addressing research questions

Before I begin asking you questions about it, I would like to define for you what I mean when I refer to specialized knowledge. Specialized knowledge refers to all of the knowledge needed for teaching. In this situation, specialized knowledge is the embedding of the Mathematical Practices while using and sequencing content in the specific CCSSM domains of Number Systems and Operations and Fractions, Ratios, and Proportions. This includes knowledge of how to create and manage learning communities in the professional workplace while making use of leadership, motivational, and accessibility skills.

1. What specialized knowledge do you identify as most valuable to support teaching with the Montana's Common Core Standards for Mathematics?

Mathematical Practices, Teacher Learning and Leadership, Number Systems and Operations, Fractions, Ratios, and Proportions.

- *(If list more than one)* Which of those that you listed do you find most valuable?
2. Can you provide an example of specific knowledge you've gained through STREAM professional development that you've found valuable in supporting teaching with the MCCSM?

3. What is the primary message you took away from the STREAM professional development experience about the Common Core?

Let's talk specifically about applying STREAM specialized knowledge next Fall.

4. What structures, either within your school or that STREAM has or will provide, do you expect to find most valuable in supporting the dissemination of your specialized knowledge?
 - What factors do you think might influence your ability to share or disseminate your specialized knowledge of the MCCSM?
 - Can you give me one positive factor and one negative factor that you foresee as influencing this process?
 - *Positive factors – admin. Support, STREAM cohort within the school, existing MCCSM resources & activities, positive attitude about MCCSM*
 - *Negative factors – time, competing priorities, negative attitudes, lack of leadership or focus*
 - What supports, needs or barriers do you think might influence your ability to disseminate STREAM materials within your school/district?
 - Can you tell me about the existing resources or barriers in your school?
 - After strategic planning, do you have any resources or barriers that you expect will influence this process?
5. Is there anything else you could tell me to further describe how you feel about sharing and disseminating your specialized knowledge about the Common Core?

Purpose: Setting up data collection for Fall

6. Can I ask one of you to be a recorder for your group? This person would create “minutes” for each of your cohort meetings and other events that occur with relation to implementation and dissemination within your school/district next Fall. (*Note to self: Share Google doc folder – get email*)
7. I would like to attend and observe your first cohort meeting back in your district. This may be before or after school starts in the Fall - you'll know this date by the end of this week. Will it be alright if I attend?

I realize that some people participate more than others in a focus group. I want to be sure that I've captured all of your thoughts. I will email you the questions we just discussed, so you can expand on your comments if you'd like. I will send these to you tonight. If you want to add to your response, please reply by Friday, July 19th.

THANK YOU!

I'd like to say again that everything you shared here today is confidential. No names, personal identification of you, your students, or your school will be made public. None of your comments will be shared with administrators or colleagues outside of this group. This is not part of the STREAM formal evaluation, although the general findings may be shared with the STREAM project and used in future presentations and publications. Transcripts of each interview will be made available if you request them. Additions, deletions, corrections, clarifications are encouraged.

APPENDIX E

ADMINISTRATOR INITIAL INTERVIEW QUESTION PROTOCOL

NAME: _____ DATE: / / TIME: : _____

Administrator Interview 1

Purpose: Prompts to address research questions.

I've reviewed the logic model you've created with the STREAM evaluator. It really helped me envision your district's current status and progress with the MCCSM. Most of these questions are very similar to the ones we've just discussed over dinner but I'd like to hear more in your own words:

1. At this point, how would you characterize your district's current status and progress in implementing the MCCSM?

After some information has been provided from the administrator, bring out the OPI stages handout and ask them:

- Where would you place your school on this continuum created by the Montana Office of Public Instruction?
2. *Based on the administrators logic model,*
 - You've identified ____ as an external variable that will help program implementation. Can you discuss a little more about why this variable will help implementation?
 - You've identified ____ as outcomes of participation in the STREAM project and implementation of the CCSSM in your district. Can you discuss how your school is working towards these outcomes outside of STREAM?
 - Could you tell me more about the process of building your logic model and your choices and decisions you made along the way?
 3. After spending the day with your seed teachers, would you describe your strategic planning progress and how you see it playing out?
 - Can you describe some factors that you foresee as influencing this school-based dissemination process?
 - Would you share what you see as your role in this process?
 4. At the end of the fall semester, I would like to interview you again to follow up on how your district's logic model has changed or stayed the same during the initial enactment of the STREAM strategic plan in your school/district. May I contact you in October or November to arrange for this interview?

THANK YOU!

I'd like to say again that everything you shared here today is confidential. No names, personal identification of you, your students, or your school will be made public. None of your comments will be shared with administrators or colleagues outside of this group. This is not part of the STREAM formal evaluation, although the general findings may be shared with the STREAM project and used in future presentations and publications. Transcripts of each interview will be made available if you request them. Additions, deletions, corrections, clarifications are encouraged.

APPENDIX F

MENTOR INITIAL INTERVIEW QUESTION PROTOCOL

NAME: _____ DATE: / / TIME: :

Mentor Interview 1

Purpose: Feasibility of the Strategic Plan

1. To begin, could each of you tell me your name, what grade level and at what school you teach? Feel free to share some specifics about your classes and your students?
Look at person on left to begin.
 - Would you please share a little more about any special or unique duties or situations you have in your school?
2. What role did you play as a mentor to your cohort last year?
3. Tell me about the strategic planning process you just went through with the district.
 - How did your cohort engage in the strategic planning process?
 - Highlight for me your cohort's key activities for next Fall.(Dissemination)
 - How will other teachers in the district be involved in the process?
4. Please comment on the feasibility of your cohort's strategic plan. This is confidential, but I'd like to hear your impressions as a somewhat objective observer.
5. What role do you expect to play in the enactment of your cohort's strategic plan?
 - How will you participate in district activities?
 - How will you support your cohort from outside?
6. Assuming the strategic plan is successfully enacted, what outcomes do you envision in your cohort district?

THANK YOU!

I'd like to say again that everything you shared here today is confidential. No names, personal identification of you, your students, or your school will be made public. None of your comments will be shared with administrators or colleagues outside of this group. This is not part of the STREAM formal evaluation, although the general findings may be shared with the STREAM project and used in future presentations and publications. Transcripts of each interview will be made available if you request them. Additions, deletions, corrections, clarifications are encouraged.

APPENDIX G

COHORT MEMBER REFLECTION INTERVIEW QUESTION PROTOCOL

NAME: _____ DATE: / / TIME: :

Follow-up/Expectations Interview Protocol - Teacher

OPENING REMARKS:

I'm going to read through a set of instructions before we begin.

Introduction:

Hi and thank you for allowing me to interview you today. Just to remind you, I am doing my dissertation research on how teachers process, share, and disseminate content knowledge and pedagogical practices learned through professional development. I'm specifically interested in how this is done when teachers (you) are provided with specialized knowledge of the Common Core State Standards for Mathematics in the areas of the Mathematical Practices, mathematics content, and teacher leadership.

I will be taking notes during the interview but I don't want to miss, misinterpret, or misquote anything said, so with permission, the interview will be audio and video recorded so that I can assure that I'm transcribing what you're saying correctly. The recorder can be turned off at any time if you wish. Do I have your permission to record?

Everything said here is confidential. No personal identification of you, your students, or your school will be made public to the best of my ability. Transcripts of each interview will be made available to you if you request them, and you can make additions, deletions, corrections, and clarifications to your comments if needed. Please be as candid and honest as possible and please take time to reflect before answering. If any questions are not clear, feel free to ask me to repeat, rephrase or elaborate on the question.

This interview is not part of the formal evaluation of the STREAM project.

General findings may be shared with the STREAM project and used in future presentations and publications. The results, including quoted material from this interview will be published in my dissertation and possibly in other publications in the future.

I'd like to define two terms before we begin. First, throughout the interview I will refer to Montana's Common Core Standards for Mathematics as the "MCCSM." Second, I will often refer to "dissemination," which in this interview means sharing the specialized knowledge of the MCCSM that you've gained through the STREAM project.

If you have no questions, let's begin.

NAME: _____ **DATE:** / / **TIME:** :

Proposal: “encourage participants to reflect on the process and success of enacting their strategic plan during the first half of the school year. Questions will focus on identifying factors that either helped or hindered the process of implementation and dissemination of professional knowledge about the CCSSM.”

First for the record, please state your **name** and the school district where you teach.

STREAM School-Based Dissemination

Even though I may have attended, I’d like to hear about what I’ll call your “launch event.” Can you please describe the very first event you had in your district as part of the STREAM implementation of the CCSSM, from the planning phase to execution? I’m interested in how you planned for it, how you chose certain topics and activities, who attended, and how it went.

- What was your role in the launch event?
- What challenges did you encounter during this event?
- What influenced the way you chose to structure this event?
- Did you use any particular STREAM activities or materials during this event? Why?
- Did you meet after the event to reflect on how the event went? What did you discuss?

Now let’s look beyond the launch event. As part of your STREAM implementation plan, you probably have continued to engage in professional learning with your peers throughout the year. This may have been formal or informal, and carried out as a cohort or individually. I’d like to hear about the other events related to professional learning that you and your cohort have facilitated with peers since the launch event.

- What types of professional learning have you facilitated for peers?
- What roles did you play in these events?
- Describe specific STREAM project content that you’ve shared with peers this year
 - How was this material useful or valuable in helping your peers use the MCCSM?
- Was it difficult to organize another event after the launch? Why?
 - Why was there such a long gap between your first event and the next event?

The STREAM project views you as a leader in MCCSM implementation. Do you feel that STREAM provided ample structure to support dissemination of the CCSSM in your school?

- Did STREAM adequately prepare you with specialized knowledge of the MCCSM?
- Did STREAM adequately support your cohort's school-based efforts? If not, what did you need?
- How would you describe the administrative support you had for this event?

We've been talking mostly about logistics so far – let's shift now to the *purpose* of the professional development you facilitated this year. What is the primary message you've tried to convey to your colleagues about Montana's Common Core Standards for Mathematics?

- What goals did you set for your school-based STREAM professional development?
- Do you think you achieved those goals? How do you know?
- STREAM's professional development emphasized mathematics content through problem solving tasks and analysis of student work. It appears you decided to concentrate on _____ (the mathematics practices, instructional tools, the learning progressions, etc.) _____ instead of focusing more on mathematics content. What led you to that decision?

Let's move on to look at some specific examples. I'd like to hear about a particularly *successful* episode or event you recall related to your STREAM activities this year.

- Why do you think this event was successful? What factors contributed to its success?
- What other successes do you want to mention?

Along with stories of successful activities in your district, I'm sure you've also encountered *challenges* during this year of standards implementation. What obstacles have you encountered in your dissemination efforts this year?

- (If "time" is mentioned): Please elaborate. How has time or scheduling affected your efforts?
- What other challenges do you want to mention?

Overall, has the process of disseminating information about the MCCSM in your district been easier or harder than you expected?

- What in particular made it easier/harder?

You'll soon be creating a Strategic Plan for school-based activities in Year 3. As you look ahead to next year, do you think engaging your colleagues in learning about the MCCSM will be easier or harder than this year? Why?

- What kinds of changes or adaptations would your cohort make in planning for next year?

Thank you for looking back and looking ahead with me. Now I'd like to revisit a question from our focus group interview. At the Summer Academy, I asked you to describe the primary message you took away from STREAM professional development regarding the MCCSM. Last July you said _____. At this point in time, how would you reconfirm, change, or add to your statement?

- **Pamela:** "It's a culture change, it's a cultural shift."
- **Roxanne:** "Collaboration."
- **Teresa:** "Depth not breadth."
- **Zachary:** NONE – not in the focus group interview
- **Fay:** It's "totally necessary...this would make it a more fluent education" with "the same expectations....We're not trying to cram so much in."
- **Brad:** "The most important thing I can do is share my knowledge with everyone at my school...we can't rely on anybody else, I have to just step up to the plate with my partner teacher here and we have to share as much as we can...We need to just take the ball and run with it....Hopefully teachers will accept that and take and pick and choose what they can or want to."
- **Carol:** Because of the same "set of expectations" across the nation "it's going to help the students as well as the teachers," particularly transient students
- **Jill:** "If you're going to do it, do it right. From the progressions to the practices and the content."
- **Kim:** "It has to be all or none."

Leadership and Change

The final part of this interview deals with teacher leadership. Let's begin by reflecting on other experiences you've had with teacher-led professional learning. How does STREAM compare to those other experiences?

- Have you been in other situations where teachers led or facilitated the learning?
- What are the advantages or disadvantages of learning from your peers?

It's not unusual for particular people in schools to be recognized as leaders. Who do you see as a leader in your school? Do you consider yourself a leader in your school? Why?

- Why did you apply (or why were you chosen) to be a Seed Teacher for the STREAM project?
- Have you been in the role of teacher leader in other projects? If so, please describe your role.

Would others say you are considered a resource regarding MCCSM for teachers in your school?

- (If yes): What led to this identification?
- Has any teacher used you as a resource? If so, how? If not, why?

Change in schools certainly doesn't happen overnight, and possibly not even in the months you've been working with your STREAM cohort. But you may have observed some changes happening with your colleagues and in your school. What changes have you seen among the teachers in your school this year with respect to Montana's Common Core State Standards for Mathematics?

- Can you attribute these changes to your dissemination efforts?
 - What other factors may be influencing change in your school?
- What percentage of your teachers would you estimate are committed to fully implementing the MCCSM in their classrooms?
 - What kind of evidence suggests that teachers are implementing MCCSM?

THANK YOU! I appreciate the time you've put into this interview. Is there anything you'd like to add? (Give plenty of wait time....) If not, I want to confirm that what you've shared here today will be kept confidential. No names or personal identification of you, your students, your colleagues, or your school will be made public. Your specific comments will be accessible only to me and my advisor, although my general findings may be shared with the STREAM project and used in future presentations and publications. Do you have any questions? (Wait time....) Thank you again!

Ampleton:

Do you think that having one teacher represented from each school was the most effective way to provide this professional development to your district?

Is there a disparity between different schools as to how much effort has been put into implementation of the Common Core Mathematics Standards? Yes: Can you provide me some insight into why that is?

There was a long break between the Launch event and the learning cadre formations, what types of dissemination occurred at your school during this time? Why did this span of time go largely un-used? What could have been done to make this time more meaningful?

Roxanne:

You were identified by multiple teachers during one of my recent observations as a teacher who is trying new things and who has shared that effort during staff meetings. Do you naturally share your practice with others or were you asked to share what you were doing?

You're a young teacher and in our first interview you said: "I'm a baby teacher and this is a pretty big thing to be involved in... (that you wanted to) be a good resource to these people that I'm going to go disseminate this information... I'm still kind of new and I want to be able to present myself, you know, where I can have that ability to make myself heard" Do you still feel like you're working to make yourself heard? If so, do you still feel like that's because you're fairly new to teaching?

Who in the STREAM Ampleton cohort was irreplaceable during this dissemination? (i.e. Could we have chosen other people and gotten similar results?)

Pamela:

During the focus group interview last July, you discussed and were very excited about your sneak PIR in May, is that still happening?

During that interview, I noticed that you were really needing for an introduction from your administration. You said, "if somebody introduced what we were doing ahead of time, I would feel better about disseminating rather than, 'Oh my gosh, there's Pamela, she's been doing another workshop'" Tell me a little bit about that comment. Do you go to a lot of workshops and if so, do you think that your colleagues have somehow devalued information you've given them because you have been to a lot of workshops?

Did you get that type of support from your administration?

Who in the STREAM Ampleton cohort was irreplaceable during this dissemination? (i.e. Could we have chosen other people and gotten similar results?)

Teresa:

You've described yourself as "the rebel in our group, and not afraid to question administrators." First tell me what you meant by you being the rebel.

Since you are a self-described rebel, tell me something others may not say about this whole dissemination process.

Because you are not afraid to question administration, how has the administrator support truly been during this project?

Who in the STREAM Ampleton cohort was irreplaceable during this dissemination? (i.e. Could we have chosen other people and gotten similar results?)

Smallville:

For many of my observations, you've met with your teachers over a lunch hour, do you believe that the short time frame (30 minute lunch times, etc.) is enough time to truly help your teachers understand and implement the Common Core Mathematics standards and practices?

Do you think that you could have provided this P.D. without Fay/Zachary? Why or why not?

How does the administration in your district view the progress made STREAM teacher in sharing MCCSM knowledge this year?

Do you have any knowledge/feeling for what the expectations were for STREAM Seed Teachers?

Zachary:

Describe the primary message you took away from STREAM professional development regarding the MCCSM.

Fay:

How did you think that facilitation went when Zachary wasn't there to assist?
OR Can you tell me about the P.D. when Zachary wasn't there?

Prepmont:

You are an interesting group because you started early sharing with your peers. Is sharing commonplace in this school?

Where did the idea for this 2-hour rotational P.D. structure come from?

Why did you begin this dissemination early? (in the Spring...)

Do you think you could have provided this P.D. without Carol/Brad? without Consultant Carlene? Why or why not?

Brad:

During the focus group interview you said "The most important thing I can do is share my knowledge with everyone at my school. We can't rely on anybody else. I have to just step up to the plate with my partner

teacher here and we have to share as much as we can in the best way possible.... Its gotta be us and I don't know everything but I'm going to share what I know." Why do you feel such a strong drive to share with your colleagues?

Carol:

During the focus group interview you said that many of the teachers in your school "think it's a two hour process to realign the whole curriculum" and that "we need to have a uniform understanding" of the Common Core and that "they need to have exposure" to know how much is changing, that "Before we can really get going, they need to really know what's going on." Do you feel like you've gotten that message across?

Riverview:

There was a long break between the Launch event and the formation of the mathematics focus groups, what types of dissemination occurred at your school during this time? Why did this span of time go largely un-used? What could have been done to make this time more meaningful?

Why did it take so long between your launch event and the next STREAM P.D. event?

Was Principal Iverson's guidance/leadership a support or a barrier for your efforts towards helping your peers with the Common Core?

Do you feel like you and Jill/Kim are working well within the confines that Principal Iverson has set forth?

After the first Mathematics focus group event, when Principal Iverson joined our conversation, we discussed a need identified by multiple teachers, with the absence of a chosen text, to help them identify valuable resources and how to adapt these resources to best suit their needs. Principal Iverson implied that teachers should already be doing this and therefore no gain would be made in facilitating this. Do you think he still feels that way?

Do you think you could have provided this P.D. without Jill/Kim? Or with someone else? Why or why not?

Kim:

During the focus group interview, you expressed a lot of apprehension towards working with your colleagues, you said you were comfortable with your team,

sharing with Jill, and with certain other teachers but in general terms you used the word fear and said, "I just don't want to come in and you know here we are standing in front and people thinking 'psh are you' giving me that look and you know 'I don't really care what you're saying' or um yeah um, 'who made you the queen of common core' you know I don't, I am so afraid of that or if I say something wrong..." Do you still feel that pressure?

Principal Iverson has tried to make sure that you and Jill are not identified as leaders of this change to try to alleviate some of that pressure, has that worked?

I know that you've worked with a group of particular teachers who are resistant to implement the Common Core mathematics standards, can you describe that a little bit for me? How is that going?

Jill:

During the focus group interview, you said, "there's a lot of people on staff that if they found out I was going to come watch them, I mean, they would flat out refuse." After organizing and having run through multiple days of your mathematics focus group lesson observations, do you still feel like that's true?

APPENDIX H

ADMINISTRATOR RELECTION INTERVIEW QUESTION PROTOCOL

NAME: _____ DATE: / / TIME: :

Follow-up/Expectations Interview Protocol – Admin.

At this point in time, how would you characterize your district's (or school's) current status and progress in implementing Montana's Common Core Standards for Mathematics?

STREAM Seed Teachers in your district are charged with creating opportunities to share their knowledge of the MCCSM with their colleagues. I'd like to hear your description of the various events that have occurred this year related to this goal.

- What kinds of activities took place related to sharing knowledge of MCCSM?
- In your opinion, have the STREAM Seed Teachers have been effective in meeting their goal?
- Describe factors that may have enhanced or hindered this school-based dissemination process.

What are your goals or expectations for continued implementation in the coming year?

- What expectations do you have for STREAM Seed Teachers going forward? For other teachers?
- How do you view your ongoing role as an administrator in the MCCSM implementation process?

THANK YOU! I appreciate the time you've put into this interview. Is there anything you'd like to add? (Give plenty of wait time....) If not, I want to confirm that what you've shared here today will be kept confidential. No names or personal identification of you, your students, your colleagues, or your school will be made public. Your specific comments will be accessible only to me and my advisor, although my general findings may be shared with the STREAM project and used in future presentations and publications. Do you have any questions? (Wait time....) Thank you again!

Ampleton:

You selected one STREAM Seed Teacher to represent each elementary school in your district. How did this arrangement enhance or hinder opportunities to engage all teachers in professional learning about Montana's Common Core Standards for Mathematics?

Your district's STREAM launch event took place early in the summer, followed by a rather long stretch of time before the learning cadres were formed and started their activities.

- Did other types of MCCSM training take place in your schools during this time?
- What might account for the break in dissemination activity following the launch event?
- What could STREAM, the Seed Teachers, or others have done to encourage a more continuous calendar of activities?

Smallville:

In your opinion, how does the administration in your district view the progress made by STREAM teachers in sharing MCCSM knowledge this year?

- What were the expectations for STREAM Seed Teachers? Were those expectations met?

What do you think would have helped the Seed Teachers more effectively reach their peers?

- Ex: stronger communication, larger cohort of Seed Teachers, more buy-in from colleagues, more support from administrators, different kinds of activities

In Smallville, it seemed that relatively short time periods were allotted for professional learning and working with the MCCSM. (30 minute lunch times, etc.) Is this adequate time to strengthen teachers' knowledge of the MCCSM using STREAM materials? Why or why not?

Prepmont:

Your STREAM cohort quickly developed a very effective dissemination strategy of rotating the staff through a series of workshops. Is school-based professional learning a common practice in your district?

- If so, please give examples of school-based learning experiences that have occurred.

Your STREAM Seed Teachers launched their dissemination efforts last spring while they were still in the midst of their own professional development. What factors do you think made this possible?

- What could other districts learn from your example about effective and efficient school-based professional learning?

Riverview:

Your district's STREAM launch event was followed by a rather long stretch of time before the mathematics focus groups were formed and started their activities.

- Did other types of MCCSM training take place in your schools during this time?
- What might account for the break in dissemination activity following the launch event?
- What could STREAM, the Seed Teachers, or others have done to encourage a more continuous calendar of activities?

Recall that after the first mathematics focus group event, we discussed how a number of teachers wanted help in identifying high-quality resources for MCCSM and adapting these resources to best suit their needs. My perception was that you believed teachers should be accustomed to doing this; therefore this would not be an appropriate emphasis in the focus groups. Is my perception correct?

APPENDIX I

PREPMONT MID-NOVEMBER MEETING AGENDA

Bring:

- MP Anchor Charts
- MAP informed lesson idea/results
- Math Notebooks
- Envisions planning materials

Aligning Curriculum with Montana Common Core Mathematical Content Standards

Wednesday, November 13, 2013

4-6 will meet 8-10:30; K-1 will meet 10:45-1:15; and 2-3 will meet 1:30-4.

How will we know if each student is learning the essential mathematical skills, concepts, understandings, and dispositions to be successful?

Anyone who has never made a mistake has never tried anything new. Albert Einstein

Goals:

Improve student engagement in math by constructing a solid foundation of common knowledge about the Mathematical Common Core

- Describe how to make the 8 Mathematical Practices student friendly
- Experience a mathematical practice
- Describe the importance of common formative assessment
- Align Envisions lessons and assessments with the MCCSM and MAP goals
- Share planning progress, lesson results and fresh ideas

Admit Reflection:

- Be ready to share several math goals you set for your students based on MAP data
- How do you plan to modify instruction to meet these goals?

(15 minutes)

Opening (Brad)

- Goals and Agenda
- Share admit reflections
- Share results of lessons you have or plan to modify

(20 minutes)

Review 8 Mathematical Practices (Carol)

- Share Anchor Charts created with students
- How are you referring to and using these in the classroom

(10 minutes)

Mathematical Practice Game/Activity (Brad)

- Game/Activity
- Identify how game engages students in one or more of the mathematical

practices

(30 minutes)

Common Assessments (Consultant Carlene)

- Text-based questioning: What are common formative assessments and why use them?
- Jigsaw readings – 2 color highlight
 - What does it do for the teacher? What does it do for students?
 - Pair/share
- Create an anchor chart

Pacing Guide/Curriculum Map

- Template
- Identify priority standards
- Lessons/adaptations
- Mathematical practices
- Assessments

(60 minutes)

Aligning Envisions Curriculum

- Collaborate with grade level partners
- Use the data to inform planning

(15 Minutes)

Planning Share Out

- Explain how you plan to modify an Envisions lessons, what MP are incorporated
- Describe the common assessment you will administer

Closing

- Next meeting Wednesday, January 15; please bring:
 - Results of a lesson, ready to explain how it incorporated the MPs
 - Student work from one common assessment to analyze
 - Notebooks; Envisions Topic planning materials

Volunteer to bring a lesson/game/activity to share?