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IMPACT OF LESSON STUDY ON TEACHERS' BELIEFS, PROFESSIONAL
KNOWLEDGE, COLLABORATION, AND INSTRUCTIONAL PLANNING

by

Megan Houtchens

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Abstract

The purpose of this qualitative action research study was to create a lesson study framework that content and grade level teams of teachers can use to develop and implement their own professional learning connected to student learning goals over the course of a school year. The knowledge claim (McNiff, 2017) for this study is lesson study will result in changes in teachers' knowledge and beliefs about their content, pedagogy and student learning, in teachers' collaborative capacity, and in the teaching and learning resources that are used to support student thinking (Lewis et al., 2009). Three teams of content specific teachers engaged in one cycle of lesson study. Data collection was done using direct observation through researcher participation, field notes, lesson study protocols, a Pre-Lesson Study Questionnaire, and semi-structured interviews with teachers. The findings from this study indicate lesson study provides a framework for teachers to connect professional learning to problems of practice directly connected to their classrooms. Collaboration through lesson study gives teachers the opportunity to dig deep into their own content knowledge, students' content knowledge, and their pedagogy to create teaching and learning resources that elicit student thinking. It also reveals barriers to instruction that may need to be addressed to effectively support teachers. Skilled facilitation emerged as a necessary component for effective implementation of lesson study. Additional cycles of lesson study over longer periods are time are recommended to determine the long-term impact of lesson study on teacher and student learning.

Table of Contents

Chapter One: Introduction	9
Culture of Teaching	11
Lesson Study	12
Statement of the Problem	14
Research Question	15
Conceptual Framework	16
Definitions of Key Terminology	19
Limitations and Delimitations	21
Significance	22
Chapter Two: Literature Review	24
Professional Development vs. Professional Learning	24
Instructional Leadership	27
History of Lesson Study	29
Lesson Study	32
Research and Develop Student Learning Goals	33
Plan the Research Lesson	33
Conduct the Research Lesson	34
Reflect Revise the Research Lesson	34
Conceptual Framework	35
Teachers' Knowledge and Beliefs	36
Teachers' Professional Community	38
Teaching and Learning Resources	39
Summary	40
Chapter Three: Methodology	41
Setting	43
Participants	45
Action Research Process	47
Observation/Plan	47
Plan Research Lesson	48
Act/Observation of Research Lesson	50
Evaluate/Reflect and Modify	50
Data Collection	52
Data Analysis	56
Trustworthiness	58
Researcher Positionality	58
Limitations	59
Chapter Four: Results	61
Theme 1: Teacher Knowledge and Beliefs- Content	63
Theme 2: Teachers' Knowledge and Beliefs- Pedagogy	69
Theme 3: Teachers' Professional Community- Collaboration	75
Theme 4: Teaching and Learning Resources	79
Theme 5: Role of the Facilitator	89
Theme 6: Barriers	93
Assertions	96

Chapter Five: Discussion	100
Assertion 1: Safe Learning Environment for Teachers	100
Assertion 2: Impact of Direct Observation of Student Learning	102
Assertion 3: Teachers' Shared Responsibility	102
Assertion 4: Instructional Resources	103
Assertion 5: Facilitation of Teacher Empowerment	104
Assertion 6: Barriers	105
Implications for Building Principals	109
Recommendations	113
Suggestions for Future Research	115
Reflection	116
Conclusion	117
References	118
Appendix A: Teaching and Learning Cycle	127
Appendix B: Pre-Lesson Study Questionnaire	128
Appendix C: Interview Protocol	130
Appendix D: Norm Setting Guide	134
Appendix E: Lesson Study Roles	135
Appendix F: Lesson Study Meeting Agenda	136
Appendix G: Research Lesson Protocol	137
Appendix H: Research Lesson Observation Protocol	143
Appendix I: Revised Research Lesson Observation Protocol	144
Appendix J: Norms for Observation	145
Appendix K: Post Lesson Discussion Protocol	146
Appendix L: Team Log Post Debriefing	147
Appendix M: Lesson Study Reflection Protocol	148
Appendix N: Lesson Study Final Report	149
Appendix O: Questionnaire/Interview Response Matrix	151
Appendix P: Axial Coding Spreadsheet	153

List of Tables

Table 1: Comparison of recommendations for professional learning	9
Table 2: Participant experience and highest level of education	46
Table 3: Team learning goals	48
Table 4: Data collection sources	53
Table 5: Teaching and learning resources developed by teacher teams	84
Table 6: Themes, descriptive characteristics, and assertions	96

List of Figures

Figure 1: Conceptual framework	17 and 62
Figure 2: Instructional improvement through lesson study	18 and 62
Figure 3: Revised Conceptual Framework	109

CHAPTER I: INTRODUCTION

The number one factor impacting the effectiveness of a school is the effectiveness of classroom teachers (Marzano, 2007). In fact, the effectiveness of the classroom teacher has serious implications for student achievement. Students with teachers who are considered effective have gains in achievement that are one-third to one-half a standard deviation higher than students who have an ineffective teacher (Nye, Konstantopoulos, & Hedges, 2004). In 1996, the National Commission on Teaching and America’s Future published a report emphasizing teacher effectiveness as “the most important influence on what students learn” (p. vi) and making the claim that “school reform cannot succeed unless it focuses on creating the conditions in which teachers can teach and teach well” (p. vi). The report included specific recommendations for effective professional learning for teachers. Fast forward thirteen years to 2009 and the National Staff Development Council sponsored another report detailing characteristics of effective professional learning for teachers (Darling-Hammond, Wei, Andree, Richardson, & Orphanos, 2009). The recommendations are almost identical. These two sets of recommendations are listed in Table 1.

Table 1

Comparison of Recommendations for Effective Professional Learning in 1996 and 2009.

<p>What matters most: Teaching for America’s Future (National Commission on Teaching and America’s Future, 1996)</p>	<p>Professional learning in the learning profession: A status report on teacher development in the United States and Abroad (Darling-Hammond et al., 2009)</p>
<p>Has the goal of improving student learning at the heart of every school endeavor</p>	
<p>Fosters a deepening of subject matter knowledge, a greater understanding of learning and a greater appreciation of students’ needs</p>	<p>Focused on student learning and the teaching of specific content</p>

Table 1 (continued)

Provides adequate time for inquiry, reflection and mentoring, and is an important part of the normal working day	Ongoing, intensive and connected to practice
Is rigorous, sustained, and adequate to the long term change of practice	
Is site-based and supportive of a clearly articulated vision for students	Aligned with school improvement priorities and goals
Is teacher designed and directed, incorporates the best principles of adult learning theory, and involves shared decisions designed to improve the school	Builds strong working relationships among teachers

Unfortunately, despite these recommendations, the current model of professional development for teachers in the United States is woefully lacking when it comes to increasing teacher effectiveness. A study of 10,000 teachers in three school districts in the United States, found that despite spending an average of \$18,000 per teacher per year on professional development, there is little improvement in teacher effectiveness (Jacob & McGovern, 2015). For the small number of teachers that did improve, it was not possible to link to specific strategies that led to the improvement (Jacob & McGovern, 2015). Teachers in the United States report attending professional development that is not connected to the realities of their classrooms, having little or no influence over the content of their professional development, engaging in traditional forms of professional development like one-time workshops or conferences, collaboration with colleagues that is often not connected to curriculum planning and issues of student learning, and little to no financial support to explore professional learning opportunities beyond what is offered through their school districts (Darling-Hammond et al.,

2009). Most teachers in the United States experience professional development as something done to them on in-service days rather than ongoing professional learning connected to their content, and to student learning.

Culture of Teaching

Why has there been so little change in professional development for teachers in the United States over the last two decades? Teaching is a cultural activity, meaning it is difficult to observe objectively by those who are part of the culture (Stigler & Hiebert, 1999). Most people in the United States have a “script or a mental picture of what teaching is like” (Stigler & Hiebert, 1999, loc. 1047). Through the analysis of videotaped lessons in Japan, Germany, and the United States, Stigler and Hiebert (1999) have concluded that lessons in each country have their own unique structure that is present in every lesson observed for that country. This structure is not something explicitly taught through teacher preparation programs (Stigler & Hiebert, 1999). It is something that teachers develop because of their participation in that education system as a student (Stigler & Hiebert, 1999). College students enrolling in teacher preparation programs as well as the professors who develop and facilitate these programs do so through their shared experience of teaching and learning. Educators have a cultural bias about what teaching should look like which makes it difficult to objectively evaluate the impact of teaching practices on student learning (Stigler & Hiebert, 1999).

Teaching is a complex system based on and driven by cultural scripts that develop at an early age (Stigler & Hiebert, 1999). To ensure that every student is learning and achieving at a high level, systemic shifts in teaching need to occur at the classroom level (Ball & Cohen, 1999). Traditional, one-off, workshops and conferences provide single-loop learning opportunities. Argyris (1991) defines single loop learning as a single response to a stimulus (a thermostat, for

example). Organizations committed to the professional development of teachers often create single-loop learning programs, teaching materials, and trainings to address specific issues connected to teaching. Districts purchase the trainings and materials or send representatives who will then become trainers of trainers to bring these programs and materials to the rest of the teachers in the district. The cycle of single-loop learning repeats each year with districts chasing the next great thing that will radically increase student achievement. The problem with single-loop learning is that it does not cause teachers to question and reflect on their mental models of what teaching and learning should look like (Ball & Cohen, 1999).

Argyris (1991) also stated, “Effective double-loop learning is not simply a function of how people feel. It is a reflection of how they think” (p. 100). When teachers engage in double-loop learning, they begin to reflect on how their actions affect student learning. Effective professional learning for teachers’ means providing the opportunity for teachers to engage in collaborative reflection and inquiry connected to their content and student learning over a sustained period of time (Darling-Hammond et al., 2009; Garet, Porter, Desimone, Birman, & Yoon, 2001; National Commission on Teaching and America’s Future, 1996; Youngs & King, 2002). Since teaching is context specific, teachers need to have the support to implement new interventions successfully, which includes “practice-based opportunities to learn, and collegial learning that enables the development of shared knowledge and commitment among teachers” (Lewis, Perry, Friedkin, & Roth, 2012, p. 368).

Lesson Study

In countries like Japan, professional development looks very different. Teachers in Japan do not engage in one-off professional development sessions. Instead, they engage in continuous professional learning through lesson study (Ermeling & Graff-Ermeling, 2016; Lewis, Perry, &

Hurd, 2009). Lesson study is a cyclical framework for professional learning that includes four steps: teachers select a long term research theme as a team, teachers collaboratively develop a “research lesson,” teachers observe student thinking and actions as one teacher teaches the research lesson, and teachers debrief by sharing the evidence collected during the observation to make changes and improvements to the lesson (Donohoo & Velasco, 2016; Ermeling & Graff-Ermeling, 2016; Fernandez, Cannon, & Chokshi, 2003; Hargreaves & Fullan, 2012; Lewis & Hurd, 2011; Lewis et al., 2009; Lewis, Perry, & Murata, 2006). The focus in Japanese education is on students doing the thinking and teachers facilitating instruction (Lewis & Tsuchida, 1999). Instead of attending workshops or trainings that may or may not be connected to the long term goals that teachers have developed for their students, Japanese teachers engage in cycles of professional learning that are directly connected to their student learning goals, and that provide evidence of the direct impact of instruction on student thinking and learning (Lewis & Hurd, 2011; Lewis & Tsuchida, 1999; Sarkar Arani, Keisuke, & Lassegard, 2010; Stigler & Hiebert, 1999). The collaborative inquiry that the lesson study framework provides helps teachers develop a common language and body of knowledge about teaching and student learning (Lewis et al., 2009).

Lesson study embodies all of the qualities of effective professional learning that have been identified and verified through a variety of research studies done at different times over the course of the last two decades. Effective professional development is teacher driven, is connected to teachers’ content and student learning, is continuous, intensive and site specific, is aligned with goals for improved student learning, and is structured to promote and support teacher collaboration (Darling-Hammond et al., 2009; Garet et al., 2001; National Commission on Teaching and America’s Future, 1996; Youngs & King, 2002). The cycle of lesson study

empowers teachers by giving them the latitude to investigate problems of practice connected to their classroom by collaboratively developing a goal for student learning (specific to their content and context), developing a research lesson(s) to address the problem of practice, collecting data on student learning during the teaching of the research lesson, and analyzing the data collected to make improvements to instruction and continue the cycle. This type of professional development is intensive and can be sustained over the course of the school year, which is different from the isolated implementation of new initiatives that most teachers in the United States are accustomed to. Lesson study provides a direct and immediate connection between professional learning and teachers' classrooms that traditional forms of professional development cannot provide (Lewis & Hurd, 2011).

Statement of the Problem

I am a district administrator for South School District, a mid-size school district in the Western United States. In 2010, South School District teachers, building administrators, and district administrators developed a framework for teaching and learning, the Teaching and Learning Cycle (TLC) (Appendix A), that established a common language for teaching and learning across the district. The school board officially adopted the Teaching and Learning Cycle as policy in 2011. Professional development efforts were redesigned to align with the Teaching and Learning Cycle. A foundational course was developed by teacher leaders, and building administrators to help staff understand and begin to implement the TLC in their buildings, and classrooms. Building leaders began to use the TLC to create building level professional development based on the needs of their staff. However, after seven years of implementation, data collected from learning walks conducted by the District Task Force (made up of representative teachers, and administrators) and building administrators (who are not on the

District Task Force) indicate professional development often stops at the initial training level and does not strategically embed what is learned at an application level in the classroom. At the district level, I have struggled to develop and implement professional learning for teachers connected to the Teaching and Learning Cycle, and to problems of instructional practice at the classroom level. Lesson study provides a method for engaging teachers in collaborative inquiry to address a problem of practice connected to their classrooms. It aligns with the components of effective professional learning for teachers: teacher driven rather than externally driven (Jacob & McGovern, 2015; Hargreaves & Fullan, 2012; Learning Forward, 2011), ongoing rather than episodic (Garet et al., 2001), focused on development of content knowledge (Garet et al., 2001), and collaboration among teachers in content or grade level teams (Garet et al., 2001).

Research Question

The following research question guided this study:

1. How does lesson study contribute to teachers' professional knowledge and continual learning?

Purpose Statement

The purpose of this participatory action research study was to create a lesson study framework that content and grade level teams of teachers can use to develop and implement their own professional learning connected to student learning goals over the course of a school year (Bradley, 2015). An action research design was used to engage two to three teams of content specific teachers in one or more cycles of lesson study. Data were collected using direct observation through researcher participation in lesson study with groups of content specific teachers, field notes, lesson study protocols, and semi-structured interviews with teachers. Each team of teachers was comprised of teachers who teach the same content or grade level (Garet et

al., 2001; Lewis & Hurd, 2011). Action research methodology was selected because lesson study results in the development of new knowledge, the improvement of learning (for teachers and students), and an emphasis on the researcher taking action to make improvements (McNiff, 2017). I will be a practitioner researcher (McNiff, 2017) serving in the role of facilitator (Lewis & Hurd, 2011) in the lesson study process. The lesson study cycle mirrors the action research cycle: investigate or observe, plan the research lesson or act, reflect and make changes or modify (Lewis & Hurd, 2011; McNiff, 2017) making action research a natural methodological fit for the study. The knowledge claim (McNiff, 2017) for the study is that lesson study will result in changes in teachers' knowledge and beliefs about their content, pedagogy and student learning, in teachers' collaborative capacity, and in the teaching and learning resources that are used to support student thinking (Lewis et al., 2009).

Conceptual Framework

The conceptual framework for this study (Figure 1) is a combination of Guskey's (2002) framework for effective professional development and Lewis, Perry and Hurd's (2009) framework for lesson study (Figure 2). Traditional forms of professional development start by seeking to change teachers' attitudes and beliefs about student learning as a means to then change teachers' practices and student learning outcomes (Guskey, 2002). However, Guskey (2002) suggests that changes to teachers' attitudes and beliefs about student learning are a result of changes to teaching practices that cause visible changes to student learning. Lewis et al. (2009) provide a framework that focuses on changing teachers' practices through the lesson study process, which engages teachers in direct observation of the impact of their instructional practices on student learning. Figure 2 provides a diagram and details of the lesson study cycle and the "Intervening Changes" in teachers' attitudes and beliefs. The teaching and observation of

the research lesson provides the visible changes to student learning that are needed for teachers to change their practices and beliefs (Guskey, 2002).

Figure 1 includes the conceptual framework for this study, a combination of Guskey’s (2002) framework for professional learning and Lewis et al. (2009) framework for lesson study. The cycle of lesson study (investigation, planning, research lesson, and reflection) represents the changes to teacher practices, which result in intervening changes to the following: teachers’ knowledge and beliefs, teachers’ professional community, and the teaching-learning resources available to teachers (Lewis et al., 2009, p. 287). The “features of lesson study”, investigation, planning, research lesson, and reflection (Lewis et al., 2009), will be used to set up the lesson study process. The stages of the lesson study process are defined in the Key Terms sections of Chapter One and the Literature Review in Chapter Two. The “Intervening Changes” represent the changes in teachers’ attitudes and beliefs about student learning. The “Intervening Changes” are defined in the Key Terms section of Chapter One and the Literature Review in Chapter Two.

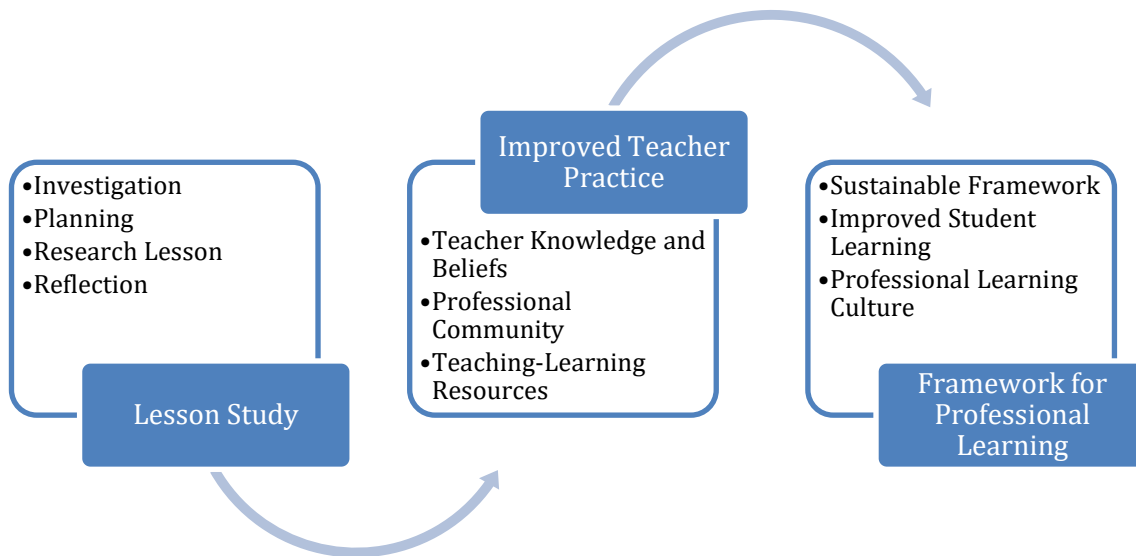


Figure 1. Conceptual framework- Combination of Guskey’s (2002) framework for effective professional learning and Lewis, Perry, & Hurd’s (2009) framework for lesson study.

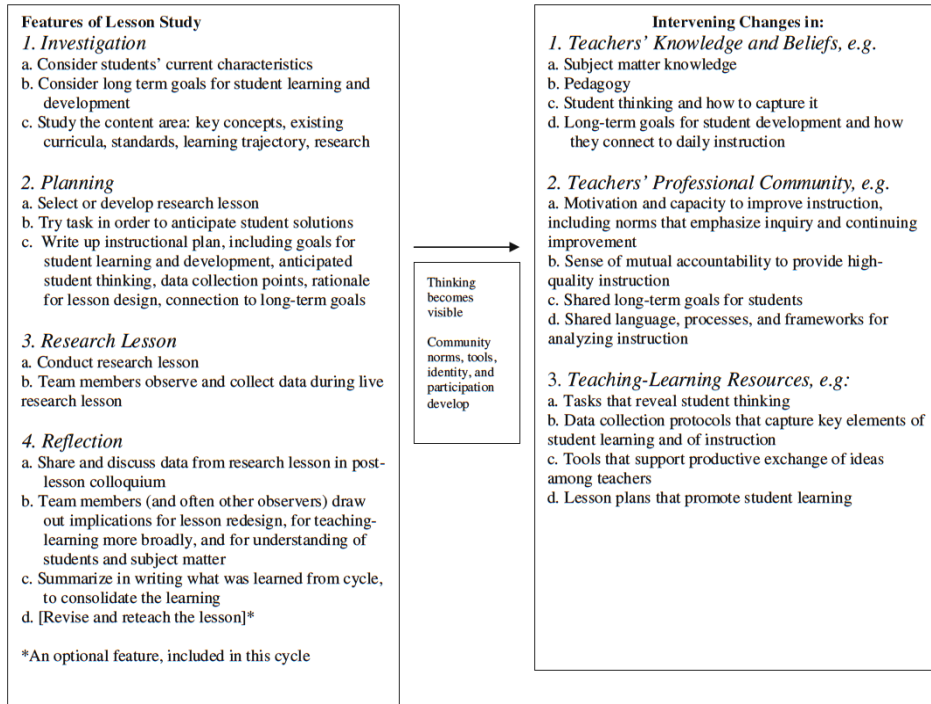


Figure 2. Instructional improvement through lesson study (Lewis et al., 2009, p. 287).

In the Introduction of the TLC (South School District 2015), the consultant, hired by South School District, emphasizes the need to go beyond simply understanding and using the practices in the TLC. Educators need to be intentional about “connecting these practices to what and how they want students to learn” and “to consciously plan how these practices will be used in classrooms with students” (South School District, 2015, p. 3). Direct observation of students interacting with the selected instructional strategies provides teachers with evidence of the impact of these instructional strategies on student thinking and learning. It informs future instructional decisions and guides teachers’ understanding of how students learn. The cycle of lesson study engages teachers in collaborative dialogue and reflection about their content, the unique nature of their content, and the skills/understandings that students need to access the content, and the instructional strategies that are best suited to their content. In short, lesson study

may provide a viable pathway to provide the visible changes to student learning that Guskey (2002) claims should be the focus of effective professional learning.

Definitions of Key Terminology

Key terminology specific to this study and used throughout the dissertation are defined in this section. Terminology related to the methodology of this study are defined in Chapter 3.

Professional development. This term is defined as trainings or in-services for teachers that are often (not always) mandated by building or district level administrators, one-time or episodic rather than ongoing, disconnected from content and specific issues of student and teacher learning, and provide little to no opportunity for teachers to construct their own learning and knowledge (Ball & Cohen, 1999; Donohoo & Velasco, 2016; Little, 2007).

Professional learning. This term is defined as an ongoing, cyclical process (Donohoo & Velasco, 2016) in which teachers collaborate to “learn in and from practice” (Ball & Cohen, 1999) by gathering data from a variety of sources to make evidence-based decisions (Donohoo & Velasco, 2016) connected to student and teacher learning (Little, 2007).

Lesson study. This term is defined as a cyclical, iterative process that teams of teachers (usually grade or content specific) use to examine problems of practice directly connected to student learning in their classrooms (Ermeling & Graff-Ermeling, 2014; Lewis & Hurd, 2011; Lewis & Tuschida, 1999; Stigler & Hiebert, 1999). Lesson study consists of the following four components:

Research and develop student-learning goals. Analyze curriculum and a variety of student data to develop a long- term student learning goal (length of one school year) to improve student achievement (Lewis & Hurd, 2011).

Plan research lesson. Teachers use available curriculum resources and/or external

resources to develop a research lesson (in depth lesson to address the issue of student learning), identify what students will know and be able to do as a result of the lesson, plan for instructional activities that elicit student thinking, and create a plan for collecting evidence of student thinking during the research lesson (Lewis & Hurd, 2011).

Conduct research lesson. One teacher on the team teaches the lesson while the other members of the team collect evidence of student thinking (Lewis & Hurd, 2011). Live observation of the research lesson is a critical component of the lesson study process since this provides the lesson study team with direct evidence of student thinking in real time (Fernandez et al., 2003; Lewis & Hurd, 2011; Lewis & Tuschida, 1999; Sarkar Arani et al., 2010).

Reflect. The team of teachers shares the evidence of student thinking that was collected during research lesson; the data collected from the research lesson is used to plan and further revise the research lesson to continue the lesson study cycle; teachers document their learning from each iteration of the cycle (Lewis & Hurd, 2011).

Problem of practice. This term is defined as the specific student-learning problem the team of educators identified at the start of the lesson study cycle (Ball & Cohen, 1999; Lewis & Hurd, 2011; Little, 2007; Stigler & Hiebert, 1999).

Teachers' knowledge and beliefs. This concept encompasses teachers' knowledge about their content, and how to teach their content in a way that helps students develop a conceptual understanding of the content (Ball, Thames, & Phelps, 2008). It includes teachers' understanding of students' prior knowledge, the impact of this prior knowledge on new learning, and how

students make meaning of content specific knowledge (Ball et al., 2008). Teachers intentionally select instructional strategies, learning tasks, and physical representations that will make student thinking visible in the classroom or through student work. By working through the student tasks, teachers will identify potential student misconceptions, and plan how to respond to these misconceptions prior to teaching the lesson.

Teachers' professional community. The development of norms that promote trust and a shared ownership of student learning. Teachers develop a shared language and knowledge of their content, and how students will interact with this content (Stepanek, Appel, Leong, Turner Managan, Mitchell, 2007). As teachers collaborate, their social and professional capital increases (Hargreaves & Fullan, 2012). The lesson study protocols provide a structure for collaboration focused on student and teacher learning.

Teaching and learning resources. The artifacts that are generated through the lesson study process that illustrate student and teacher thinking (Lewis & Hurd, 2009; Stepanek et al., 2007). Examples include research lesson, lesson observation protocols, post lesson debriefing protocols, final lesson study report, and any curricular materials that the team develops to support instruction and elicit student thinking.

Collaborative inquiry. A framework for professional learning that teams of teachers can use to identify a common problem of practice connected to their classrooms, and to develop and implement solutions to address the problem of practice (Donohoo & Velasco, 2016).

Limitations and Delimitations

This study was limited by the narrow focus on the immediate needs of the research site. Lesson study is designed to help teachers address problems of practice that are directly connected to their students, classrooms, and communities. The knowledge that teachers construct

through the lesson study process cannot be used directly by other teachers to immediately address similar problems of practice in their respective settings. Additionally, the number of lesson study cycles that the teams of teachers undertook was limited. The deep cultural changes that are outlined in the conceptual framework for the study take time to develop (Ermeling & Graff-Ermeling, 2016; Fernandez et al., 2003; Lewis & Hurd, 2011; Watanabe, Takahashi, & Yoshida, 2008). Since the study was limited to one school year, several teams of teachers were selected from different school sites and with different lengths of time spent working as a team so that the lesson study framework can be applied throughout the research site.

In terms of delimitations, the results of this study are not generalizable beyond the research site. However, one of the characteristics of effective professional learning for teachers is that the learning is directly connected to the specific content and context in which the team of teachers are working (Darling-Hammond et al., 2009). Lesson study was selected because it is a cyclical framework that teachers can use collaboratively to address problems of practice that are directly connected to the context of their classrooms and building goals for improved student learning. Although the evidence collected from each team's cycles of lesson study cannot be directly applied to another team's problem of practice, the framework of the lesson study cycle can be applied by all of the teacher teams in South School District to implement professional learning at an application level in the classroom.

Significance

This study is important because it will provide an alternate, more effective form of professional learning for teachers directly connected to the instructional problems of practice they are working through at the classroom level (Ermeling & Graff-Ermeling, 2014; Vrikki, Warwick, Vermunt, Mercer, & Van Halem, 2017). One of the persistent root causes for the lack

of student achievement is that professional development often stops at the initial training level and does not strategically embed teacher learning at an application level (Darling-Hammond et al., 2009). Lesson study provides coherence between teachers' professional learning and their instructional practices. Teachers in South School District are already engaged in the investigative phase (Lewis et al., 2009) of lesson study. Each year, teachers are required to write content specific student learning objectives based on analysis of classroom, building, district, and state data (Bradley, 2015). Teachers must select a skill that is foundational to their content and that requires long-term student learning across units. Lesson study provides a framework developed and implemented by teachers to ensure students meet the established student-learning goal. Through lesson study, teachers developed a deeper understanding of their content and how to elicit student thinking to make changes to their instruction to better meet students' needs (Dudley, 2013; Hurd, & Licciardo-Musso, 2005; Cerbin, & Kopp, 2006).

Study Organization

This doctoral research project is comprised of five chapters. The first chapter is an introduction of the study, the purpose of the study and the significance of the study. The second chapter includes a review of the literature pertaining to lesson study and the impact of lesson study on teachers' beliefs, professional knowledge, collaborative relationships, and instructional planning for teaching and learning. The third chapter includes the methodology used to conduct the study. The fourth chapter includes the findings. The fifth chapter includes an analysis of the findings and potential next steps.

CHAPTER II: REVIEW OF THE LITERATURE

This chapter includes a review of the literature pertaining to effective professional learning, the history and definition of lesson study, the connection between lesson study and instructional leadership, and the impact of lesson study on teachers' professional knowledge and beliefs, teachers' professional collaboration, and the development of instructional resources. The purpose of this review is to frame this participatory action research study in terms of the potential of lesson study to transform professional learning for teachers by providing opportunities for teachers to understand the impact of their instructional decisions on student thinking.

Professional Development vs. Professional Learning

For the purpose of this study, professional development is differentiated from professional learning. Most educators in the United States associate the term "professional development" with one-time trainings selected by district and sometimes building administrators, delivered on district in-service days, using a trainer-of-trainers model to engage teachers in learning the latest strategy to improve student achievement (Ball & Cohen, 1999; Donohoo & Velasco, 2016; Little, 2007). Teachers report little to no connection between this form of professional development and their classrooms (Jacob et al., 2015). However, professional learning is an ongoing, cyclical, collaborative process, directed by teachers, connected to classroom practice, focused on analyzing the impact of instruction on student learning, and improving the content and pedagogy knowledge of teachers (Ball & Cohen, 1999; Darling-Hammond et al., 2009; Donohoo & Velasco, 2016; Given et al., 2009; Little, 2007).

Effective professional learning provides coherence between the learning, the teachers' content and classroom, the building goals, and the teachers' personal goals (Desimone, 2009; Garet et al., 2001; King & Newmann, 2001; Penuel, Fishman, Yamaguchi, & Gallagher, 2007).

Teachers' perception of the coherence between the professional learning, the goals established by their schools and district, and their own personal goals is a characteristic of effective professional learning, and a predictor of effective implementation of this learning at the classroom level (Peneul et al., 2007). Effective professional learning helps teachers develop an awareness of how to align instructional practices and pedagogies for the unique context they are working in (King & Newmann, 2001). Teachers need to have opportunities to engage in inquiry to determine whether their instructional practices are having the desired impact on student learning (King & Newmann, 2001).

Empowering teachers to take ownership of their learning by providing the opportunity for teachers to determine the content and direction of their professional learning is a more effective form of professional learning than learning that is mandated by educational leaders or facilitated by external experts (Lewis et al., 2012; Kennedy, 2016; Warren Little, Gearhart, Curry, & Kafka, 2003; Zeichner, 2003). The facilitator of professional learning for teachers matters. The most effective forms of professional learning are facilitated by people who have an understanding of what it means to be a teacher and the challenges that teachers contend with in their classrooms (Kennedy, 2016). Warren et al. (2003) studied groups of teachers engaging in the analysis of student work and they found deeper conversations resulted when teachers selected the problem of practice/student learning and how to address the issue, making changes to protocols to suit the group's needs. Providing teachers with the autonomy to develop and conduct their own research, in place of traditional forms of professional development, helps teachers focus more on the impact of their instructional decisions on student learning (Zeichner, 2003). When teachers are empowered to facilitate and lead their own professional learning, in a safe, supportive

environment, their voices, and expertise as professionals are validated and teachers take ownership for their learning as well as their students' learning (Zeichner, 2003).

In 1986, Judith Warren Little conducted seminal research on collaborative learning in schools through a comparison study of two professional development programs in the late seventies into the early eighties. Both programs focused on “mastery teaching and interactive learning” (p. 28). One program was more of a traditional model in which teachers were pulled out for training with classroom follow-up done on in-service days throughout the school year. The other program followed a more innovative approach for the time. There was an intentional process to include teachers and building level administrators from the start. While the first program was externally driven with some teacher input, the second program was a collaborative effort between professional development facilitators, building principals, and teachers. The second program was more successful in changing the school culture and classroom practices (Little, 1986).

When teachers are given the opportunity to facilitate their own learning in collaborative groups, connected to their content and their classrooms, the professional capital of each individual teacher is expanded (Hargreaves & Fullan, 2012). Professional capital is a combination of the social capital (relationships between educators) and decision capital (pool of experience available for teachers to use to make decisions) of the individuals in an organization (Hargreaves & Fullan, 2012). Pareja Roblin and Margaleaf (2013) found “differences in expectations, educational beliefs, and teachers’ styles surfaced primarily during the planning and implementation of cross curricular activities” (p. 26). Collaborative discussions of a common problem of practice helped these teachers examine and evaluate the practices they used to get their students to reflect and collaborate with each other. Teachers were able to learn from the

experiences of their colleagues and their students' work to make changes to their instructional methods (Pareja Roblin & Margaleaf, 2013). Through collaboration, each teacher shared his or her decision-making capital. The collaboration resulted in increased social capital, as the teachers became resources for one another. Schools that have higher levels of social capital among staff, have higher levels of student achievement (Leana, 2011).

Instructional Leadership

Effective professional learning requires effective instructional leadership. Robinson, Lloyd, and Rowe (2008) conducted a meta-analysis of the impact of instructional leadership on student outcomes. They identified five characteristics that had moderate to strong effect sizes on student outcomes: establishing and communicating clear goals for student learning, providing resources aligned with the instructional goals, collaboration with teachers to plan and evaluate teaching, develop and participate in professional learning for teachers, and create a safe and supportive learning environment (Robinson et al., 2008). Moderate effect sizes were found for establishing and communicating clear goals for student learning/developing a vision (Robinson et al., 2008). However, when principals work with teachers to develop a shared vision for teaching and learning, trust increases between the principal and the teachers, and between teachers (Wahlstrom & Lewis, 2008). Principals also develop trust with staff when there is coherence between the building goals and professional development, providing structures for teachers to collaborate, and involving teachers in developing and implementing professional learning activities (Youngs & King, 2002).

Providing the structure for professional learning and participating in teachers' professional learning were found to have a strong effect size for student achievement (Robinson et al., 2008). Leaders who actively participate as learners with teachers are more likely to be

perceived as credible instructional resources who are able to contribute meaningfully to the instructional process (Robinson et al., 2008). Active involvement in professional learning provides feedback for the instructional leader regarding teachers' understanding of instructional strategies and expectations, which is critical for developing a common language for teaching and learning.

While the principal is often thought of as the instructional leader in the building, she cannot be the sole person responsible for instructional leadership (Robinson et al., 2008; Scribner, Sawyer, Watson, & Myers, 2007; Spillane, 2015; Wahlstrom & Louis, 2008). Youngs and King (2002) define the organizational capacity of a school as "the collective power of an entire faculty to strengthen student performance throughout their schools" (p. 645.) Schools with greater organizational capacity tend to be higher performing schools (Youngs & King, 2002). Teachers in these schools are aware of the coherence between the school's instructional goals and their collaborative work at the classroom level. As collaborative structures are put into place to engage teachers in collaborative professional learning focused on improving instruction, principals need to communicate a clear instructional purpose, and the role of teachers in that process (Scribner et al., 2007).

Lesson study provides a framework for principals to implement effective instructional leadership and effective professional learning. Principals are responsible for establishing the structures that will support lesson study through site-based collaborative inquiry (Hurd & Licciardo-Musso, 2005). This includes establishing a clear purpose for lesson study, creating master schedules that provide consistent opportunities for teachers to collaborate, and locating resources to support each group's work. Principal participation in each step of the process provides valuable feedback regarding teachers' beliefs and knowledge about teaching, their

ability to effectively collaborate, and the resources the groups are creating. This feedback can be used to find additional resources for the group or to provide opportunities for the group to make their findings public to support instruction in other areas of the school. Additionally, principal participation communicates the importance of lesson study, builds trust between teachers to help promote deeper conversations focused on learning, and provides authentic opportunities for principals to engage in conversations about student learning at the classroom level.

History of Lesson Study

Lesson study originated in Japan in the early 1900's (Makinae, 2010; Sarkar Arani et al., 2010). The Meiji government in Japan sought to make changes to the educational system by bringing in some Western educational structures: elementary, secondary, and university (Makinae, 2010; Sarkar Arani et al., 2010). The normal school was introduced and Japan set about training teachers to use Western teaching approaches: whole group instruction involving one teacher using a chalkboard to instruct a larger group of students (Makinae, 2010). Japan also imported Pestalozzian theory: the idea that intuition is an important component of cognition, and we use our senses to evaluate the images that we receive (Makinae, 2010). So rather than learning by reading, we learn through observation of the familiar. Makinae (2010) gives the example in math of teaching students addition and subtraction by having them count objects that are given to them or taken away to determine the total sum or total remainder. In this way, students set up the equations rather than teachers first telling them the operations and how they work and then having students solve rote subtraction and addition problems. Students are doing the thinking and coming up with the rules rather than being told the rules.

In normal schools, teachers could observe each other's' lessons, implement new strategies, and reflect on instructional methods (Sarkar Arani et al., 2010). Normal schools began

to incorporate components of Sheldon's (1871) model lesson and critical lesson (Makinae, 2010). The critical lesson is taught by a new teacher who is learning. The teachers observing the lesson pay careful attention to the following criteria: matter, method, teacher and children. Specific points are given for each area. The model lesson is taught by an experienced teacher and new or inexperienced teachers watch and take notes. After teaching a criticism lesson, there was a debriefing and summary of findings by the teachers involved. These form the basis of current lesson study practice in Japan: develop and investigate a research theme, plan a research lesson, observe the research lesson being taught, and reflect and make revisions to the research lesson (Ermeling & Graff-Ermeling, 2016).

The collaborative and inquiry-based culture that developed through the normal school helped teachers understand learning from the perspectives of their students (Sarkar Arani et al., 2010). Teachers soon realized that a one-size fits all model did not work for every student. As the Japanese government developed policy from the late 1800s to the early 1900s, the teachers were able to use lesson study to help them understand how to implement the policy and meet the needs of students (Sarkar Arani et al., 2010). Teachers who graduated from the first normal school moved throughout the country to teach and train more teachers, which helped to develop a collaborative approach to teaching across Japan (Sarkar Arani et al., 2010).

Today, lesson study continues to be a central component of professional learning, and policy development and implementation in Japan. Lesson study incorporates two types of research lessons: in-school lessons (observed by internal teachers) and public research lessons (observed by teachers, educational leaders, and policymakers from all over Japan) (Lewis & Tsuchida, 1999). Public research lessons are used to create policy, to implement policy, and to train new teachers in how to implement policies (Lewis and Tsuchida, 1999). There are 73,

highly selective admission public schools in Japan that typically develop new educational approaches (Lewis & Tsuchida, 1999). Research lessons are conducted over two days and educators from around the country flock to these schools to observe and participate in the reflection sessions that follow. Japan uses lesson study to create and implement new national curriculum, which is a major shift from how educational policy is implemented in the United States. It may be why there is more coherence among schools across Japan.

In 1999, Stigler and Hiebert brought lesson study to the United States in their book, *The Teaching Gap*. Through the Third International Mathematics and Science Study, Stigler and Hiebert (1999) analyzed videos of instruction from Japan, Germany and the United States. Japan was of particular interest because Japanese students outscored students from Germany and the United States. They found that while reform efforts in the United States espoused a shift from teacher-centered instruction to student-centered instruction (emphasis on making student thinking visible by engaging students in critical thinking and problem solving); reform efforts in Japan actually resulted in implementation of this shift to student-centered instruction (Stigler & Hiebert, 1999). Reform efforts in the United States have resulted in superficial changes to instruction, and the implementation of the latest strategies and manipulatives, without providing professional learning that helps teachers reflect on how they provide instruction, and the impact of that instruction on student learning (Stigler & Hiebert, 1999). In Japan, changes to instruction are done through lesson study to ensure that teachers have a common understanding of the expected change and the impact of the change on student thinking (Stigler & Hiebert, 1999).

Catherine Lewis was one of the pioneers to implement lesson study in the United States in the late 1990s after studying elementary science education in Japan in the early 1990s (Lewis, 2002). She is cited in much of the research regarding lesson study in the United States (Cheung

& Wong, 2013; Ermeling & Graff-Ermeling, 2016; Fernandez et al., 2003; Groth, 2011; Hurd & Licciardo-Musso, 2005; Watanabe et al., 2008; Yarema, 2010). Lesson study is now being used as a form of professional learning in California (Hurd & Licciardo-Musso, 2005), Chicago Public Schools (LessonStudyAlliance.org), New Jersey and Maryland (Lewis, 2002), Florida (Druken, 2015), and Texas (Ellinger, Launius, & Scott, 2017). It is also being used as a framework for professional learning in England (Dudley, 2013; Hadfield & Jopling, 2016), Norway (Bjuland & Musvold, 2015), and South Africa (Ono & Ferreira, 2010).

Lesson Study

Lesson study is a cyclical, iterative process in which teams of teachers collaborate to address a specific problem of practice directly connected to their classrooms (Ermeling & Graff-Ermeling, 2014; Lewis & Hurd, 2011; Lewis & Tsuchida, 1999; Stigler & Hiebert, 1999). There are four major components that make up a lesson study cycle: research and develop student learning goals, plan the research lesson, conduct the research lesson, reflect and discuss the research lesson (Lewis & Hurd, 2011). Lesson study is more about the “intellectual process” (p. 523) than the product that is created (Chokshi & Fernandez, 2004). The goal of lesson study is to make student and teacher thinking visible to understand how instruction impacts student learning, and make changes that will improve instruction and learning (Yarema, 2010). Lesson study is a more effective form of professional learning because it is ongoing, teacher driven, explicitly connected to teachers’ practice, aligned with building goals, and focused on improving content knowledge and pedagogy (Ermeling & Ermeling- Graff, 2014; Hurd & Licciardo-Musso, 2005; Lewis, Perry, & Hurd, 2009; Lewis & Tsuchida, 1999; Lewis et al., 2012). Lesson study generates knowledge about teaching and learning that is specific to the local context in which it

takes place, which enables teachers to apply their learning directly to their classrooms (Lewis et al., 2006).

Research and develop student-learning goals. During the first phase of lesson study, teachers collaborate to research and develop student learning goals (Lewis & Hurd, 2011) through the analysis of student data (Yarema, 2010), discussion of challenges teachers are encountering in the classroom (Hurd & Licciardo-Musso, 2005), and identification of the skills and/or knowledge students should have (Groth, 2011). Yarema (2010) studied three groups of middle and high school teachers in nine school districts in Texas as they participated in three lesson study groups. Teachers collaboratively determined the skills and/or knowledge they want all students to have in the area of mathematics compared with the mathematics skills students were currently demonstrating (Yarema, 2010). Students struggled with problem solving (Yarema, 2010). State assessment data were used to identify areas of deficiency within the mathematics curriculum that could be used to support the development of problem solving skills in students (Yarema, 2010). Teachers developed a long-term goal focused on problem-solving using specific mathematics content (Yarema, 2010).

Plan the research lesson. In the second phase of lesson study, teachers collaborate to develop a detailed research lesson that specifies what students will know and be able to do as result of the lesson, how student thinking will be made visible, the misconceptions that students may have, and how the misconceptions will be handled (Lewis & Hurd, 2011). In Japan, this step is called, *kyozaikenkyu*, which translates to “study of instructional materials” (Watanabe et al., 2008, p. 133). During *kyozaikenkyu*, Japanese teachers look in depth at the content in terms of the understandings that students must develop regarding the content, the problems that students will need to be able to solve, and the instructional tools that are most appropriate for teaching the

concepts (Watanabe et al., 2008). It is critical for all teachers to have the same, in-depth understanding of the content and concepts students are learning (Yoshida, 2012). During this phase, teachers complete the same tasks that students will complete during the research lesson (Lewis & Perry, 2015; Puchner & Taylor, 2006). This step is one of the biggest hurdles for successful implementation of lesson study in the United States since teachers in the United States do not typically engage in this depth of planning (Fernandez et al., 2003; Yoshida, 2012). Teachers need to have dedicated time to collaboratively plan the research lesson with great detail.

Conduct the research lesson. During the third phase of a lesson study cycle, one teacher volunteers to teach the research lesson while the rest of the team observes how students interact with the lesson (Lewis & Hurd, 2011). The team develops an observation protocol that will be used to capture data regarding student thinking during the implementation of the research lesson (Lewis & Hurd, 2011). In addition to the observation protocol, the team establishes norms for the observation to ensure that the team is not interfering with the delivery of the lesson and is instead focused on the student outcomes for the lesson (Fernandez & Chokshi, 2002). Live observation of the lesson is a critical component of effective lesson study as it provides full context of student thinking and learning (Lewis et al., 2009; Lewis & Tsuchida, 1999). While some lesson study groups have relied on video recordings of lessons because sections can be replayed (Ermeling & Graff-Ermeling, 2014), it is not possible to capture the thinking of all students in all parts of the room with a video. Live observation of the research lesson allows the team to canvas the entire classroom to capture student thinking (Lewis & Tsuchida, 1999).

Reflect revise the research lesson. In the fourth phase of lesson study, the team comes together to share the data that was collected during the teaching of the research lesson (Lewis &

Hurd, 2011). Each team determines how they want to structure these discussions; however, the focus of the discussion should be the student thinking that was captured using the observation protocol that was developed for the research lesson (Lewis & Hurd, 2011). Fernandez and Chokshi (2002) recommend starting the conversation by having the person who taught the lesson share first and then having the rest of the team share the data they collected. During this phase, teachers engage in discussions of actual student thinking rather than making inferences about students' thinking based on artifacts of student work (Groth, 2011; Lewis & Hurd, 2011; Lewis & Tsuchida, 1999; Puchner & Taylor, 2006; Yarema, 2010). The lesson study team makes revisions and plans next steps based on the observations and data that were collected during the teaching of the research lesson (Lewis & Hurd, 2011). Sometimes the revisions are made to the existing lesson so that it can be taught by other members of the team (Lewis & Perry, 2015) and sometimes the team takes what they have learned and apply it to future lessons (Ermeling & Graff-Ermeling, 2014). After each cycle of lesson study, the teachers develop a written report of knowledge they gained (Lewis & Hurd, 2011, Lewis & Tsuchida, 1999, Ogden, Perkins, & Donahue, 2008). Making teacher learning public helps to build a professional knowledge base for the area in which the lesson study was completed (Lewis et al., 2009). In Japan, these reports are often published and shared at a national level to promote teacher learning and provide research for local lesson study teams (Lewis & Tsuchida, 1999). Often what is learned through the lesson study process is used to begin the next cycle of lesson study.

Conceptual Framework

Lewis et al. (2009) developed a conceptual framework to illustrate how lesson study leads to changes in teachers' knowledge and beliefs, teachers' professional community, and teaching and learning resources. These changes result in instructional improvement as teachers

make changes to their instruction based on the impact of their instructional practices on students (Guskey, 2002). Through lesson study, teachers are given the opportunity to make their thinking visible by engaging in collaborative discussions that challenge and deepen their pedagogical and content knowledge (Lewis et al., 2009). Teachers develop an increased sense of collegiality and collaboration through the lesson study process as they develop long-term goals for student learning, create a common research lesson, and investigate the impact of that lesson on student learning (Lewis et al., 2009). They are empowered to take ownership for their learning, and their students' learning, which creates a shared sense of responsibility for student learning (Lewis et al., 2009). Teaching resources (tasks, strategies, lesson plans, collection protocols) that have a positive impact on student learning are created and refined through the cyclical process of lesson study (Lewis et al., 2009).

Teachers' knowledge and beliefs. For the purpose of this study, content knowledge and pedagogy knowledge are combined into pedagogical content knowledge (PCK). Ball et al. (2008) define PCK as the teachers' ability to use what they know about their content to inform their teaching pedagogy, taking into consideration the prior knowledge that a student has, and how that knowledge may affect students' understanding of new content. Teachers have to have a well-developed understanding of their content that goes beyond what most adults have to know about that same content. For example, a math teacher needs to be able to understand and explain the reasoning behind a simple algorithm because students will need to apply this conceptual understanding as they progress through math (Ball et al., 2008). An average adult need only know how to do the algorithm. Teachers need to understand content, and how to select instructional strategies that will help students understand and apply their learning of the content.

Lesson study engages teachers in collaborative discussions about pedagogical content knowledge. As teachers develop the research lesson, they engage in deep study of the content being taught, the materials available to teach the lesson (curriculum resources), and the appropriate instructional strategies to facilitate learning (Watanabe et al., 2008). Ogden et al. (2008) engaged in a lesson study with the goal of understanding how students' prior knowledge of slavery influences their understanding of the complexity of slavery beyond issues of morality. Through lesson study, they found it was important to have students "surface their prior knowledge, beliefs, and values before they read, so they can interrogate them in light of their reading and so teachers can point out dissonance between old ideas and new ideas and new reading if students do not" (Ogden et al., 2008, p. 480). The team can use this new content and pedagogical knowledge as they develop future lessons but social studies teachers can also use it as they develop lessons in which students analyze primary sources.

Peter Dudley (2013) studied video footage of teachers engaged in planning and debriefing research lessons to analyze what teachers learn through the lesson study process and how they "utilize and develop knowledge" (p. 108). The teachers in the study found that students learned differently than they predicted students would learn (Dudley, 2013). The response of students to the research lesson caused teachers to think differently about how their students learn, and how they assess their students (Dudley, 2013). One teacher changed her beliefs regarding students' ability to answer open-ended questions in mathematics through discussions to plan the research lesson, direct observation of students' interactions during the research lesson, and reflective discussions with her colleagues after the research lesson (Dudley, 2013). Teachers reported making changes to how they use formative and summative assessments because of the lesson study process (Dudley, 2013).

The planning and debriefing of research lessons revealed differences in understanding and defining instructional models that teachers previously thought they were implementing similarly in their classrooms (Dudley, 2013). Teachers developed common understandings of how to use instructional strategies like success criteria, self-assessment, and peer assessment to communicate learning intentions to students, and how to have students take responsibility for their learning through problem solving tasks and partner discussions (Dudley, 2013). Teachers continued to use this knowledge in their teaching beyond the lesson study work (Dudley, 2013). One of the criticisms of traditional professional development models in the United States is that teachers are left on their own to interpret how the training should be implemented in their own classrooms, which can result in variation in implementation between teachers (Stigler & Hiebert, 1999). Lesson study provides a pathway to close this gap between intended implementation of professional learning and actual implementation of professional learning.

Teachers' professional community. Lesson study helps teachers develop collegiality, a shared sense of responsibility for student learning, and an inquiry approach to instruction (Lewis et al., 2009). The lesson study process helps teachers become more comfortable with one another as they begin to see each other "equally as learners" (Dudley, 2013, p. 115). The collaborative planning of research lessons focuses on improving student learning for a shared purpose, and helps to build the "social capital" of the group, which helps teachers navigate differences of opinions (Dudley, 2013, p. 116). Puchner and Taylor (2006) studied five elementary lesson study groups, most of whom had little or no experience with lesson study. Teachers recognized the process of lesson study changed how they talked about content, lesson planning, and student learning (Puchner & Taylor, 2006). Their collective efficacy increased after they collaborated to develop a challenging lesson that students successfully completed (Puchner & Taylor, 2006).

The makeup of the lesson study group is important. In Japan, an outside expert (instructional coach, master teacher, or university professor) is invited to be part of the lesson study group (Lewis & Perry, 2011; Lewis & Tsuchida, 1999; Watanabe et al., 2008). This expert typically pushes the group to think more critically at each step of the process. However, an outside person can disrupt the dynamics of the lesson study group. Puchner and Taylor (2006) found outside experts might threaten the autonomy of the group if the expert does not view the teachers as professional equals, and seeks to impart knowledge rather than build knowledge with the teachers. Hadfield and Joplin (2016) also found that “professional autonomy” (p. 211) for all members of the group was a key component of successful collaboration, and teachers’ willingness to take risks. Decisions to include outside experts should be made by the group and include clear expectations for how the expert will engage in the process.

Teaching and learning resources. Through the lesson study cycle, teachers create a variety of instructional resources that support improvements to classroom instruction. Each lesson study cycle results in a detailed research lesson plan that includes what students will know and be able to do as a result of the lesson, the tasks or problems that will be used to elicit student thinking, and the misconceptions students are likely to have (Fernandez et al., 2003; Hurd & Licciardo-Musso, 2005; Groth, 2011; Lewis & Hurd, 2011; Lewis et al., 2009; Lewis & Tsuchida, 1999; Ogden et al., 2008; Puchner & Taylor, 2006; Watanabe et al., 2008). In the United States, these lesson plans are frequently revised and improved after each lesson study cycle based on the data collected from students (Lewis et al., 2009). The result is a lesson plan with clearly defined instructional strategies that have been found to effectively elicit student thinking. These strategies can be applied by members of the lesson study team outside of the lesson study process to improve student learning.

Each group develops norms that help to create a supportive environment in which teachers are willing to share their beliefs about teaching (Hurd & Licciardo-Musso, 2005; Lewis et al., 2009; Puchner & Taylor, 2006). The teams also create the protocols that are used to collect evidence of student thinking during the research lesson (Lewis et al., 2009). Changes are made to the protocols as the team uses the protocols to debrief and reflect on the effectiveness of each research lesson.

Summary

Much like the Japanese teachers during the Meiji era discovered, a one-size fits all approach to teaching does not work for all students, it also does not work for engaging all teachers in professional learning that is meaningful and connected to their practice. It is imperative that school leaders become directly involved in professional learning so they know how to meet the diverse needs of the teachers in their buildings. Lesson study provides a framework for professional learning that aligns with research-based recommendations for effective professional learning. It is an ongoing, iterative cycle focused on improvement that is directly connected to teachers' content and classrooms, empowers teachers to take ownership of their learning, aligns with building and district goals for student learning, and provides opportunities for authentic collaboration among teachers. Lesson study provides a pathway for school leaders and teachers to work collaboratively to understand how instruction affects student learning, situating professional learning in the context of local classrooms.

CHAPTER III: METHODOLOGY

A participatory action research design was used to collect qualitative data in this study to answer the following research question:

1. How does lesson study contribute to teachers' professional knowledge and continual learning?

The study was grounded in the social constructivist worldview in which knowledge is “constructed” through social interactions (Cresswell, 2014). Rather than the belief in an absolute truth waiting to be discovered, social constructivists believe that each person creates his or her own knowledge through his or her interactions with the world (Cresswell, 2014). In the realm of education, social constructivists seek to have practice inform theory rather than theory informing practice (Cobb & Yackel, 1996). Lesson study engages teachers collaboratively (socially) in the production of new knowledge in the areas of content, pedagogy, and student thinking. The purpose of participatory action research design is the development of new knowledge based on the systematic research of practice in a natural setting, like a school or a community, and taking action to make improvements in these settings (Kemmis & Wilkinson, 1998; McNiff, 2017).

Lesson study as a form of professional learning results in the development of new knowledge through social interactions between teachers and students, the improvement of teaching and learning (for teachers and students), and an emphasis on teachers taking action to make improvements (Dudley, 2013; Lewis et al., 2009). This is a paradigmatic shift from traditional forms of professional development in which teachers passively receive information through trainings conducted by external experts who tell teachers what they should be doing. Typically, teachers are forced to attend trainings and in-services based on needs that building and district leaders identify as a priority (Ball & Cohen, 1999). Lesson study empowers teachers to

analyze their own classrooms to determine problems of practice, to develop interventions to address these problems, to reflect on the effectiveness of the interventions, and to make changes to continue the cycle of improvement.

The research site for this study has recognized that professional development often stops at the initial training level and does not strategically embed what is learned at an application level in the classroom. Action research design helps teachers and administrators engage in a cyclical, reflective process that connects professional learning to teacher practices at the classroom level, to embed professional learning beyond the initial training level. The knowledge claim for the study is that lesson study will result in changes to teachers' knowledge and beliefs about their content, pedagogy and student learning, to teachers' collaborative capacity, and to the teaching and learning resources used to support student thinking (Lewis et al., 2009).

Participatory action research is distinguished from other forms of action research in that it requires the participation of those who are being impacted by the problem of practice (Adelman, 1993). In this study, the classroom teachers are the ones directly connected to the problem of practice. The goal of action research is to help participants "change their practices, their understanding of their practices, and the conditions in which they practice" (Kemmis, 2009, p. 463). It is a cyclical process divided into five phases: observe, plan, act, evaluate, and modify (McNiff, 2017). Participatory action research was the methodology selected for this study because lesson study closely mirrors the five phases of action research: study/create goals (action research observe phase), plan research lesson (action research plan phase), conduct research lesson (action research act phase), and reflect (action research evaluate and modify phases) (Lewis & Hurd, 2011). The phases of lesson study and action research were used to develop an understanding of how lesson study impacts teachers' knowledge and beliefs about their content,

pedagogy, and student learning, teachers' collaborative capacity, and the teaching and learning resources that are used to support student thinking (Lewis et al., 2009). Data collection methods included a Pre Lesson Study Questionnaire, semi-structured interviews with teachers, direct observation through participation in the lesson study process, protocols used to structure the lesson study process, field notes, and the analysis of artifacts generated through the lesson study process.

Setting

South School District is a midsize school district in the Western United States serving a population of about 9,500 students in grades preK- 12. There are two comprehensive high schools, one alternative high school, three junior highs (grades 6-8), nine elementary schools and one pre-school. The district is located in an unincorporated portion of the county in which it resides. To avoid corrective action from the state, South School District leaders hired a consultant to identify and analyze the root causes for stagnating and dropping state assessment scores. A list of root causes was identified through extensive learning walks in every building, interviews with every building principal and direct observation of district practices and policies. Principals were asked to assemble a team of 10 early adopters/teacher leaders to represent their buildings at what was later called the Group of 100. Each principal and their group of early adopters/teacher leaders attended the Group of 100 workshop where the root causes were shared. The consultant challenged the Group of 100 to look at the root causes, and begin to brainstorm how to address these causes using research.

A smaller group (District Task Force), made up of a teacher representative from each building, a building administrator from each level (elementary, junior high, and high school), and several district level administrators worked on creating a common framework to define teaching

and learning for South School District. In 2011, the Teaching and Learning Cycle (TLC) was finalized and shared with staff across the school district. The South School Board adopted the TLC as policy in January 2012. The Teaching and Learning Cycle was updated in August 2015.

The TLC represents a cultural shift from traditional forms of teaching in which students passively receive information from teachers to one in which students are engaged in creating meaning through critical thinking and problem solving. A foundational professional development course was created to help teachers, administrators, and special service providers understand the rationale for the shift, and an overview of each component of the TLC. Every teacher and administrator in the district were required to take the foundation course. Financial compensation was provided as an incentive. The South School Board set a goal to have all teachers complete the foundation course. Building principals were held accountable for ensuring all staff members completed the course. However, this training followed the typical format of most professional development courses. Teachers attended outside of the school day for five, three-hour sessions. While research-based teaching strategies were modeled for teachers, it was left to each teacher to determine how these strategies connected to their content, students, and classroom settings. There were no follow-up classes to provide time for teachers to collaborate and share how they were using the strategies, and how the strategies impacted student learning. Even though this professional development was created by a team of teachers and administrators, it was still something that was done to teachers rather than a training that empowered teachers to take ownership of their learning.

South School District changed their internal professional development system, requiring all new professional development classes to be explicitly aligned with the TLC. Teachers and administrators were encouraged to create and teach classes to help teachers implement the TLC

with fidelity in their classrooms. A two-tiered financial incentive system was developed to encourage teachers to take multiple professional development courses through the district. Once the first tier was complete, teachers had to apply to move to the second tier by demonstrating how they were using what they learned through the professional development courses in their instruction. Administrators were required to approve teachers' requests. In theory, this appeared to be a sound system of accountability. In practice, teachers were taking instructional strategies learned from these professional development courses and integrating the strategies into traditional instructional models. The professional development courses did not engage teachers in deep reflection of their current instructional practices in comparison to instructional practices required of the TLC. After seven years of implementation, professional development still stops at the initial training level. Teachers are not applying what they are learning through professional development to strategically improve instruction and learning for students. South School District was selected for this research because of the difficulty the district is experiencing in making the cultural shift from traditional, teacher-centered instruction to student-centered instruction in which students are actively engaged in the learning process.

Participants

Lesson study is most successful when teams of teachers volunteer to participate and when they are open to examining and reflecting on their teaching practices and the impact of these practices on student learning (Ermeling & Graff-Ermeling, 2014; Lewis et al., 2009; Shuilleabhain, 2016). Three teams of teachers volunteered to engage in one cycle of lesson study over the course of the 18-19 school year. The teams were representative of all levels of schooling, elementary, junior high, and high school. To maintain confidentiality, the teams were not identified by level or content; however, each team included four teachers from either the

same grade level or content. Table 2 includes the participants' individual years of teaching experience, the number of years the teachers have worked together as a team, and each teacher's highest level of education completed.

Table 2

Participant Experience and Highest Level of Education

	Teaching Experience	Team Experience	Highest Level of Education
Team A			
Teacher 1	18 years	5 years	Bachelors
Teacher 2	23 years	5 years	Bachelors
Teacher 3	7 years	5 years	Bachelors
Teachers 4	5 years	5 years	Masters
Team B			
Teacher 5	5 years	5 years	Bachelors
Teacher 6	18 years	7 years	Bachelors
Teacher 7	1 year	1 year	Bachelors
Teacher 8	15 years	7 years	Bachelors
Team C			
Teacher 9	18 years	4 years	Masters
Teacher 10	5 years	1 year	Bachelors
Teacher 11	2 years	1 year	Bachelors
Teacher 12	4 years	4 years	Bachelors

Action Research Process

Research phase one: observation/plan. Prior to beginning the lesson study cycle, participants completed the Pre-Lesson Study Questionnaire through Google forms (Appendix B). The answers to the questionnaire were used to develop baseline information about how teachers work together to plan for instruction. Teachers answered similar questions at the end of the lesson study cycle through one-on-one, semi-structured interviews (Appendix C).

The researcher met with the teams to introduce lesson study. Each team member read the following article, “A Practical Guide to Translating Lesson Study for a U.S. Setting” by Clea Fernandez and Sonal Chokshi (2002) prior to the first meeting. This article was chosen because it provides an overview of the lesson study process as well as tips for implementing lesson study for the first time. After reading the article, each team discussed their concerns, and positive outcomes for lesson study. The researcher started the lesson study cycle in the role of facilitator for each team to help the team understand how lesson study works. The teams used the norm setting protocol developed by Lewis and Hurd (2011) (Appendix D) to develop norms for collaboration to guide the observation and planning phases of the lesson study process. Group roles (Appendix E) were discussed and members of the team volunteered for a role of their choosing. While the roles can be fluid over the course of the lesson study process, the teams chose to maintain the group roles selected at the start of the lesson study cycle. For teams A and B, the researcher maintained the role of facilitator. For Team C, Teacher 9 co-facilitated with the researcher. The researcher (in the role of the facilitator) developed meeting agendas for each meeting for all three teams (Appendix F).

After assigning group roles and developing group norms, the teams identified their problem of practice and developed a goal for the lesson study connected to the identified

problem of practice. The teams utilized a variety of locally available resources to guide their planning: district approved textbooks and supporting materials, data gathered from classroom assessments, and discussion of areas in which students are struggling. For Teams A and B, the researcher provided research articles to help teachers develop a better understanding of content and/or pedagogy based on their identified needs. For Team C, Teacher 9 shared resources she gathered from the National Science Teachers' Association website, the College Board website, and the National Math and Science Initiative website. Each team developed a student-learning goal, and a timeline for the lesson study process. Table 3 includes each team's learning goal.

Table 3

Team Learning Goals

	Learning Goal
Team A	Students will have an increased understanding of how to solve unit rate problems.
Team B	Students will be able to tell time to the nearest five minutes using digital and analog clocks.
Team C	Teachers will develop a graphic organizer that helps students develop a written claim supported by evidence (from research or laboratory experiments) and scientific reasoning.

Research phase two: plan research lesson. In collaboration with the researcher, each team developed a research lesson connected to the learning goal from the first phase. The teams used lesson study protocols to account for the same components in their research lesson: “learning activities and key questions” (Stepanek et al., 2007, p. 166), “role of the teacher(s)” (Lewis & Hurd, 2011, p. 141), “expected student reactions or responses” (Stepanek et al., 2007, p. 167), and “points to notice or remember” (Lewis & Hurd, 2009). The teams developed a learning intention for the lesson that specified what students will know and be able to do as a result of the lesson, why students need to learn this skill and/or concept, and how students and

teachers will know the learning intention has been achieved (success criteria). A completed lesson plan protocol is included in Appendix G. Each team developed a lesson plan template that worked for their team and included the components detailed above. Lessons were designed to elicit student thinking. The facilitator posed questions to help the team think through each step of the research lesson plan in terms of how student thinking will be made visible. For the first round of lesson study, the decision to include external support (coaches, university partners, etc..) was not included as part of the process so that each team could work through the process on their own, build trust with each other, and identify when, where, and how they may need support (Puchner & Taylor, 2006).

After completion of the research lesson, a sample observation protocol was provided (Appendix H). Team B made changes to this protocol, to remove the “Evidence of Student Thinking” box and extend the “Demonstration of Learning” box. The team decided student thinking is included in demonstrations of learning. Teams A and C also used the revised observation protocol (Appendix I). The observation protocol included the learning intention for the lesson, and the success criteria that were used to determine whether students achieved the learning intention. Teams used the observation protocol to organize data collection during the observation phase of the lesson study cycle.

Each team developed a timeline for the implementation of the research lesson, the debrief of the research lesson, and the implementation of the revised research lesson. In a typical lesson study, one teacher from each team volunteers to teach the first research lesson. The teacher who is teaching the lesson provides each team member a copy of the seating chart for the class being observed as well as any information about individual students that the team may need to know. For example, the teacher may identify a student with very specific needs so that a team member

doesn't inadvertently cause an issue for the student. Teams B and C followed a typical lesson study format. Teacher 8 taught the research lesson for Team B and Teacher 10 taught the research lesson for Team C. Prior to the development of the research lesson, Team A created a unique approach to delivering the research lesson. They developed a schedule that provided an opportunity for each teacher to teach a version of the research lesson.

Research phase three: act/observation of research lesson. Sub coverage was secured for the teachers who observed the research lesson. On the selected day, Teams A and B, to include the researcher, observed the lesson while one member of the team taught the lesson. I was not able to observe Team C's research lesson due to schedule conflicts. Prior to the observation of the research lesson, I shared sample norms for the observation (Appendix J). The norms included focusing on what students are doing rather than focusing on what the teacher is doing since the purpose of lesson study is to understand how instruction impacts student thinking (Lewis & Hurd, 2011). All three teams used the norms I provided. Teams A and B decided the observing teachers would not interact with students as they engaged in learning. Team C discussed questions for the observing teachers to ask students to help them collect data regarding student thinking. The revised observation protocol (Appendix I) includes the learning intention, success criteria, and questions Team C developed for the observing teachers to ask.

Research phase four: evaluate/ reflect and modify. The teams determined when to debrief the lesson, either immediately following the lesson, later that same day, or the following day. Team A incorporated immediate debriefing sessions followed by implementation of the revised research lesson. Each teacher on the team taught the research lesson over the course of one school day. Teacher 4 taught the research lesson first period and the team debriefed and revised the research lesson second period. Teacher 2 taught the revised research lesson third

period and the team debriefed and further revised the research lesson fourth period. Teacher 3 taught the newly revised lesson fifth period and the team debriefed and made additional revisions sixth hour. Teacher 1 taught the revised research lesson seventh period and the team debriefed and made final revisions to the research lesson. Team B debriefed at the end of the day the research lesson was taught and Team C debriefed the following day during their common plan time.

I started each debriefing session by reviewing the group norms established during the first phase and sharing the protocol for the post lesson discussion (Appendix K) (Lewis & Hurd, 2011). The teacher who taught the lesson shared his or her thoughts regarding the teaching of the research lesson. After he or she shared, each group member used the revised observation protocol to share the student thinking observed in their assigned area of the classroom. The team engaged in reflection and evaluation of the research lesson, taking student responses and thinking into account. The debriefing log was used to guide the team's post lesson discussion (Appendix L).

From this point, each team determined whether revisions needed to be made and whether to reteach this lesson or to create a new research lesson to continue the lesson study cycle. As discussed in Research Phase 3, Team A engaged in a continuous cycle of debriefing, revising and re-teaching. Team B felt students met the established success criteria for the lesson. However, they decided to see how students performed on the unit assessment to determine if the research lesson needed revisions. Based on students' performance on the unit assessment, teachers decided further revisions were not necessary. Team C wanted to have another teacher implement the revised research lesson, but they ran out of time because of weather related school cancellations.

After completing the second classroom observation, the teams developed a final lesson study report that included the impact of the lesson on student learning and thinking, as well as teachers' final reflections on their own learning. Each teacher completed an individual reflection log (Appendix M) to prepare for the final report. The group discussion of teachers' individual reflections was used to create the final report. There is not a standard format for a lesson study final report. The teams used Stepanek et al. (2007) recommendations to include the following components: introduction, an overview of each phase of the lesson study process, and a conclusion that includes the revisions made to the research lesson, and the evidence that was used to make those decisions. Teams also included artifacts that represented the work that was done in each phase. (Stepanek et al., 2007). One of the team's final reports has been included in Appendix N.

Data Collection

Data were collected in each phase of the lesson study cycle to answer the following research question:

1. How does lesson study lesson study contribute to teachers' professional knowledge and continual learning?

Data were collected from a variety of sources during each phase of the lesson study cycle. Table 4 includes a list of the data sources collected, the rationale for using each source, and the data analysis look-fors. These look-fors were taken directly from the conceptual framework for the study. Each meeting was audio recorded using an external microphone and the researcher's laptop. The recordings of the meetings were transcribed using a transcription service. A total of 49 hours of recorded meetings were transcribed. The researcher took field notes during each meeting with each team of teachers.

At the conclusion of the lesson study cycle, the researcher conducted semi-structured one-on-one interviews (Appendix C) with each participant to understand how participants experienced the lesson study process. Participation in the interview process was voluntary. All twelve teachers agreed to be interviewed. One-on-one interviews were conducted in the teacher’s classroom during a planning period of the participant’s choosing or after school. An external microphone and the researcher’s laptop were used to record the interviews. Each interview was about 20-30 minutes in length. Interviews were transcribed using a transcription service. Table 4 provides a summary of data collection sources.

Table 4

Data Collection Sources

Data Source	Rationale	Data Analysis Look-Fors
Pre-Lesson Study Questionnaire	Develop baseline information about how teachers work together and plan for instruction, used to compare to post lesson study interview to see how lesson study impacts teachers’ content and pedagogy knowledge, collaboration, and teaching and learning resources	Teachers’ beliefs about student learning, collaboration, and instructional improvement; structures for collaboration, ownership of student learning, creation of teaching and learning resources to support collaboration and provide instruction; knowledge of students’ conceptual understanding and the instructional strategies that help to make this knowledge and thinking visible
Team Norms	Connected to building collaborative capacity of the team, shared ownership for professional learning,	Value inquiry and shared responsibility for student learning, focused on improvement of instruction

Table 4 (continued).

Meeting Agendas	Specified norm for each meeting builds collaborative capacity, documentation of the group’s work, could include components of pedagogical content knowledge	Shared responsibility for collaboration, expand content and pedagogy knowledge, inquiry focus
Meeting Notes	Documentation of group’s work over the course of the lesson study cycle, makes the team’s thinking (and changes in their thinking) about student learning and pedagogical content knowledge visible	Development of common understanding of pedagogical and content knowledge, shared ownership of student learning, improved content and pedagogical knowledge
Audio Recordings of Meetings	Captures the team’s dialogue during each meeting, could be used to help identify changes in the teams thinking regarding pedagogical content knowledge, student learning, team collaboration, and ownership for student learning	Development of common understandings of content knowledge and pedagogy, shared goal for student learning, evaluation of available and/or needed resources to support instruction, teachers’ beliefs about student learning, collaboration, and instructional improvement, inquiry focus; creation of teaching and learning resources to support collaboration and provide instruction, tools to make student thinking visible
Research Lesson	Illustrates teachers’ selection of instructional strategies, rationale for their selection, anticipated student misconceptions, plans for teacher’s response to misconceptions, helps teachers view the concepts and skills through students’ perspectives	Clear learning objectives and success criteria, connection between instructional strategies and intended student learning outcomes, focus on making student thinking visible during instruction

Table 4 (continued).

Lesson Observation Protocol	Shows each teacher’s interpretation of how students responded to the selected instructional strategies which illustrates their understanding of the connection between the instructional strategies and the development of student understanding (pedagogical content knowledge)	Collection of evidence of student thinking that was observed during the lesson, demonstrations of student learning
Norms for Lesson Observation	Development of structures that help build trust and capacity for collaboration	Focus on evidence of student thinking rather than teacher actions
Post Lesson Discussion Protocol	Development of structures that help build trust and capacity for collaboration, focuses the discussion on students’ actions and thinking rather than the teacher’s instruction, builds collective ownership of the lesson and student learning	Focus on demonstrations of student learning and student thinking
Post Lesson Debriefing Protocol	Builds collaborative capacity, focuses the discussion on making explicit connections between the goal for the lesson, the instructional strategies used in the lesson and the impact on student learning	Impact of instructional strategies on student thinking and learning, ownership of improvement based on student response, changes to pedagogy to improve student learning, evaluation of available and/or needed resources to support instruction
Lesson Study Reflection	Illustrates each teacher’s take-aways in the areas of student learning, pedagogy (student learning and pedagogy together comprise pedagogical content knowledge) and the lesson study process.	Teachers focus on changes in student learning between the first teaching of the research lesson and subsequent teaching of the research lesson, continued focus on inquiry and the impact of instructional strategies on student thinking and learning,

Table 4 (continued).

Lesson Study Final Report	Illustrates the teams’ final take-aways in the areas of student learning, pedagogy (student learning and pedagogy together comprise pedagogical content knowledge), the lesson study process, and their professional learning	Impact of the lesson study process on teachers’ pedagogical and content knowledge, knowledge of students’ conceptual understanding and the instructional strategies that help to make this knowledge and thinking visible, evaluation of available and/or needed resources to support instruction
Post Lesson Study Interview Protocol	Compare to pre-lesson study responses to see how lesson study impacts teachers’ content and pedagogical knowledge, collaboration, and teaching and learning resources	Teachers’ beliefs about student learning, collaboration, and instructional improvement; structures for collaboration, ownership of student learning, creation of teaching and learning resources to support collaboration and deliver instruction; knowledge of students’ conceptual understanding and the instructional strategies that help to make this knowledge and thinking visible

Data Analysis

Field notes, lesson study artifacts, and interview transcripts were manually coded in two stages. The first cycle of coding was a combination of provisional coding and in vivo coding (Saldana, 2016). Provisional coding is used when the researcher has predetermined the codes based on a literature review or previous research (Saldana, 2016, p. 168). Field notes, and lesson study artifacts were manually coded using provisional codes developed from the conceptual framework for the study: changes in teachers’ knowledge, beliefs, professional community, and teaching resources. In vivo coding was used to capture the participants’ voices (Saldana, 2016, p.

106). This coding technique lends itself to action research in which understanding the participants' experience is an important component of the research (Saldana, 2016). Interview transcripts were coded using in vivo coding to develop an understanding of how the teachers experienced the lesson study process. Participant responses were entered in a spreadsheet to place the corresponding questions from the questionnaire and the interview next to each other (Appendix O). This made it easier to see changes in teachers' knowledge, beliefs, professional community, and teaching resources.

Axial coding was used to bring the provisional codes and in vivo codes together to determine if these codes are related, and to identify any resulting major categories (Saldana, 2016). These categories were compared to the conceptual framework to determine how the lesson study process impacted teachers' knowledge and beliefs, teachers' collaborative capacity, and the development of teaching resources. Another spreadsheet was created to combine the provisional codes and in vivo codes from all of the data sources (Appendix P). Through the combining of codes, themes began to emerge across the teams and the data sources. For example, all three teams shared instances (through multiple data sources) of how observing the impact of instructional strategies on student learning helped them change their teaching practices. The themes were used to develop the assertions presented in Chapters 4 and 5.

During the provisional coding process, several themes emerged that were not connected to the conceptual framework for the study: student behavior, district adopted resources, district lesson plan templates, and the model of core instruction embedded in South School District's TLC. Teams A and B repeatedly discussed behavior of students with the introduction of new instructional strategies or approaches. Additionally, Teams A and B shared concerns about the district adopted resources and the district lesson plan templates. These teachers identified

contradictions between the TLC's model of core instruction and the model of instruction found in the articles they read. The themes were organized and addressed through the Resource Assertion and the Barriers Assertion. While these themes are not directly connected to the conceptual framework for this study, the themes could be potential barriers to implementing lesson study.

Trustworthiness

The use of a variety of data sources provided multiple opportunities for the triangulation of data. For example, the audio recordings of meetings, the individual observation protocols, and the individual lesson study reflections were compared to understand how each teacher changed as a result of the lesson study process. The coding of teacher's semi-structured interview was compared with coding of the teacher's artifacts from the lesson study to see if similar categories emerged. This provided a comparison of the teacher's espoused beliefs (interview coding) with the teacher's actual beliefs (artifact coding). Member checking was not completed due to time constraints. However, during the interview process, the researcher asked follow-up questions to help the teachers expand on their answers. For example, when teachers described the lesson study process as "powerful," the researcher prompted the teachers to explain what "powerful" means to them.

Researcher Positionality

As an employee of the research site for the last 19 years, I have been involved in the development and implementation of the Teaching and Learning Cycle. I was a building level administrator for eleven years, which meant I was responsible for the supervision and evaluation of licensed staff before and after the implementation of the Teaching and Learning Cycle. Based on this experience, I have developed my own beliefs about the depth of implementation of the

Teaching and Learning Cycle using traditional models of professional development. To limit bias, I have bracketed these beliefs to keep them separate from this study and to keep myself open to the research process. As a facilitator, my knowledge of the lesson study process was helpful, however, the use of the structured lesson study protocols kept me from leading the team in a direction that is influenced by my beliefs. When Team A wanted to create a different structure for teaching and debriefing the research lesson, I started to explain why that was not a good idea. The lesson study protocols helped me facilitate rather than direct the development of their structure.

A power differential existed between me and the teachers who participated in the study. In my current role, I am a district level administrator. However, I am not involved in the evaluation and supervision of licensed staff. I made sure each team knew that I am not responsible for evaluating licensed staff members and that their participation in the study was completely confidential. The purpose of the study (to improve professional learning for teachers across the district) was clearly communicated to all three teams. Identifying information about the teachers engaged in the study was omitted to maintain confidentiality and trust. Teachers were willing to be transparent about what they did not know and where they need help.

Limitations

Several limitations emerged over the course of the study. The first limitation was time. All three teams expressed the need to begin the lesson study cycle at the start of the school year so they have enough time to complete several iterations of the cycle. Teams B and C began the process in the middle of the year. Team C was not able to teach the revised lesson. Team B wanted to have more time to implement what they learned about pedagogy through the lesson study process. Even though Team A completed multiple revisions and re-teaching, they wanted

to start another lesson study cycle to address the gaps in student learning identified through the lesson study process.

Another limitation is access to resources that support teacher learning. The researcher and one teacher were able to provide articles or book chapters to address the needs identified by each team. Both the teacher and the researcher had access to university databases because of their enrollment in graduate programs. These articles and book chapters promoted in-depth discussions of content and pedagogy. If the members of the team do not have access to relevant resources, it will be difficult to engage teachers in meaningful learning.

The changes in teachers' knowledge and beliefs about content and pedagogy, in teachers' professional community, and in the learning resources created through lesson study take time to evolve and develop. The teams only conducted one cycle of lesson study. While the teams continued to use what they learned in the short term, additional research needs to be done to analyze the long-term results of lesson study on teacher practice.

CHAPTER IV: FINDINGS

The purpose of this study was to create a lesson study framework that content area and grade-level teams of teachers can use to develop and implement their own professional learning connected to student learning goals over the course of a school year (Bradley, 2015). The following research question guided the study:

1. How does lesson study contribute to teachers professional knowledge and continual learning?

The conceptual framework for the study was built from the three areas (*Intervening Changes*) that contribute to teachers' professional learning: teachers' knowledge and beliefs, teachers' professional community, and teaching and learning resources in the lesson study model (Figure 2) developed by Lewis et al. (2009). The conceptual framework (Figure 1) identifies the anticipated changes to teachers' professional learning.

After an initial phase of open coding, the "*Intervening Changes*" were used for provisional coding. Six themes emerged through the provisional coding of the data. Four themes aligned with the expected *Intervening Changes*: teachers' knowledge and beliefs- content, teachers' knowledge and beliefs- pedagogy, teachers' professional community- collaboration, and teaching-learning resources. Two additional themes emerged that were not connected to the conceptual framework for the study: role of the facilitator and barriers. Axial coding was used to develop descriptive characteristics for each theme. The descriptive characteristics were used to develop assertions about the lesson study process. The following chapter presents the evidence that supports the six themes, the descriptive characteristics, and concluding assertions. I was the facilitator during this process, and I have used the term facilitator rather than researcher because of the emergence of the importance of the role of the facilitator.

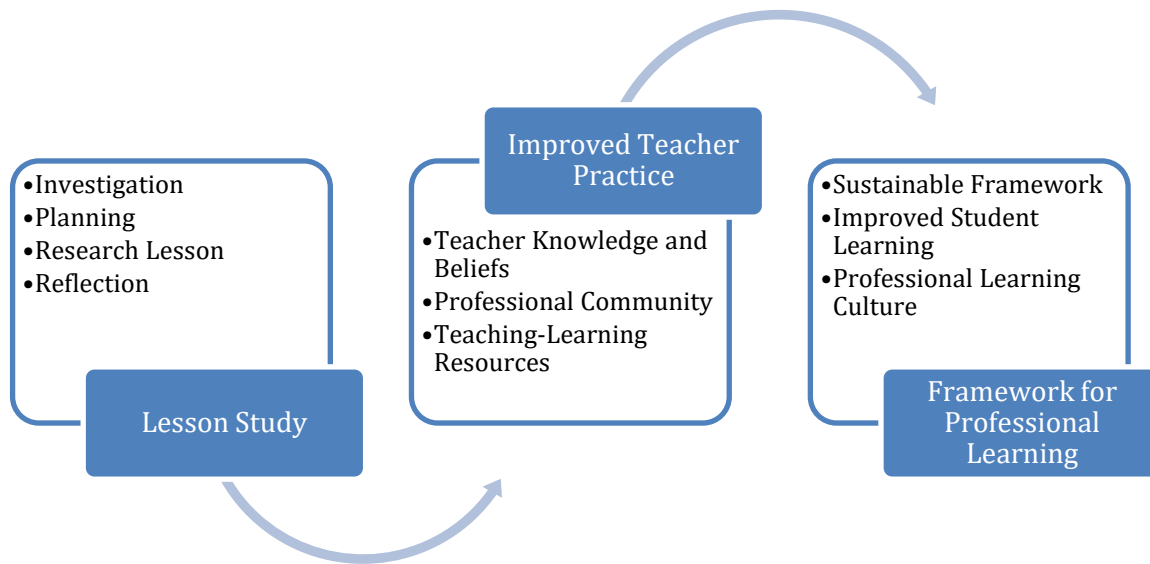


Figure 1. Conceptual framework- Combination of Guskey’s (2002) framework for effective professional learning and Lewis et al. (2009) framework for lesson study.

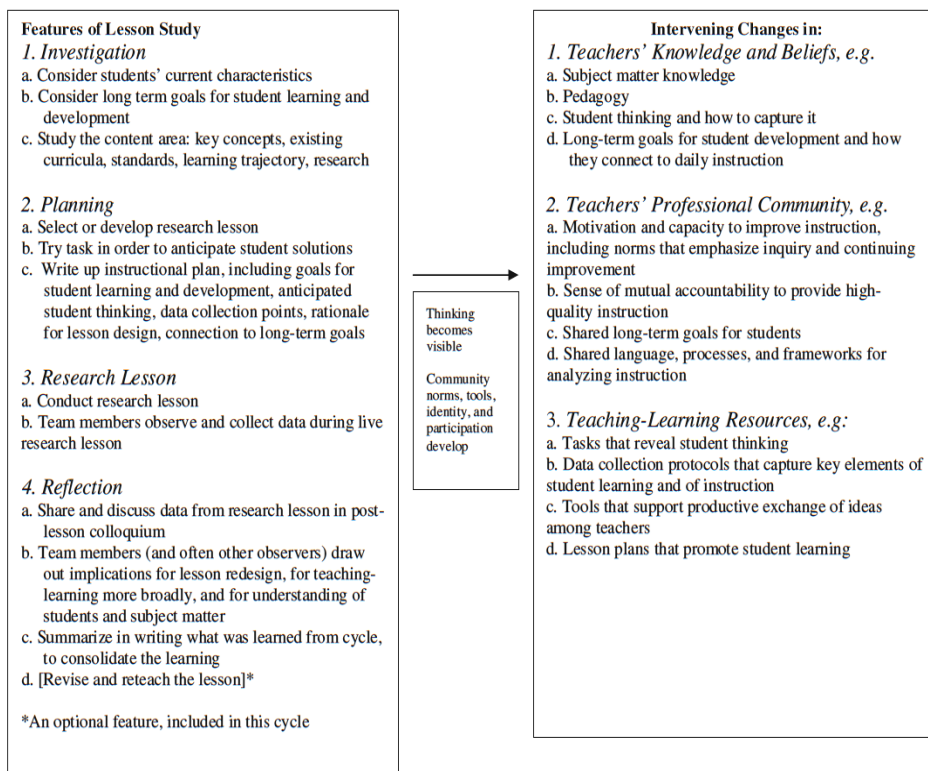


Figure 2. Instructional improvement through lesson study (Lewis et al., 2009, p. 287).

Theme 1: Teacher Knowledge and Beliefs- Content

Teacher and student understanding of content emerged as a theme across all three teams. Content knowledge is defined as the teachers' understanding of students' prior knowledge, the impact of this prior knowledge on new learning, and how students make meaning of content specific knowledge (Ball et al., 2008). Teacher knowledge and beliefs about content was operationalized in three ways: (1) teachers focus on developing students' conceptual understanding of content. (2) teachers develop their own conceptual understanding of content. (3) teachers were willing to share what they did not know about their content.

Teachers focus on developing students' conceptual understanding of content. Team B engaged in repeated conversations about students' conceptual understanding of content. The teams struggled with the need to build students' conceptual understanding of telling time versus teaching students' rules and tricks for telling time. During the second meeting, teachers shared pre-assessment data regarding students' ability to skip count by five. This skill was identified by the teachers as necessary prior knowledge. The pre-assessment was designed to require students to count forwards and backwards by fives starting from numbers other than zero. Although students should have learned this skill in kindergarten, they did poorly in the pre-assessment. One of the veteran teachers on the team expressed her concern with the structure of the pre-assessment. She felt students knew how to count by fives but were confused by the layout of the assessment.

I really think it's like the alphabet, I honestly want to take the same page, white out the numbers and stick H in one and M in another and see how many of them can do that. I really just think, it was taken out of context, the way they were used to seeing it. "They're used to, "Okay, count by 5s!", Okay! 5, 10, 15, 20! They aren't used to, "Okay, now start at 25." I think we just really took them out of their comfort zone. (Teacher 8, December 19, 2018)

The facilitator asked the teachers,

Do you think they conceptually understand counting by fives, if they know to start with five and go up? Do you think it's important for them conceptually, as we move into time, for them to be able to move forward and backward and start in different places?
(December 19, 2018)

Teachers made changes to how they have students practice skip counting by fives to have them start counting at different numbers.

However, students continued to struggle with concept of skip counting. When students had to apply skip counting to the arrangement of minutes on an analog clock, their lack of conceptual understanding was evident. On February 27, 2019, Teacher 7 shared, "Well, they're not realizing that they're looking at the numbers on the clock. They're not conceptually getting that the minute hand, if it's pointing to the one is actually five minutes." Teacher 5 shared that when her alarm goes off; she asks students, "What number is the minute hand pointing to? What number does that represent in minutes? The higher students are able to answer it." She went on to explain that she is concerned that even with the repetition, students are not developing a conceptual understanding of how to tell time.

Teacher 7 suggested the team use one of the activities from the article the facilitator shared to make an explicit connection between skip counting by fives and the number of sets of fives represented by the numbers on the clock. On March 6, 2019, the teachers shared how the activity impacted students' thinking. "I said write the twelve. When we start on our clock, we start at our twelve. We haven't said a number yet. We're at zero, and then we started counting, and they were like dink (referring to ticks on a clock) dink dink..." (Teacher 5, March 6, 2019). She went on to say that once students got to fifteen, they understood the pattern. One student recognized and corrected his mistake with counting. Teacher 8 indicated her students were also able to successfully make the connection between the organization of the minutes on the clock and skip counting by fives. "So I thought this was very beneficial. It seems so simplistic"

(Teacher 8, March 6, 2019). The other two teachers had not done the activity with their students prior to the meeting on March 6. The team's pedagogy and learning resources that were created through the exploration of students' conceptual understanding will be discussed in later sections.

Teachers develop their own conceptual understanding of content. Team A worked on developing their own conceptual understanding of content. The focus for their lesson study was the calculation of unit rates. The team engaged in repeated conversations about how to define fractions, ratios, rates. On February 4, 2019, the team used the article provided by Teacher 4 to discuss the difference between a ratio and a fraction. Teacher 3 read the definition of a fraction from the article. "A fraction is a number that names part of a whole or part of a group. The denominator represents the total number of the equal parts the whole is divided into. A ratio is a comparison of two quantities" (February 4, 2018). The facilitator responded with "In my mind, you have to name those quantities" (February 4, 2019). Teacher 1 agreed, describing those quantities as being anything. "So the differences are very slight" (Facilitator, February 4, 2019). "I guess I don't get it" (Teacher 2, February 4, 2019). Teacher 1 attempts to explain, "I got seven out of ten questions. But that's very different than there are seven girls for every ten boys so I think the labels are important" (February 4, 2018). "Or if I just say seven-tenths" (Facilitator, February 4, 2019). "So it's all about words and how you use them, more so than..." (Teacher 3, February 4, 2019). There was a moment of silence after this realization where teachers appeared to be processing this information. After letting the teachers process for a minute, the facilitator said, "So I think that, that's kind of an interesting... I mean we're gonna have to be able to agree as a group because that's going to impact how we instruct kids" (February 4, 2019). Teacher 3 began to see the relationship between fractions and ratios differently as result of the discussion of the article. "Because really now, what I'm thinking is maybe its opposite of what I was thinking.

Like a ratio is a fraction. Like the fraction is the umbrella and a ratio is under the umbrella” (February 4, 2019).

After the conversation on February 4, 2019, the facilitator provided a chapter from *Teaching Fractions and Rates for Understanding* (Lamon, 2012). This chapter helped teachers clarify their understanding of fractions, rates, and ratios. Through the identification of a common student misconception, “That one over two is not equal to two over one. Two girls to four boys is not the same as four boys to two girls” (Teacher 1, February 25, 2019). Teacher 2 realized she has been teaching ratios incorrectly. “And then I realized I’ve been teaching that wrong all these years. I’ve been telling them that yes, it is the same, ‘cause it’s still two girls and one boy no matter which way you put it“ (February 25, 2019). Teacher 3 asked, “Why is it, why is it wrong” (February 25, 2019)? “According to the article, it’s not the same, but they don’t say why” (Teacher 2, February 25, 2019). “Well, the only reason I would say it’s not the same is because $\frac{2}{4}$ is different than $\frac{4}{2}$ ” (Teacher 3, February 25, 2019). The facilitator references context as being a key component of ratios.

If you say they’re the same, then essentially what you’re saying to the kids is no matter how the question is worded, it doesn’t matter the order with which you put the ratio, but it does matter the order in which you put the ratio, because it describes the relationship differently. So the relationship of girls to boys, unless I have equal numbers of boys and girls, is not going to be the same as the relationship of boys to girls. (Facilitator, February 25, 2019)

Teachers continued to think about their conceptual understanding of ratios and unit rates as they developed the success criteria for the lesson and the thinking they wanted students to demonstrate. However, the team never came to a clear consensus of how they were going to define and differentiate between fractions, rates, and unit rates.

The initial teaching of the research lesson did not account for context when determining unit rate. Teachers noted that students struggled to set the unit rate ratio up correctly. Their

conversation started with the instructional video that is a supplemental material with the district adopted text. They noted the instructor did say she was looking for price per cupcake, but she did not explain why she put money in the numerator of her unit rate. Teacher 2 questioned whether the team should just tell students money is always going to be on top. “Because I was like do we just tell them to put the money on the top all the time? It’s not always going to be right, but more often than not it will be” (March 15, 2019). The facilitator encouraged teachers to think deeper by having students think about what the problem is asking students to find the cost of.

At the end of the research lesson and reflection, teachers and students continued to struggle with their own conceptual understanding of ratios and unit rates. However, during the one-on-one interviews, three of the four teachers referenced their understanding of rates and ratios in their answers.

The thing that was different to me is I wasn't thinking about all the technical things like the fraction, whether it is a fraction or it is a ratio. That lesson that we read about with all the different representations and trying to figure out what was what, I struggled with that. So I know the kids struggled (Teacher 1, Interview).

“What I learned about the content? That ratios and proportions are not the same thing or could be. That I learned much more about just the why of unit rate than just the process” (Teacher 2, Interview).

That there's a lot more to ratios than I thought that there was. Like rate is a specific kind of ratio and the fractions and you have to label it, otherwise it is not a ratio it is just a fraction so I learned a lot about ratios (Teacher 4, Interview).

Based on teachers’ interactions during the lesson study process and their answers from the interviews, it is evident that lesson study contributed to their conceptual understanding of fractions, ratios, rates, and unit rates.

Teachers’ willingness to share what they do not know or understand. During the second team meeting, Teacher 3 shared her struggles with teaching students when and how to

draw models during the problem-solving process. “They (students) don't know when... When to draw a model, when to do a bar diagram, when to do a picture. I don't know how to teach that. I'll be honest, I don't know how to teach that (Teacher 3, November 5, 2018). Team A's discussion and process of developing their own conceptual understanding of fractions, ratios, rates and unit rates is also an example of how teachers were willing to publicly share their thinking. At several points in the discussion, teachers shared their misconceptions, and how they have been teaching the concept of ratios incorrectly. During a discussion of how to pose questions to students that provide purpose and structure for play to help students make connections between the play and their math learning, Teacher 6 shared,

Well I think the problem that I sometimes run into is that I just don't know how to do it. Like I know what you're saying and I agree, but figuring out, knowing the right kind of question and knowing how to incorporate those blocks into play is...you know, I think that my problem is I just don't know how to go about doing that to launch a lesson (January 24, 2019).

In his one-on-one interview, Teacher 10 noted that the lesson study process itself provides a safe environment for teachers to connect with other teachers who are experiencing similar struggles. “And the emphasis is not on the teacher. And so you might have skill gaps with different teachers on how well they can implement these techniques” (Teacher 10, April 30, 2019). Since the focus of lesson study is investigating the impact of instruction on student learning, teachers may feel more comfortable sharing what they do not know so they can improve student learning. The descriptive characteristics of the Teachers' Knowledge and Beliefs about Teaching- Content theme and the supporting evidence led to the assertion that lesson study provides a safe learning environment for teachers to explore their conceptual understanding of content, and how to develop students' conceptual understanding of content.

Theme 2: Teachers' Knowledge and Beliefs- Pedagogy

Teacher pedagogy emerged as a theme across all three teams. Pedagogy is defined as teachers' knowledge of how to teach their content in a way that helps students develop a conceptual understanding of the content (Ball et al., 2008). It is separated here from teachers' content knowledge to help with the organization of the themes and descriptive characteristics that were collected through the lesson study process. However, content and pedagogy are closely related. The work that Team B did to build students' conceptual understanding of skip counting and telling time was used to develop instructional strategies to implement in the classroom. The discussions that Team A had to develop their conceptual understanding of fractions, ratios, rates, and unit rates helped the team develop learning intentions, success criteria, and to identify student misconceptions during the instructional planning. This theme was operationalized in two ways: 1) teachers observed the impact of their instructional strategies on student learning; 2) sustainable pedagogical practice.

Teachers observed the impact of their instructional strategies on student learning.

This component was noted across all three teams. Over the course of the lesson study cycle, Team B created numerous resources that were intentionally sequenced to provide repetition of the prior knowledge that students need to tell time to the nearest five minutes. These resources will be discussed in greater detail in a later section. Through the development of these resources, teachers realized two things: students need to be taught how to use the resources and anchor charts available to them; and students need a lot of repetition to build their prior knowledge and apply it to new learning. During the meeting on December 19, 2018, teachers discussed students' inability to use context clues on the counting by fives pre-assessment.

So them not knowing that, so you know they got through the second row and then them not knowing that they could look at the second row to get through the third row to get them started was interesting for me to see. (Teacher 6, December 19, 2018).

On January 24, the teachers shared frustration with students' inability to transfer play with manipulatives into math learning. The teachers indicated they have not shown students how to use the manipulatives. Students were given opportunities to play with the manipulatives.

Didn't we set the timer for like two minutes? I think I set the timer for like two minutes. Okay, you get two minutes to play, okay, put them back, set them on your name tag. Don't touch them. And then when it was time to solve the math problems, my higher kids never touched them, and my lower kids didn't know how to use them correctly (Teacher 8, January 24, 2019).

After implementing multiple activities that gave students the opportunity to play with time, Teacher 8 noted an "ah-ha" moment,

We brought in a lot of additional resources to support the target that we were trying to reach. It was interesting, I learned a lot about, I guess the way students respond to those different things, and things that I think you would assume that they would understand, you really have to pre-teach every little bit of it (April 5, 2019).

In addition to explicitly teaching students how to use their resources, the teachers on Team B made note of the number of repetitions that students needed to develop a conceptual understanding of content. Three of the teachers discussed this in their interviews. They shared having previous knowledge of the need for repetition. However, the lesson study process helped them develop an appreciation for the power of multiple repetitions and the number of repetitions needed to help build students' conceptual understanding. "I think I always knew that they need those multiple repetitions, but this is the first time it's truly been like every single day we were doing something that involved time" (Teacher 5, April 19, 2019). "So, with our curriculum especially, it goes from one thing to another without giving the students repetition. So, we've had to include it ourselves. And that really opened my eyes when we were doing time" (Teacher 7, April 5, 2019.).

Time to incorporate the repetition that students needed was also something that teachers previously thought they couldn't do. In her Pre-Lesson Study Questionnaire, Teacher 6 discussed not having enough time to provide the repetition and differentiation needed to meet students' needs.

Perhaps the other classes in my grade level did well, but my students need re-teaching. When do I do that? How do I fit that in if we are all expected to be teaching the same things at the same time (Teacher 6, Pre-Lesson Study Questionnaire)?

In her final interview, Teacher 6 shared how the lesson study process helped her see how to incorporate repetition of skills for all students by looking for ways to build the repetition into the daily routine. "I think, and just seeing how little time it takes to bring in different skills throughout the day, you just have to be mindful of it, and thoughtful of doing it that way." After collaborating with her peers to develop activities to provide repetition of skills, Teacher 6 was able to see she could utilize instructional time more effectively to promote student learning.

As Team B began to see improvement in students' understanding of skip counting, they began to discuss how they could incorporate more opportunities for students to practice this skill. "I thought that was telling that already I feel like it's making a difference. And now that you mentioned that I think tomorrow I'm going to make them count by fives past 100 and see what happens" (Teacher 8, January 17, 2019). Teachers 7 and 6 also shared their plans to have students practice skip counting again. "Yeah, I did my too before, but I want to do it again after" (Teacher 7, January 17, 2019).

Team C also saw how repetition and teaching students how to use their resources can have a significant impact on student learning. The team focused on improving students' ability to make a claim and support the claim with evidence and scientific reasoning. Students were using every piece of evidence gathered whether or not the evidence supported the claim. The team

developed a graphic organizer, which will be discussed in a later section, to help students prioritize and evaluate the evidence they collect. Teacher 12 noted the importance of providing multiple opportunities for students to use the graphic organizer to help students improve their writing.

The benefit of that repetition like that. How much can we practice this, and the more we practice the better it's going to be, and not just like, "Well, here's our fifth one and then we're done for the data." This is a good value, this is a valuable tool, and strength that I want them to be able to use going forward (Teacher 12, April 29, 2019).

In addition to repetition, teachers noticed through direct observation of students using tools that are designed to elicit student thinking, it doesn't really take as much time to help students think more deeply. "That it doesn't take that much longer with the right tools for them to be more accountable in their learning" (Teacher 12, April 29, 2019). Another teacher shared how lesson study helped him understand the importance of scaffolding instruction.

What I've learned now is that scaffolding simply means that you're teaching students a new language of thinking so that you get to a point where they find a situation that's similar, so then they can translate to that new language. But all that's really doing is making it accessible to them, because you're still requiring them to do the thinking. You are just providing that flow that you need them to eventually be able to do on their own (Teacher 10, Interview).

While teachers have previously learned these instructional strategies, seeing how the instructional strategies directly impacted student learning, helped teachers understand the value of the instructional strategies to make student thinking visible.

Team A also discussed the value of seeing how instructional strategies impact student learning. During one of the meetings, the facilitator shared how another lesson study group learned that intentionally grouping students generates richer conversations among students. "The first teacher strategically grouped kids and the second teacher did not strategically group kids" (Facilitator, February 20, 2019). Conversations among students in the first teacher's classroom

resulted in multiple ways to solve the same problem while the conversations in the second teacher's classroom yielded limited ways to solve the problem. Teacher 3 felt it was valuable to hear how instructional strategies affect student learning. "See, those are good things to learn though" (February 20, 2019). Lesson study also helped Teacher 3 understand the value of formative checks for understanding to help improve student learning. She has been employed by South School District since the inception of the Teaching Learning Cycle. Formative checks for understanding have been the focus of numerous professional development offerings. After observing the research lesson, Teacher 3 shared her "ah-ha" moment regarding the power of exit tickets to inform her instructional planning.

And I think I realized watching the lesson study how important it is to have some kind of an exit ticket. Because in your mind you're looking at these kids. In my mind, I guess. I'm looking at these kids and thinking, oh they get it because there's ten of them that are out loud ... replying to what questions I ask or whatever. But then those other thirteen that sometimes are truly struggling and you don't see that unless you have an exit ticket. Not just verbal, not just thumbs up, thumbs down. 'Cause we do a lot of that at the end of class. We always have some kind of closure, but it is never, it is not always an exit ticket or something written. And I think having that written document. And then the other thing that we really, we came back to that exit ticket the next day, so we went through and graded them (Teacher 3, March 21, 2019).

Despite having participated in previous trainings on how to use formative checks for understanding, direct observation of how to use the instructional strategy to elicit student thinking helped Teacher 3 understand why she needs to use the strategy.

Sustainable pedagogical practice. During the debrief of the research lesson and their interviews, Team B discussed how they are continuing to use the instructional strategies they developed during the lesson study process. Teachers are much more aware of the need to explicitly teach students how to use anchor charts and the resources in the classroom. "We talked about, we've started money now, and the anchor chart, the kids refer to it" (Teacher 8,

Interview). The teachers discussed how valuable it is to build students prior knowledge by frontloading the skills they need prior to teaching new lessons.

With our curriculum especially, it goes from one thing to another without giving the students repetition. So, we've had to include it ourselves. And that really opened my eyes when we were doing time. And so, we've included it for money and measurement (Teacher 7, April 5, 2019).

During her interview, Teacher 5 shared how she is going to start the next school year by planning for multiple activities that will help to build the prior knowledge that the district's adopted text assumes all students have. "Even with me going to first grade. I know what they struggle with in second grade and I can pre-load them there in hopes that they can be more successful" (Teacher 5, Interview).

Teacher 3 used the revised instructional strategies that were developed through the research lesson to teach the rest of her students that were not part of the research lesson.

The next day with the classes that we didn't teach that day, we went over those changes. We specifically talked about labeling and we specifically talked about the division and how it worked and why it worked that way. And we even did a problem where the larger number wasn't the divisor (Teacher 3, March 21, 2019).

She elaborated on how she gave students the opportunity to make mistakes and then pose questions to help students identify and fix their mistakes. This was a technique that was discussed and modeled during the research lesson. Teacher 3 carried this strategy into her classroom.

During his interview, Teacher 10 noted that he is focusing more on eliciting feedback from students during his instruction in all of his classes.

I am taking a lot more time to get feedback from students to understand what their thinking is and what their process of thinking is. I am asking more and more questions in all of my classrooms. Asking them just more generalized questions like, well, where do I go next? Or where do you think you should go next? Or what resources do you have to help you in this situation? And so- Yeah. So I'm trying to figure out ... Because then based on their answers from that, I'm able to find gaps in where their procedural thinking

is, and that's just as important as knowing content wise, what they know and what they don't know (Teacher 10, April 30, 2019).

His questioning technique has changed because of the questioning strategies that were used during the research lesson. Making student thinking visible has enabled him to better predict and prepare for student misconceptions. "I was able to acknowledge the misconceptions that my students were having, and where they're specifically getting stuck. And then for our closure that day I was providing supplementary content or strategies to help them with those misconceptions" (Teacher 10, April 30, 2019). The descriptive characteristics of the Knowledge and Beliefs about Teaching- Pedagogy theme and the supporting evidence led to the assertion that direct observation of the impact of instruction on student learning increases teachers' use of instructional strategies in the classroom.

Theme 3: Teachers' Professional Community- Collaboration

Teachers' Professional Community-Collaboration theme is defined as collaboration among teachers to develop a shared language and knowledge of their content and how students will interact with this content (Stepanek et al., 2007). Teachers' professional community (collaboration) was operationalized in three ways: 1) collaboration focuses on examining content and pedagogical issues in depth; 2) teachers feel accountable and responsible to each other and their students; 3) provides a voice for new teachers. These characteristics emerged across all three teams.

Collaboration focused on examining content and pedagogical issues in depth.

Teachers were asked to describe their typical planning and collaboration patterns in the Pre-Lesson Study Questionnaire. It was evident that most teams were not using their common plan time to engage in in-depth discussions of content and pedagogy. It was more typical for teachers to review student data and discuss how they were going to sequence each unit or topic. Team A

meets once a month as a department for vertical planning. “Teacher 1 leads that and goes through and does the meetings with us so that we can all make, or be on the same page. We don't get into things like that (referring to discussion of their own conceptual understanding of content)” (Teacher 2, February 4, 2019). Each grade level team meets weekly. Their discussions were more focused on pacing than planning and collaborating.

Outside, we're much less specific outside. It's more what are you teaching on Monday? What lesson are you teaching on Tuesday? How long does lesson three take? We don't talk specifics like that. Sometimes in our PLCs we will pick something and talk about how we teach it. It's just us telling other people how we teach it. Nobody really ever, we don't ever plan an actual lesson together (Teacher 3, March 21, 2019).

Team B shared similar collaboration patterns. “We meet during our regularly scheduled PLC time and adhere to our norms” (Teacher 6, Pre-Lesson Study Questionnaire). “We take our curriculum and map out what we are going to teach each week and what other resources we will use that expand from the curriculum” (Teacher 7, Pre-Lesson Study Questionnaire). Team C was unique in that it was made up of teachers from two different content areas (biology and physics). While the entire department had a daily common plan, this group did not necessarily plan together. However, they also shared similar patterns of collaboration.

We would reflect on how a lesson "went" with students: general uptake from the students, flow of the lesson, qualitative assessment on helping students reaching a learning target. We would then try to improve on the lesson, sometimes diving as far back as addressing the purpose of the lesson. Frankly, the process feels superficial compared to our need to check on student learning in a concrete way (Teacher 10, Pre-Lesson Study Questionnaire).

“We meet during a common plan hour to discuss and plan curriculum at a minimum of once a week oftentimes more. We try to integrate new ideas and activities as often as possible” (Teacher 11, Pre-Lesson Study Questionnaire).

The depth of teachers' collaborative conversations about content and pedagogy has been illustrated in Assertions 1 and 2. Teachers' responses during their final interviews demonstrated

their awareness of the difference in their collaboration through lesson study. “Collaboration is so powerful” (Teacher 6, April 5, 2019). When prompted to describe what she meant by powerful, “I think that it enhanced it (referring to lesson study). The time that was spent, the time that we were able to spend on it enhanced the quality of instruction. I think that it ... that the lesson study provided better materials” (Teacher 6, April 5, 2019).

It was a valuable experience to me to work with my colleagues and not just say, "Hey, we're going to do 4-1 on Monday. We're going to do 4-2 on Tuesday. We're going to do a test on Wednesday, but really get down into the nitty gritty, the details of what we're doing (Teacher 1, March 22, 2019).

“I thought meeting so much with them extra, I was really able to see like how they taught, how they thought as well and how they've done things. So, it really helped me to prepare my teaching” (Teacher 7, April 5, 2019). Lesson study gave teachers the opportunity to collaboratively examine content and pedagogy to support student learning.

I mean we discussed those misconceptions. You don't necessarily discuss those misconceptions in PLC. You might in PLC evaluate the data of, oh, this is what they did, and then maybe I'm going to go back and reteach. But with lesson study you're already looking at it to begin with. So you are already picking up on what those misconceptions might be and how you are going to approach them before they ever happen (Teacher 1, March 22, 2019).

Overall, collaboration through lesson study was more focused on content and pedagogy than traditional forms of collaboration.

Teachers felt accountable and responsible to each other and to their students. For Team A, Teacher 1 shared feeling more accountable and connected to her colleagues. “I held myself more accountable for getting things done, but it was also great to work with colleagues and learn that other people have the same struggles or to bounce ideas off of each other” (March 22, 2019). In addition to feeling more accountable to her peers, Teacher 2 extended that accountability to changes in her instruction.

It held me more accountable to making sure it happened. The lesson, that it happened on time, because I personally tend to apparently over teach things and I probably ... it probably would have taken me another week to get to that lesson if I had been doing it on my own (March 22, 2019).

For Team B, Teacher 8 expressed a strengthening of the team's collaboration through accountability. "We've always worked together collaboratively but, I feel like maybe holding each other a little more accountable, instead of I forgot, or something like this" (April 5, 2019).

For Team C, Teacher 12 indicated the sense of accountability pushed her to reflect so that she was ready to contribute to the collaboration. "Knowing that I get to take my information back to the group helps me be more reflective as I'm grading their written work" (April 29, 2019). When asked what she meant by this statement, she elaborated, "More aware of the gaps in their thinking, or the strengths of a certain tool" (April 29, 2019). Having to take her thinking back to the group helped her reflect more deeply on how she was evaluating student work so that she was able to explain her thinking to her peers. Accountability to her peers also motivated her to push herself and her students.

Having people who are creating more rigorous expectations for their kids, and having that voice to help me create more rigorous expectations for my freshmen. It helps me... be motivated. I would not have done that without them. There is no way I would have done that without the lesson study (Teacher 12, April 29, 2019).

Collaboration provided a voice for new teachers. Team B was the only team that included a first-year teacher. During the final interviews, the new teacher and one of the veteran teachers noticed a change in the new teacher's participation over the course of the lesson study cycle. On February 27, 2019, Teacher 7 (first year teacher) connected students' continual struggle to conceptually understand skip counting to their struggle to understand how minutes are arranged on a clock. Based on her recommendation, the team modified an activity from the article I shared earlier in the process. Prior to Teacher 7's recommendation, the group was not

interested in using any of the activities from the article. In her final interview, Teacher 6 noted, “Teacher 7 was real quiet at first. And then she started putting it in... ”(April 5, 2019). Teacher 7’s confidence in sharing her thoughts with the team increased as she implemented the strategies in her classroom. “And now that I’m seeing it and front loading as well, I’m able to participate. Yeah, I know. At first, I was just so quiet. And now I’m like, hey I can have an input now” (April 5, 2019). The descriptive characteristics of the Teachers’ Professional Community-Collaboration theme and the supporting evidence led to the assertion that teachers developed a shared sense of responsibility as they focused on examining content and pedagogical issues.

Theme 4: Teaching and Learning Resources

Teaching and learning resources are defined as the artifacts that are generated through the lesson study process that illustrate student and teacher thinking (Lewis & Hurd, 2011; Stepanek et al., 2007). All three teams generated the teaching resources that are part of the lesson study process: meeting agendas, a detailed research lesson, and final lesson study report. This theme was operationalized in three ways: 1) teachers created resources to support student learning and tested the effectiveness of these resources; 2) the district-adopted resource (text) is lacking supplemental materials needed to help teachers facilitate student learning; 3) district common math lesson plan templates for elementary and secondary are burdensome and lack instructional value for teachers.

Teachers created and tested the effectiveness of resources to support student learning. At the start of the lesson study process, Team A created a problem-solving template to help students work through multi-step problems. The template included a six-step process: 1) highlight important information; 2) what do you know/need to find out; 3) solve using a model or table; 4) solve using an algorithm or equation; 5) does the answer make sense; 6) use RACE

format to explain your answer (Meeting Agenda, November 5, 2018). RACE is a format for writing: restate the question, answer all part of the question, cite evidence, explain using evidence (Meeting Agenda, November 5, 2018). The template was used for about a month for “Word Problem Wednesday.” When students followed the steps, teachers were able to see student thinking. During the meeting on November 28, 2018, teachers collaboratively reviewed students’ completed templates. “They (students) don’t understand that when you divide, you’re making every side equal” (Teacher 1, November 28, 2018). “A lot of them are just dividing, and they’re not sure why they are dividing” (Teacher 3, November 28, 2018). From their collaborative review of student work, teachers were able to identify what students were struggling with. However, the team stopped using the template. When the facilitator suggested they use the template to help students set up the context for the unit rate problems, the team decided to use the lesson and accompanying resources from the district text (Transcript, March 5, 2019).

Team B developed multiple resources to build prerequisite knowledge and skills through repetition. They started with pre-assessments to determine students’ understanding of skip counting by fives and telling time to the hour and half hour. Based on the results of the pre-assessment, students struggled to count by fives when starting from numbers other than zero. They also struggled with the hour and minute hand. “Mine had a hard time between the hour and minute hand too. They would switch them” (Teacher 8, December 19, 2018). Students understood the format for writing time but they struggled with determining the hour and minutes correctly. “I noticed a lot that instead of looking at the last number they put the next hour” (Teacher 7, December 18, 2019).

From the pre-assessments, the team developed a series of repetitive activities to address the skills and knowledge that students struggled with. They agreed to include practice with skip counting throughout the day, ensuring that students started with numbers other than zero, and moved backwards and forwards with their counting. They intentionally scaffolded the activities for telling time, beginning with the watch activity to help students become familiar with the arrangement of the clock and then moving to activities that helped build students' understanding of how to use the arrangement of the clock to tell time first to the hour and half hour and then to the nearest five minutes. After using each activity in their classroom, the teachers shared students' struggles and successes. These conversations led to changes in the sequence of activities based on students' needs. In their final lesson study report, the teachers included the revised sequence of activities and an explanation of how the activities were used.

Team C developed two teaching and learning resources: a research organizer and a revised rubric for claim, evidence, and reasoning (CER) written responses. Based on students' written responses over the course of first semester, the team noted students' struggled to select evidence that supports their claim, and to provide scientific reasoning that explains why that evidence supports their claim. The graphic organizer was created to help students analyze data in terms of what does and does not support the claim, and the scientific reasoning that supports the connection between the claim and the data. "They have to make a claim and use the evidence they examined. So I don't know if some format... This is me just figuring out how to help them flow better" (Teacher 12, January 30, 2019). "Think through the process" (Teacher 11, January 30, 2019). "Yeah. Think through the evidence and then being like okay. I use this and this and this to make my claim. Therefore, I need to talk about all three of those things when I give my evidence supporting my claims" (Teacher 12, January 30, 2019).

Teachers included a section for pre-lab questions to help students think about the scientific knowledge they have and how this knowledge might be used to support their evidence. They also included a section for students to select the data that connects to their claim. After teaching the research lesson, they included a section for data analysis questions to help students determine what their results mean. A student suggested teachers create a completed model of the research graphic organizer that was used to create the model CER so that they could see how the teacher thought through each section of the research graphic organizer to create the final paragraph.

I had already gotten good feedback from the student in which they said it would have been more helpful, if instead of providing the big paragraph exemplar that I simply had basically done that paragraph exemplar but in the rough draft organizer format (Teacher 10, April 4, 2019).

While the team did not have enough time to teach a revised research lesson, Teacher 9 used the improved graphic organizer, and a model of the completed graphic organizer and corresponding CER paragraph. “It worked and they did have better reasoning. They even used the language in the graphic organizer in their reasoning” (Teacher 9, May 9, 2019). She explicitly taught students how to connect the graphic organizer to their CER paragraphs.

The CER rubric, developed prior to the lesson study, made it difficult for teachers to differentiate objectively between each proficiency level. It was difficult to establish clear differences between proficient and advanced. “It’s hard for us to do the grading of that” (Teacher 12, January 17, 2019). Teacher 10 identified gaps in scoring. He shared how he interpreted the rubric from a student’s perspective. “When I first read this rubric in my mind this rubric suggested that I was supposed to write three sentences. Is that the ideal length” (Teacher 10, January 30, 2019)? The group told him no. He pointed to several places in the rubric that contained inconsistencies in language that were confusing. “So one thing that kind of brought me

to that is the language as to what I was supposed to write was not consistent” (Teacher 10, January 30, 2019). The teachers used resources from the National Science Teachers’ Association website to develop an improved rubric with more clearly defined proficiency levels. As the group was preparing the final lesson study report, they felt the difference between proficient and advanced was very clear. “I think it’s probably my favorite part of our rubric is that three was proficient and we allowed for a very structured four, so you can, like make what you’re going towards very clear and evident” (Teacher 12, May 9, 2019).

The rubric also allowed for better differentiation to meet students’ needs. The new criteria for advanced led students to ask questions about how to develop an alternate claim. Teacher 9 shared the comments from her students when she had them use the revised rubric. “How do I do the alternate claim” (Teacher 9, May 9, 2019)? Teacher 12 described how the new rubric and research graphic organizer helped her differentiate more effectively.

I liked how we added the proficient column as the baseline, and then it being asked was you know, over and above. And then the lower level kids are still... I don't know, the wording was clearer for them and it was simpler, rather than, this here is this massive huge rubric (Teacher 12, April 29, 2019).

While the group was preparing the final lesson study report, she elaborated on how she can use the rubric for differentiation. “If you have those students that you want to push, you can, but you also, because you have that clear path through, you can help bring up the lower level students” (Teacher 12, May 9, 2019). Teacher 9 agreed, “I think that’s evident, too when you can use it in a Biology class and also an AP Physics class” (May 9, 2019). Table 5 includes a list of all of the learning resources the teams developed to support student learning over the course of the lesson study process. The rationale explains why the resource was developed, and how the resource was used to support student learning and elicit student thinking.

Table 5

Teaching and Learning Resources Developed by the Teacher Teams

Teaching and Learning Resource	Team	Rationale
Problem Solving Template	Team A	Six-step process to help students think through multi-step problems; student thinking is visible for each step of the process so teachers can isolate where students need support
Skip Counting by Fives Pre-Assessment	Team B	<ul style="list-style-type: none"> a. Initial assessment - students determined numbers that came before and after the given number b. Upon determining that students did not perform well, counting by 5's games were incorporated throughout the day c. Pre-assessment was modified to begin each line with given number, then given again to students
Telling Time to the Hour and Half Hour Pre-Assessment	Team B	Helped teachers determine students' prior knowledge of clocks and telling time to the hour and half hour (this was a skill that students should have learned in the previous grade level)

Table 5 (continued).

Color My Space	Team B	Teachers used to help students understand how to determine which number the number hand is pointing to; developed to address student deficiencies that were identified through the pre-assessment for telling time; teachers turned this activity into an anchor chart in the classroom and modeled how to reference the chart as needed
See, Think, Wonder- picture of an analog clock	Team B	Teachers displayed a picture of an analog clock and students shared what they see, what they think, and what they wonder; made students understanding of a clock visible for teachers
Watches	Team B	Teacher drew times to hour and half hour, students had to find partners based on time shown on their watch; students were asked to form two groups using similarities on their watches, they had to figure what criteria to use to form the groups (half hour and hour); provided repetition with half hour and hour

Table 5 (continued).

Movie Time Posters	Team B	Teacher created posters for a variety of kid friendly movies, students had to select a movie and a complete a worksheet that required them to draw the minute and hour hand on a clock for three different movie times; they also had to write the time they selected in digital format; movie times were on the hour and half hour to provide repetition of this skill; by having students draw the hour and minute hand, teachers were able to determine their progress with using the minute and hour hand correctly
Musical Clocks	Team B	Each student had to draw a time on a clock that was taped to their desk, when the music played, they moved around the room, when the music stopped they had to write the time on the clock that was taped to the desk they were next to; provided repetition with using the hour and minute hand correctly; gave teachers feedback regarding students' progress with using the minute hand and hour hand correctly
Formative Check/In Progress Assessment- Time to Hour, Half Hour, and Nearest Five Minutes	Team B	Students had to write the time indicated on the analog clock; gave teachers feedback on students' progress with telling time to specific intervals

Table 5 (continued).

Tick Marks	Team B	Blank clock (no numbers or tick marks); students counted by ones all the way around the clock to help them understand how the numbers on the clock represent minutes in five minute intervals
Research Graphic Organizer	Team C	Provides a structure to help students analyze data, select the data that supports their claim, and make connections to scientific reasoning that supports the connection between the evidence and the claim; makes student thinking visible for each component of the CER development so teachers can isolate where students need support
Teacher Created Models of Research Graphic Organizer and Corresponding CER Paragraph	Team C	Student suggested teachers develop a model of the research graphic organizer they used to create a model CER paragraph so that the teacher's thinking was visible for students
Revised CER Rubric	Team C	Provides clear criteria for each proficiency level that teachers can use to provide feedback to students to help them improve; helps teachers differentiate to meet the needs of students

The district-adopted resource (text) is lacking supplemental materials needed to help teachers facilitate student learning. Teachers on Teams A and B felt the district-adopted resource (text) is lacking the supplemental materials needed to help facilitate student learning. Teams A and B focused on the same content. South School District has adopted resources for math, from the same company for kindergarten through high school. Team C focused on a

different content and did not reference district-adopted resources. Teams A and B noted the text assumes students come to each grade level with the knowledge needed to jump right into the content for that grade level. However, teachers know this is not the case. The pre-assessments that Team B used demonstrated the gaps that exist in student's prior knowledge. The district resource does not provide materials to help teachers fill in the gaps. "I think it's a wonderful curriculum but, I think there's some gaps. I feel like as you go from one grade level to the next, it's like they assume that they took a summer program? I don't know" (Teacher 8, April 5, 2019). A first-year teacher described her experience with the curriculum, "I sometimes struggle in finding materials that will best fit with the lesson that I am teaching" (Teacher 7, Pre-Lesson Study Questionnaire).

Teachers also had concerns about the instructional materials included with the topic lesson plan. For the direct instruction portion of the lesson, students already have the answers to the example problems modeled during the lesson. "I don't like that they give them the answers to the example. I wish the workbook was blank" (Teacher 2, February 11, 2019). During her interview, Teacher 3 noted the way the examples are set up in the district-adopted text is contradictory to what the team learned about how to organize and model the set-up for rates and unit rates. She expressed frustration with the disconnect between the resources and what students and teachers need.

Well, and the book doesn't do it. We watched a video yesterday for five- seven and the ratio is written up there and the kid's like, "Well, what's 135?" And I said, "I dunno, let's write it up there. What is 135" (Teacher 3, March 21, 2019).

While Team B learned the importance of context and labeling quantities, this is not included in the text.

District common math lesson plan templates for elementary and secondary are burdensome and lack instructional value for teachers. This component only applies to Teams A and B. When the facilitator shared the district planning template for math, the teachers recognized the template and indicated they used the template for the first couple of units. “We did really well, topic one, and two, and three, and then we did nothing after that. Like we have every single one, for every single lesson topic one, two, and three, and then...” (Teacher 2, February 4, 2019). “Then we were done” (Teacher 4, February 4, 2019). “And that happened in our grade level too, I mean just everything...” “We just got busy” (Teacher 1, February 4, 2019). “It’s just too much” (Teacher 3, February 4, 2019).

Team A expressed feeling like they spend too much time trying to use the district math lesson planning template. “I feel like we had been doing them, and then they kind of backed off and said we didn't need to because we were spending like all of our PLC time doing that” (Teacher 8, January 24, 2019). The facilitator asked the group if the template helps them think about the progression of skills and the connection of skills across each unit in the district resource. The teachers indicated the template did not do this for them. It was something they did because they were told to create lesson plans using the template. The descriptive characteristics of the Teaching and Learning Resources theme and the supporting evidence led to the assertion that teachers need instructional resources that support instructional planning and student learning.

Theme 5: Role of the Facilitator

The lesson study facilitator is responsible for: 1) keeping the conversation focused and moving forward; 2) ensuring all participants have a voice and that norms are adhered to; 3) developing and following the agreed upon agenda; 4) securing coverage for teachers to observe

the research lesson (Lewis & Hurd, 2011). I served as the facilitator for all three teams. In their final interviews, six of the twelve teachers mentioned the role of the facilitator as an important component of a successful lesson study. The Role of the Facilitator theme was operationalized in three ways: 1) guides the lesson study process; 2) uses effective questioning techniques to promote teacher thinking and reflection; 3) provides outside resources to support needs identified by teachers.

Guides the lesson study process. The teachers identified the value of a facilitator who guides and structures the process. “You being there showed us what it was that we needed to do. So I think a facilitator needs to at least participate in lesson study first” (Teacher 1, March 22, 2019). “For a facilitator, I think being able to keep you on topic. Being able to keep us goal oriented” (Teacher 9, May 9, 2019). The facilitator also needs to provide a space for teachers to guide their own learning. Teacher 9 identified teacher empowerment as a key component of her growth over the course of the lesson study process. “I think teacher agency piece of teachers knowing, like what is it we need to grow in” (Teacher 9, May 9, 2019). In his final interview, Teacher 10 referenced the need for facilitators and administrators to have training on how to facilitate lesson study effectively so that teachers have the freedom to direct their learning. “Because I do have concerns with one, leaders not leading effectively. I'm concerned with administration providing those kinds of freedoms to teachers” (Teacher 10, April 30, 2019). He emphasized the importance of modeling the facilitation process. “Provided the proper scaffolding and introductions and modeling, I think a lot of teachers can learn a lot of things from this” (Teacher 10, April 30, 2019).

Uses effective questioning techniques to promote teacher thinking and reflection.

There were key moments in the lesson study process that the facilitator posed questions to help

teachers develop their own meaning rather than telling teachers what and how to think. “Being able to question about the reflection pieces. Like the learning pieces, keeping the conversation going and digging deeper into the learning. I think is super important and powerful” (Teacher 9, May 9, 2019). Team A struggled to differentiate between the learning intention and success criteria for the research lesson. The facilitator asked the teachers about the thinking students should demonstrate to achieve the learning intention. “What thinking do you want to see from them” (Facilitator, February 27, 2019)? Teacher 3 shared the learning intention for the lesson she just taught, “Today I will find surface area, so that I can paint a house, I know I have it when I've bought enough paint” (February 27, 2019). Teacher 2 explained the thinking that supported the learning intention, “I have found the area of all of the sides, of all the faces, and can calculate how much paint I need for that much area” (February 27, 2019). The facilitator’s question, helped the teachers find their own answers. In her final interview, Teacher 3 shared how the discussion of learning intentions and success criteria improved her understanding. “I think in the lesson study there were so many other things that I learned to think about... And we talked about learning targets” (Teacher 3, March 21, 2019).

The facilitator posed questions to help Team B develop a common understanding of play. Teachers were frustrated with behavior during play and students not making a connection to math learning but their definition of play didn't include guiding questions that cause students to think about their play and make connections to math. The facilitator gave examples of questions that elicit student thinking. Teachers began to connect these questions to the research lesson. The facilitator shared an example of play that is more guided.

So I wonder with those base 10 blocks, if they are looking at how could you ... or if they build something, just let them build something, and then say, "OK, how many blocks did you use? Because then they have to add up how many blocks they used. If the lesson is they have the number, nine and you have to represent, use your blocks to represent how

you could get to nine. Use your blocks to represent how you could get to nine, but give me how could you do your groups differently (Facilitator, January 24, 2019).

This conversation helped teachers begin to develop connections between play and the learning they want students to get from the play. After this conversation, teachers developed the See, Think, Wonder- Picture of an Analog Clock activity to get students thinking about clocks.

Provides outside resources to support needs identified by teachers. For Team A, Teacher 4 shared an article that included an activity requiring students to develop their own definitions for fraction, ratio, and rate. Students had to use their definitions to categorize given quantities. This article prompted teachers to begin to discuss their definitions of fractions, rates, and ratios. When the team struggled to develop a common definition, the facilitator gave them Chapter 11: Ratios and Rates from the book, *Teaching Fractions and Ratios for Understanding* (Lamon, 2012). This resource helped teachers begin to develop a better conceptual understanding of fractions, ratios, and rates as discussed in Theme 1.

For Team B, the facilitator provided several resources. The first resource was an article about the importance of providing young students the opportunity to play with mathematical concepts before having students work procedurally with these concepts (Post, 1981). This article set the stage for the activities the teachers developed to provide opportunities for students to play with time and counting through repetition. Even after multiple repetitions, students continued to struggle with conceptually understanding that the numbers on the clock represented intervals of five minutes. The facilitator shared another article that contained a series of seven lessons designed to by a team of second grade teachers to help students tell time to the nearest five minutes (McMillen & Ortiz Hernandez, 2008). After reading the article, the teachers decided they were not going to use the activities. “We thought if we were going to use them, then it should have been at the beginning” (Teacher 5, February 27, 2019). However, later in the

discussion, Teacher 7 mentioned using one of the activities from the article to help students understand how the numbers on the clock represent minutes. “Maybe we need to the cube activity” (Teacher 7, February 27, 2019). In her final interview, Teacher 7 shared she would have liked to create their own research lesson rather than using the lesson from the district text. “Maybe if we created our own lesson based off our research that was apart from the curriculum, that could be really beneficial as well” (Teacher 7, April 5, 2019). The teachers modified the activity from the article to create the Tick Marks activity. As noted in Theme 3 the Tick Mark activity helped students understand the numbers on the clock represent the number of five-minute intervals in an hour. The descriptive characteristics of the Role of the Facilitator theme and the supporting evidence led to the assertion that the facilitator empowers teachers to take ownership of their learning and the direction of the lesson study process.

Theme 6: Barriers

Barriers are obstacles that could prevent teachers from implementing new strategies in their classrooms. This theme was operationalized in two ways: 1) concerns about student behavior can be a barrier to implementing new instructional strategies; 2) teachers question the “I do, We do, You do” model of core instruction in the district’s Teaching and Learning Cycle as an effective method for facilitating math instruction. These components only emerged for Teams A and B. Team C did not mention behavior. Since they did not focus on mathematics, Team C did not mention difficulties with implementing the model of core instruction in the district’s Teaching and Learning Cycle.

Concerns about student behavior can be a barrier to implementing new instructional strategies. When Teacher 4 introduced the article with an activity that required students to convince their peers that they had the correct definition of fraction, rate, or ratio,

Teacher 3 voiced concerns about student behavior. “My fear was that the smartest kid would make their argument, and everybody knows that, that's the smartest kid, so they just go to that corner, because that's the smartest kid. You know, everybody thinks that's the smartest kid” (Teacher 3, February 4, 2019). Teacher 2 expressed concerns about the behavior of her students when the team was discussing arranging students in groups based on skill level. “There are so many behaviors in those alternate classes. Now I do it as their regular seating is behavior, but then if I want them to do group work, I have a different arrangement” (Teacher 2, February 20, 2019). She views student behavior as a barrier to arranging students in groups based on skill. During a discussion of learning intentions and importance of helping students understand the rationale behind the learning intention, Teacher 3 shared, “Kids don't have a lot of buy-in to this. I have a lot of twiddling of thumbs and kids being behavioral problems” (February 25, 2019). In each of these instances the facilitator posed questions to help the teachers think differently about the behavior.

In her Pre-Lesson Study Questionnaire, Teacher 6 indicated, “One of the barriers I encounter is classroom behaviors.” Her teammates shared similar concerns when they discussed the use of manipulatives to help students develop conceptual understanding. Behavior with manipulatives is a problem because students want to play instead of listening so the teachers use manipulatives to reward expected behavior.

So I always tell mine, because they just want to play, that is all they want to do, and so as we are talking, maybe we let them play first. Because I'm always like okay, if you're quiet, you know, they earn their 10 minutes just to build. Because that's what they want to do, they just want to build (Teacher 5, 2019).

Teacher 7 was an outlier for behavior. In her final interview, she shared that she was nervous to implement the repetitive activities because the students had to work with a partner or in small groups. “My class really struggled with working in partners and working together and getting

along through activities” (Teacher 7, April 5, 2019). However, she was surprised by how well her students worked together. “Yeah, they really improved like when we did the musical clocks, for example, I was afraid that they were going to argue over who was at the desk at the same time. But they were so flexible about it” (Teacher 7, April 5, 2019).

Teachers question the “I do, We do, You do” model of instruction in the district’s Teaching and Learning Cycle as an effective method for facilitating math instruction.

Teachers on Teams A and B noted a disconnect between what they were learning through the lesson study process and the model of direct instruction, “I do, We do, You do” that is embedded in South School District’s Teaching and Learning Cycle (South School District, 2011). During a discussion of the article that Teacher 4 shared with Team A, the facilitator noted the approach used to facilitate student thinking, “When you set up instructions to where the kids are the ones that have to do the thinking and they have to explain and justify their thinking, that’s a different approach” (February 4, 2019). “I think that’s the problem. We have a very direct instruction curriculum that they bought us and the thinking now is less direct instruction” (Teacher 3, 2019). Team B shared similar sentiments when they were discussing the article, “Why Americans Stink at Math” (Green, 2014). Teacher 5 noted, “I liked that “you, y’all, we” (January 24, 2019). She was referencing the model of math instruction endorsed in the article. She went on to say, “They’re figuring it out on their own, then it becomes more guided as they move on to peers, and then all together. But that’s the opposite of what we are told do” (Teacher 5, January 24, 2019). The opposite of what they are told to is the model of direct instruction in the Teaching and Learning Cycle that requires the teacher to model the skill (I do), then have the class practice together (We do), and finally, have students work independently (You do). The descriptive characteristics of the Barriers theme and the supporting evidence led to the assertion that when

implementing lesson study, groups will encounter barriers that may impede the implementation of the group’s learning.

Assertions

Table 6 includes a summary of the six themes that emerged through the open, provisional, and in vivo coding of the data. Axial coding was used to further refine the themes into descriptive characteristics. Six assertions were drawn from the themes and descriptive characteristics. Table 6 includes a summary of the six themes, the descriptive characteristics of the themes, and the assertions that were made for each theme.

Table 6

Themes, Descriptive Characteristics, and Assertions

Themes	Descriptive Characteristics	Assertions
Teachers’ Knowledge and Beliefs- Content	<p>Teachers focus on developing students’ conceptual understanding of content.</p> <p>Teachers develop their own conceptual understanding of content.</p> <p>Teachers are willing to share what they know and don’t know about their content.</p>	Lesson study provides a safe learning environment for teachers to explore their conceptual understanding of content, and how to develop students’ conceptual understanding of content.
Teachers’ Knowledge and Beliefs- Pedagogy	<p>Teachers observed the impact of their instructional strategies on student learning.</p> <p>Sustainable pedagogical practice</p>	Direct observation of the impact of instruction on student learning increases teachers’ use of instructional strategies in the classroom.

Table 6 (continued).

<p>Teachers’ Professional Community- Collaboration</p>	<p>Collaboration focuses on examining content and pedagogical issues in depth.</p> <p>Teachers feel accountable and responsible to each other and their students.</p> <p>Provides a voice for new teachers.</p>	<p>Teachers developed a shared sense of responsibility as they focused on examining content and pedagogical issues.</p>
<p>Teaching and Learning Resources</p>	<p>Teachers created resources to support student learning and tested the effectiveness of the these resources.</p> <p>The district adopted resource (text) is lacking supplemental materials that are needed to help teachers facilitate student learning.</p> <p>District common math lesson plan templates for elementary and secondary are burdensome and lack instructional value for teachers.</p>	<p>Teachers need instructional resources that support instructional planning and student learning.</p>
<p>Role of the Facilitator</p>	<p>Guides the lesson study process.</p> <p>Uses effective questioning techniques to promote teacher thinking and reflection.</p> <p>Provides outside resources to support needs identified by teachers.</p>	<p>The facilitator empowers teachers to take ownership of their learning and the direction of the lesson study process.</p>

Table 6 (continued).

Barriers	<p>Concerns about student behavior can be a barrier to implementing new instructional strategies.</p> <p>Teachers question the “I do, We do, You do” model of core instruction in the district’s Teaching and Learning Cycle as an effective method for facilitating math instruction.</p>	<p>When implementing lesson study, groups will encounter barriers that may impede the implementation of the group’s learning.</p>
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Four of the assertions directly answer the research question for the study: how does lesson study contribute to teachers’ professional knowledge and continual learning?

- Lesson study provides a safe learning environment for teachers to explore their conceptual understanding of content and how to develop students’ conceptual understanding of content.
- Direct observation of the impact of instruction on student learning increases teachers’ use of instructional strategies in the classroom.
- Teachers developed a shared sense of responsibility as they focused on examining content and pedagogical issues.
- Teachers need instructional resources that support instructional planning and student learning.

There were two assertions that were not directly connected to the conceptual framework or to answering the research question. However, these assertions have implications for the successful implementation of lesson study.

- The facilitator empowers teachers to take ownership of their learning and the direction of the lesson study process.

- Groups will encounter barriers during implementation that may impede the the group's learning.

In the next chapter, the findings are discussed in relation to the research question and the conceptual framework. Recommendations are made for implementing lesson study as a more effective form of professional learning to help South School District address the root causes identified in Chapter One.

CHAPTER V: DISCUSSION

The purpose of this participatory action research study was to create a lesson study framework that content area and grade-level teams of teachers could use to develop and implement their own professional learning connected to student learning goals over the course of a school year (Bradley, 2015). The knowledge claim (McNiff, 2017) for the study was lesson study will result in changes in teachers' knowledge and beliefs about their content, pedagogy and student learning, in teachers' collaborative capacity, and in the teaching and learning resources that are used to support student thinking (Lewis et al., 2009). Over the course of the study, four themes emerged that support the knowledge claim and two emerged that while not directly connected to the knowledge claim, are important factors to consider in the implementation of lesson study.

In this chapter, the findings are connected to the research literature and the conceptual framework. Recommendations are made to help South School District use lesson study to address the problem identified in Chapter 1: professional development often stops at the initial training level and does not strategically embed what is learned at an application level in the classroom. An action plan is outlined to help South School District develop and implement professional learning for teachers that is connected to the Teaching and Learning Cycle and to problems of instructional practice at the classroom level.

Assertion 1: Lesson study provides a safe learning environment for teachers to explore their conceptual understanding of content and how to develop students' conceptual understanding of content.

As noted in the literature review, effective professional learning provides coherence between the learning, the teachers' content and classroom, the building goals, and the teachers'

personal goals (Desimone, 2009; Garet et al., 2001; King & Newmann, 2001; Peneul et al., 2007). Teachers on all three teams engaged in discussion and read research to help them build their own conceptual understanding of content and/or to develop students' understanding of content. They analyzed student data from pre-assessments to help them identify the skills and content that students struggled with. The teams developed goals to address these gaps. Through the lesson study process, the teams built their conceptual knowledge, so they were able to develop instruction to build students' conceptual knowledge.

As noted in the literature review, in a study by Dudley, (2013), teachers developed common understandings of how to use instructional strategies like success criteria, self-assessment, and peer assessment to communicate learning intentions to students and how to have students take responsibility for their learning through problem solving tasks and partner discussions. Team A worked on developing a common understanding of fractions, ratios, and rates. Team B developed a common understanding of play and how to help students develop a conceptual understanding of skip counting so they could tell time to the nearest five minutes accurately. The teachers on both teams were willing to share what they didn't know with their colleagues to improve their instruction for students.

Much like Dudley (2013) discovered teachers changed their beliefs or practices based on their learning through the lesson study process. Team A recognized they had been teaching rates and ratios incorrectly and they made changes to their instruction accordingly. Team B changed their instruction to ensure students moved beyond memorization of skills and content to a conceptual understanding of content. Lesson study gave teachers the opportunity to connect their professional learning to their content and the development of learning for their students.

Assertion 2: Direct observation of the impact of instruction on student learning increases teachers' use of instructional strategies in the classroom.

Through the lesson study process, it was evident that when teachers can see the impact of their instruction on student learning, they are more likely to make changes. Despite having had prior professional development to learn how to use specific instructional strategies like exit tickets and providing opportunities for repeated practice, teachers needed to see how the strategies impacted student learning before they made changes to their instruction. As noted in the conceptual framework for this study, changes to teachers' attitudes and beliefs about student learning are a result of changes to teaching practices that cause visible changes to student learning (Guskey, 2002).

The goal of lesson study is to make student and teacher thinking visible to understand how instruction impacts student learning and make changes that will improve instruction and learning (Yarema, 2010). In South School District's own Teaching and Learning Cycle, the need to be intentional about "connecting these practices to what and how we want students to learn" and "to consciously plan how these practices will be used in classrooms with students" (South School District, 2015, p. 3) is noted. Lesson study provides the structure that teachers need to select instructional strategies to elicit student thinking and to directly observe the impact of those strategies on student thinking. Teachers have continued to use the instructional strategies that proved to be effective.

Assertion 3: Teachers developed a shared sense of responsibility as they focused on examining content and pedagogical issues.

In their lesson study framework, Lewis et al. (2009) purport lesson study helps teachers develop collegiality, a shared sense of responsibility for student learning, and an inquiry

approach to instruction. All three teams discussed the power of collaboration as a motivator to improve their knowledge and instruction. Teachers described traditional collaboration as sequencing instructional topics while collaboration during lesson study was more focused on the development and implementation of instruction. Teachers reported feeling accountable to their peers and their students. They made changes to their instruction that by their own admission they would not have made without the collaboration of their peers through lesson study. This is confirmed by the Puchner and Taylor (2006) study mentioned in the literature review, in which teachers recognized the process of lesson study changed how they talked about content, lesson planning, and student learning.

Lesson study also provides an opportunity for new teachers to increase their professional capital through interactions with their more experienced colleagues (Hargreaves & Fullan, 2012). The first-year teacher on Team B reported a better understanding of how to supplement student learning to make up for the gaps in the district-adopted text. She also reported having increased confidence as the lesson study progressed to share her thoughts on how to make changes to instruction to address students' continued struggles with skip counting and understanding how minutes are arranged on a clock. Her colleagues noted the change in her interactions as well. Overall lesson study strengthens teachers' collegial relationships and improves their instructional planning.

Assertion 4: Teachers need instructional resources that support instructional planning and student learning.

Through the process of lesson study, the teams created a variety of resources to support teaching and learning. In addition to the resources that are part of lesson study (meeting agendas, group norms, observation protocols, research lesson plans, research lesson reflections, and final

lesson study reports), teachers created resources that elicited student thinking (Lewis & Hurd, 2011). Each team developed at least one resource that can be used beyond lesson study. Teams B and C created several different resources that made student thinking visible. These resources enabled teachers to isolate students' specific areas of need and adjust their instruction accordingly. Each team indicated they will continue to use these resources to support instruction. South School District can use the resources that were created to begin to build a database of instructional lessons and resources that can be used to build the professional capital of teachers beyond the lesson study groups (Hargreaves & Fullan, 2012). Recommendations for addressing the lack of supplemental materials and the issues with the district's common lesson plan template for math will be addressed in the recommendations section.

Assertion 5: The facilitator empowers teachers to take ownership of their learning and the direction of the lesson study process.

The role of the facilitator to empower teachers to take ownership of their learning is well documented in the research literature (Lewis et al., 2012; Kennedy, 2016; Warren Little et al., 2003; Ziechner, 2003). As mentioned by the teachers on all three teams, the facilitator is a key component of the lesson study group. The facilitator must have an understanding of the lesson study process and an understanding of what it means to be a teacher, and the challenges that teachers face in the classroom (Kennedy, 2016). The facilitator has to be able to pose questions to the group that challenge the group to reflect and dig deeper into their learning while still providing teachers the autonomy to direct that learning. In the literature review, a study by Warren et al. (2003) found deeper conversations resulted when teachers selected the problem of practice/student learning and how to address the issue, making changes to protocols to suit the

group's needs. Teachers across all three teams valued being able to direct the focus of their learning with the facilitator's support, and to connect that learning to their classrooms.

While the facilitator does not have to be the one to locate outside resources to support the team's learning, it is likely this responsibility will fall to the facilitator at the start of the lesson study process. The teacher who provided the article for Team A was completing her master's degree and had access to her university's research database. As the facilitator, I also had access to university research databases. Recommendations will be made in a later section to help South School District build a professional research database to support teacher learning.

Assertion 6: • Groups will encounter barriers that may impede the implementation of the group's learning

Relationship between instruction and learning. Teachers mentioned student behavior in the Pre-Lesson Study Questionnaire, and when new activities were introduced over the course of the lesson study cycle. While they mentioned concerns about behavior, there was no evidence that anticipated student behavior prevented the teams from implementing their research lessons. The facilitator helped teachers address their concerns and process through how they might plan for and avoid these concerns. In some cases, other team members offered suggestions to prevent behavior problems from becoming an issue. Facilitators will need to be ready to work with teams to prevent behavior from becoming a barrier to implementation.

Disconnect between new learning and district requirements. This component is specific to South School District. The Teaching and Learning Cycle was accepted as district policy in 2011. The district has recently surveyed staff and found there are some content areas in which teachers struggle to see the connection between their content and implementation of the Teaching and Learning Cycle. The professional development program that accompanied the

implementation of the Teaching and Learning Cycle accounted for a one-size fits all approach to pedagogy. Content and pedagogy specific to content was not discussed. As noted in the literature review, there is pedagogical knowledge that is specific to content areas (Ball et al., 2008).

Effective professional learning includes connections to teachers' content (Darling Hammond et al., 2009). Recommendations will be made to help South School District leaders address the disconnect between the Teaching and Learning Cycle and new learning that teachers experienced.

Conceptual Framework Revision

“Skilled Facilitation” was added to the conceptual framework because it emerged as a significant element during this study. The original lesson study framework has been placed in a circle of “Skilled Facilitation” to illustrate how skilled facilitation supports each component of the lesson study cycle. A skilled facilitator empowers teachers through his or her knowledge of the lesson study process, his or her ability to pose reflective questions, and an understanding of the challenges that teachers face in the classroom. Skilled facilitation helps teams overcome barriers that may be encountered over the course of a lesson study cycle.

Facilitator Knowledge of the lesson study process. The lesson study process provides a structure and the resources to engage teachers in collaboration that goes beyond a surface level discussion about pacing and student data. The norms and lesson study protocols provided tools for a knowledgeable facilitator to guide discussions focused on the goals the teachers established at the beginning of the process. I used the Norm Setting Guide (Appendix D) with each team to develop norms that created an environment in which teachers were willing to take risks. At the start of each meeting, the teams selected a norm to focus on to keep the meeting on track. At the end of the meeting, the team reflected on whether they effectively implemented the norm focus

and what they needed to work on for the next meeting. This continual cycle of the use and reflection of norms helped teachers examine their mental models of teacher collaboration. In their final interviews, several teachers mentioned the value of focusing on a norm for each meeting. It helped the norms become part of each team's collaborative process.

I used the protocols for the research lesson, observation of the research lesson, debriefing the research lesson, and the final report to help teachers make the connection between teaching and learning. These protocols held teachers accountable to each other for thinking about and then directly observing the impact of their instructional planning on student learning and thinking. For example, as teachers planned the research lesson, they predicted potential student misconceptions and scripted how they would respond to these misconceptions. This required the teachers to engage in deeper conversations about student learning and whether their instruction had the intended outcome. While I provided sample protocols, each team had the autonomy to change the protocols to meet their needs, thus empowering them to take ownership of their learning (Warren et al., 2003).

Reflective questioning. Skilled facilitation requires knowledge of lesson study that is much more than an understanding of the steps of the lesson study process. It encompasses an understanding of the power and importance of teacher autonomy. At the beginning of the lesson study cycle, teachers had many questions about whether they were implementing lesson study correctly. They wanted lesson study to be a set of steps with paper work to fill in as proof that each step was completed. Their focus was on the product, rather than the process. They looked to me to tell them what to do, and how to do it. Had I answered their questions, their learning would not have moved beyond the traditional single loop learning that is characteristic of most professional development opportunities for educators in the United States. By posing open-ended

questions, I transferred the responsibility for thinking and reflection to the teachers. My questions required them to focus on the direct impact of their instructional decision-making on student learning while challenging them to examine their mental models of what teaching and learning should look like (Ball & Cohen, 1999).

Over the course of the lesson study cycle, the teams came to points where the conversation shifted from a polite sharing of instructional strategies to a deep discussion of teacher and student conceptual understanding. While the lesson study protocols prompted these conversations, facilitation through open-ended, reflective questioning helped the teams delve deeply into the conversations. For example, Team B was surprised to find that students struggled with skip counting. This was a skill the students should have learned two years' previously in kindergarten. The teachers made comments about the repetition the kindergarten teachers did with students as they frequently heard kindergarten students singing skip counting songs. When the team had students begin skip counting forwards and backwards starting from numbers other than zero, students struggled. One of the teachers felt that students knew how to skip count; they were confused because of the structure of the assessment. The focus of the lesson study was telling time to the nearest five minutes. I asked the team to think about what it means to conceptually understand skip counting, and how this understanding is or is not connected to telling time to the nearest five minutes. The team worked to answer this question over the course of the lesson study cycle. As students continued to struggle with telling time to the nearest five minutes, one of the teachers on the team suggested using an activity that would help students visually connect the arrangement of minutes on a clock to skip counting by five. Reflective questioning helped the team find their own answers and engage in deep, meaningful discussions about how students learn. Engaging in these types of discussions results in double loop learning

as teachers reflect on how their actions impact student thinking and learning. Figure 3 illustrates the revised conceptual framework.

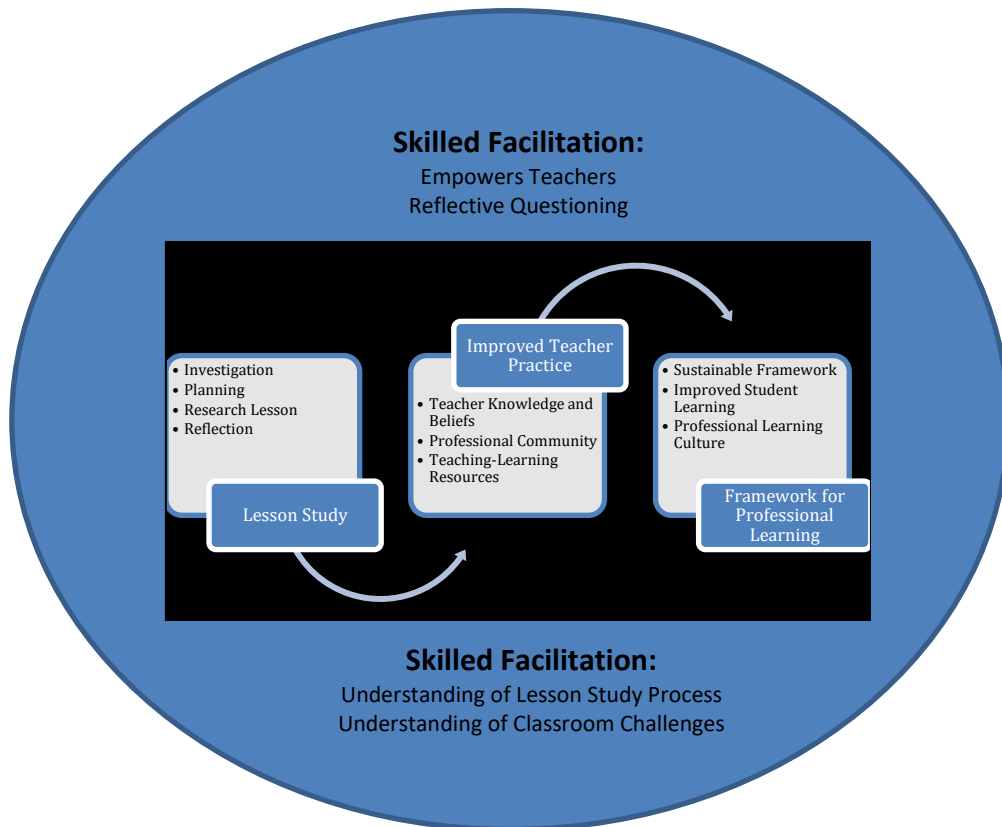


Figure 3. Revised Conceptual Framework. The conceptual framework was revised to embed the lesson study framework in a circle of “Skilled Facilitation.”

Implications for Building Principals

Effective implementation of lesson study requires the support of building level leaders in a variety of ways. First, lesson study is a teacher driven process. It is implemented effectively when teachers volunteer to participate. Introducing lesson study through a whole-school approach negates teacher autonomy and turns lesson study into the latest teacher mandate. It is more effective to describe lesson study, and provide teachers the option to engage in lesson study

as they choose. Teachers need to have the time and the resources to implement a lesson study cycle. Building leaders need to think about how they will provide time for teachers to engage in lesson study. For example, they may structure the master schedule to provide common plan time for teachers to conduct lesson study or they may provide release time on in-service days. When teachers conduct, and debrief the research lesson, they will need coverage for their classes. Over the course of the lesson study process, teachers may need access to resources that require the support of building leaders. Those who take it upon themselves to secure coverage for classes, include teachers in the decision-making regarding time for lesson study, and provide resources as needed, demonstrate the importance and value of lesson study as a form of meaningful professional learning. This builds trust and respect between teachers and building leadership.

In addition to the physical considerations described above, building leaders need to think about how the culture of the building will support lesson study. Is there a shared vision for teaching and learning? Is there coherence between the building goals, teacher goals, and professional learning opportunities? Are there structures in place that provide for and promote teacher collaboration? Who determines the content and focus of professional learning? When leaders work collaboratively with teachers to create a shared vision for student learning, there is a significant positive impact on student outcomes and an increase in trust between building leaders and teachers and between teachers (Robinson et al., 2008; Wahlstrom & Lewis, 2008). Developing a shared vision for teaching and learning creates a culture of trust that will support teachers as they engage in deep discussions of content and pedagogy through lesson study.

At the start of each school year, South School District teachers are required to develop a student-learning objective (SLO) and a professional practice goal. The SLO is developed based on analysis of student data from state, district, and building level assessments. The professional

practice goal is developed to target areas of growth identified through the evaluation process.

There might be some connection between the professional practice goal and the student-learning objective, however this is the exception not the norm. The professional practice goal should be developed based on the shared vision for teaching and learning, and the instruction (the professional practice goal) that is needed to help students meet the student learning objectives. Professional learning activities, like lesson study, are then designed and implemented to support the aligned student learning objectives and professional practice goals. In-service days are used to provide time for teachers to direct and implement their own learning. This alignment helps lesson study groups across a building focus on similar goals to support teacher and student learning. When there is coherence between building goals, student learning objectives, professional practice goals, and professional learning activities, a culture of trust develops (Youngs & King, 2002).

Building leader participation in professional learning communicates the importance of the professional learning. Those who participate with teachers in professional learning are more likely to be perceived as credible instructional resources who can contribute meaningfully to the instructional process (Robinson et al., 2008). While this participation helps to build trust between building leaders and teachers, when it comes to lesson study, leaders' participation should be by invitation from the lesson study group. Building leaders are charged with the supervision and evaluation of teachers, which can make it difficult for the group to feel safe to take risks and engage in discussions of content and pedagogy that may expose areas of weakness or vulnerability. I have had the opportunity to facilitate lesson study as a leader who also evaluates and as a leader who does not evaluate. It was much easier to facilitate and evaluate when the

group invited me to participate. Even then, I made a clear distinction between lesson study and evaluation. What happened in lesson study, stayed in lesson study.

When teachers are given the autonomy to implement lesson study effectively, it has the potential to overcome team demographic variables such as years of teaching experience, levels of teacher education, content taught, grade level taught, and time spent working as a team. The participants in this study represented elementary, middle and high school teachers. They had varying levels of experience and years spent working together as a team. One of the teams was made up of science teachers from a variety of science contents. Learning and progress was made across all three teams. The teachers engaged in conversations about their understanding of content and pedagogy and how this understanding directly impacts student learning. Teacher learning from lesson study goes beyond the development of the single research lesson. For example, Team B learned the importance of explicitly teaching students how to use the anchor charts and resources that are in the classroom to support their own learning. Team A uncovered misconceptions in their own conceptual understanding of content. Team C developed a rubric that helps teachers and students clearly differentiate between “Advanced” and Proficient” pathways. The rubric can be used across all science disciplines to standardized expectations for scientific writing. There were universal learnings that each team took away from the lesson study process because the teachers had the autonomy to design and implement their own professional learning. When leaders serve as support for teacher professional learning rather than the director of teacher professional learning, they are building teacher leadership capacity and increasing the organizational capacity of schools. Schools with greater organization capacity tend to be higher performing schools in terms of student achievement (Youngs & King, 2002).

Recommendations

Much as the teachers reflected on their observations of student learning to revise the research lesson, the next stage of action research includes planning for next steps based on the data collected during the implementation phase. Based on the findings from this study, lesson study can be used to provide a framework for effective professional learning for teachers.

District and building leadership: The first recommendation is to support building leaders in creating a professional culture that will promote the implementation of lesson study. Building leaders need to work with staff to develop a clear vision of teaching and learning grounded in the district's TLC 2.0. Engage teachers in collaborative analysis of student data from state, district, and building level assessments to set building goals for student achievement. These building goals will be used to help grade level and content area teams create student-learning goals that are aligned with the buildings' goals for student achievement. Support teachers in developing professional practice goals that are aligned with the shared vision for teaching and learning, and student achievement goals. Share the description of lesson study with staff and support interested teachers in learning how to facilitate lesson study effectively. Work in collaboration with teachers to repurpose staff in-service days to support the implementation of lesson study. Collaborate with teachers to provide the time and structures to implement lesson study effectively.

Offer lesson study to all district teachers. The second recommendation is to expand the district's professional development offerings to include lesson study. Develop an in-depth training for facilitators focused on the structure of lesson study, questioning techniques, developing and adhering to group norms, and keeping the group focused on achieving their goals. Plan for providing continual support for facilitators as they implement lesson study with

their teams by setting a schedule for monthly or quarterly support meetings for facilitators to share their team's progress and any barriers they have may have encountered. Teams should be encouraged to attend the facilitator training as a group so that all members understand the framework and structure for lesson study. At a minimum, one person from the team will have to attend the training for the team to begin the lesson study process.

Facilitators should be given a manual that includes all of the protocols needed to implement lesson study. However, the team needs to have autonomy to modify the protocols to meet their needs. Each team will create a timeline for their research. This timeline will be shared with building administration to coordinate substitute coverage for teachers when they observe the research lesson. Each team will be required to submit a research lesson plan, learning and teaching resources created to support the research lesson, and a final lesson study report detailing their findings. The district professional development office should keep a database of the lesson study artifacts by grade level and content. Teachers across the district should have access to this database.

Alignment of the district's core instructional model with research based best practices for math instruction. The third recommendation is for district leadership to look into alignment of the district's core instruction model (I do, We do, You do) embedded in the Teaching and Learning Cycle policy with research-based best practices for math instruction and the lack of supplemental materials for the district adopted text. The district's math leadership team should be included as part of the district leadership team. This study was conducted with two teams of teachers using the district adopted math resource. Additional research needs to be done regarding best practices for math instruction to determine if the Teaching and Learning Cycle contradicts best practices for math instruction. The same is true for the lack of

supplemental resources provided by the district resource. These might be areas that teachers from the district math leadership team or from schools across the district decide they want to research through lesson study. The findings from these teams can then be used to make decisions about the Teaching and Learning Cycle and the lack of supplemental resources.

Build a robust library of professional resources. The fourth recommendation is for the district to create a professional library of resources that teachers can access as they engage in the lesson study process. The district's Teaching and Learning Resource department should work on adding subscriptions to journals that include specific instructional strategies that have been used by teachers in a variety of content areas and grade levels.

Suggestions for Further Research

The purpose of this participatory action research study was to create a lesson study framework that content area teams of teachers can use to develop and implement their own professional learning connected to student learning goals over the course of a school year (Bradley, 2015). Three teams of teachers successfully used lesson study to develop and implement their own professional learning that was directly connected to student learning goals for their classrooms. The framework was flexible, allowing for each team to make the structure fit their needs. Teachers engaged in meaningful conversations about content and pedagogy, improved the way they collaborate, observed the direct impact of their instruction on students, and developed teaching and learning resources to support their students. While the teachers reported continued use of the strategies and practices they developed, research should be done to see if they continue using the strategies and resources into the next school year. All three teams identified a topic for their next lesson study. Additional research should be done to see if the teams follow through to determine the sustainability of lesson study. South School District has

been struggling to move professional development from the training stage into the classroom. Lesson study provides a pathway for the district to move from professional development to professional learning by connecting teacher learning to student learning.

The facilitator is a key component in the lesson study process. Additional research needs to be done on how to build the capacity of teachers and administrators to facilitate lesson study effectively. This will help the district provide more focused and effective professional learning for facilitators. Building the capacity of teachers to facilitate their own learning may help them better facilitate student learning, so that students have more agency and autonomy in the classroom.

Reflection

For the past twelve years, I have been responsible for developing programs to provide professional growth opportunities for educators at the building and district level. It has been difficult to help teachers implement professional development at the classroom level. Even including teachers in the planning and delivery of professional development did not result in classroom implementation. However, even when teachers were involved in the planning, I was still largely determining the focus of the professional development. As I began to research lesson study, I thought it might be difficult for me as a leader to let go and empower teachers to take full control of their professional learning. Lesson study has been just as empowering for me as it has been for the teachers who participated. Over the past year, I have been able to engage with teachers on a deeper, more meaningful level. While there is a significant power differential between us, the teachers were willing to be very open and honest with me and their teams about what they do not know. They opened themselves to examining their current knowledge and practices to make real improvements. Their struggles with content knowledge, the district

resource, behavior, and the Teaching and Learning Cycle are all issues that leaders need to understand so they can provide the appropriate support.

I realize that this experience was powerful for me because it aligns with my social constructivist worldview that each person creates his or her own knowledge through his or her interactions with the world (Cresswell, 2014). Lesson study empowers participants to create their own knowledge through the collaborative interactions of people with a common goal: student learning. The potential of this framework to transform instruction through professional learning is significant.

Conclusion

This chapter examined the findings of the study and offered potential next steps for South School District to implement lesson study to improve professional learning for teachers. Lesson study provides a framework for teachers to connect professional learning to problems of practice directly connected to their classrooms. Collaboration through lesson study gives teachers the opportunity to dig deep into their own content knowledge, students' content knowledge, and their pedagogy to create teaching and learning resources that elicit student thinking. It also reveals barriers to instruction that may need to be addressed to effectively support teachers. Recommendations for lesson study implementation have been provided to help South School District provide a more effective structure for professional learning.

References

- Adelman, C. (1993). Kurt Lewin and the origins of action research. *Educational Action Research*, 1(1), 7-24.
- Argyris, C. (1991). Teaching smart people how to learn. *Harvard Business Review*, 69(3), 99-109.
- Ball, D. & Cohen, D. (1999). Developing practice, developing practitioners: Toward a practice-based theory of professional education. In L. Darling Hammond, & G. Sykes (Eds.), *Teaching as the learning profession: Handbook of policy and practice* (pp. 3-32), San Francisco, CA: Jossey-Bass Publishers.
- Ball, D., Thames, M., & Phelps, G. (2008). Content knowledge for teaching: What makes it special? *Journal of Teacher Education*, 59(5), 389-407.
- Bradley, J. (2015). *Designing schools for meaningful professional development*. Thousand Oaks, CA: Sage Publishing.
- Bjuland, R., & Musvold, R. (2015). Lesson study in teacher education: Learning from a challenging case. *Teaching and Teacher Education*, 52(2015), 83-90.
- Cerbin, W., & Kopp, B. (2005). Lesson study as a model for building pedagogical knowledge and improving teaching. *International Journal of Teaching and Learning in Higher Education*, 18(3), 250-257.
- Cheung, W. & Wong, W. (2013). Does lesson study work? A systematic review of the effects of lesson study and learning study on teachers and students. *International Journal for Lesson and Learning Studies*, 3(2), 137-149.
- Choki, S., & Fernandez, C. (2004). Challenges to importing Japanese lesson study: Concerns, misconceptions, and nuances. *Phi Delta Kappan*, 85(7), 520-525.

Cobb, P., & Yackel, E. (1996). Constructivist, emergent, and sociocultural perspectives in the context of developmental research. *Educational Psychologist*, 31(3/4), 175-190.

doi:10.1080/00461520.1996.9653265

Cresswell, J. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches*. Thousand Oaks, CA: Sage Publications, Inc.

Darling-Hammond, L., Wei, R., Andree, A., Richardson, N., & Orphanos, S. (2009).

Professional learning in the learning profession: A status report on teacher development in the United States and abroad. Dallas, TX: National Staff Development Council.

Desimone, L. (2009). Improving impact studies of teachers' professional development:

Toward better conceptualizations and measures. *Educational Researcher*, 38, 181-199.

doi:10.3102/0013189X08331140

Donohoo, J. (2017). *Collective efficacy: How educator's beliefs impact student learning*.

Thousand Oaks, CA: Corwin Press.

Donohoo, J., & Velasco, M. (2016). *The transformative power of collaborative inquiry:*

Realizing change in schools and classrooms. Thousand Oaks, CA: Sage Publishing.

Druken, B. (2015). *Sustaining lesson study: Resources and factors that support and*

constrain mathematics teachers' ability to continue after the grant ends (Doctoral

dissertation). Retrieved from ProQuest Dissertations and Theses Database. (ProQuest No. 10024139)

Dudley, P. (2013). Teacher learning in lesson study: What interaction-level discourse

analysis revealed about how teachers utilised imagination, tacit knowledge of teaching

and fresh evidence of pupils' learning, to develop practice knowledge and so enhance

their pupils' learning. *Teaching and Teacher Education*, 34(2013), 107-121.

- Ellinger, A., Launius, K., & Scott, A. (2017). Metamorphosis: Texas district opts for learner centered professional learning. *The Learning Professional*, 38(6), 38-41.
- Ermeling, B., & Graff-Ermeling, G. (2016). *Teaching better: Igniting and sustaining instructional improvement*. Thousand Oaks, CA: Sage Publishing.
- Ermeling, B., & Graff-Ermeling, G. (2014). Learning to learn from teaching: A first-hand account of lesson study in Japan. *International Journal for Lesson and Learning Studies*, 3(2), 170-192.
- Fernandez, C., Cannon, J., & Chokshi, S. (2003). A US-Japan lesson study collaboration reveals critical lenses for examining practice. *Teaching and Teacher Education*, 19(2), 171-185.
- Fernandez, C., & Chokshi, S. (2002). A practical guide to translating lesson study for a U.S. setting. *Phi Delta Kappan*, 84(2), 128-134.
- Garet, M., Porter, A., Desimone, L., Birman, B., Yoon, K. (2001). What makes professional development effective? Results from a national sample of teachers. *American Educational Research Journal*, 338(4), 915-945.
- Given, H., Kuh, L., LeeKeenan, D., Mardell, B., Redditt, S., & Twombly, S. (2009). Changing school culture: using documentation to support collaborative inquiry. *Theory into Practice*, 49(1), 36-46. doi: 10.1080/00405840903435733
- Green, E. (2014). Why do Americans stink at math? *New York Times*. Retrieved from <http://www.nytimes.com/2014/07/27/magazines/why-do-americans-stink-at-math.html>
- Groth, R. (2011). Improving teaching through lesson study debriefing. *The Mathematics Teacher*, 104(6), 446-451.
- Guskey, T. (2002). Professional development and teacher change. *Teachers and*

- Teaching*, 8(3), 381-391.
- Hadfield, M., & Jopling, M. (2016). Problematizing lesson study and its impacts: Studying a highly contextualized approach to professional learning. *Teaching and Teacher Education*, 60(2016), 203-214.
- Hargreaves, A., & Fullan, M. (2012). The power of professional capital with an investment in collaboration, teachers become nation builders. *Journal of Staff Development*, 34(3), 36-39.
- Hurd, J., & Licciardo-Musso, L. (2005). Lesson study: Teacher led professional development in literacy instruction. *Language Arts*, 82(5), 388-395.
- Jacob, A., McGovern, K., & TNTP. (2015). The mirage: Confronting the hard truth about our quest for teacher development.
- Kemmis, S. (2009). Action research as a practice-based practice. *Educational Action Research*, 17(3), 463-474.
- Kemmis, S., & Wilkinson, M. (1998). Participatory action research and the study of practice. In B. Atweh, S. Kemmis, & P. Weeks (Eds.), *Action research in practice: Partnerships for social justice in education* (pp. 21-36). New York: Routledge.
- Kennedy, M. (2016). How does professional development improve teaching? *Review of Educational Research*, 86(4), 945-980.
- King, M., & Newmann, F. (2001). Building school capacity through professional development: Conceptual and empirical considerations. *International Journal of Educational Management*, 15(2), 86-94. Doi: 10.1108/09513540110383818
- Lamon, S. (2012). *Teaching fractions and ratios for understanding*. New Your, NY: Routledge.
- Leana, C. (2011). The missing link in school reform. *Stanford Social Innovation Review*,

9(4), 30-35.

Learning Forward. (2011). Standards for professional learning. Oxford, OH: Learning Forward.

Lewis, C. (2002). Does lesson study have a future in the United States? *Nagoya Journal of Education and Human Development*, 2002(1), 1-25.

Lewis, C., & Hurd, J. (2011). *Lesson study step by step: How teacher learning communities improve instruction*. Heinemann: Portsmouth, NH.

Lewis, C., & Perry, R. (2015). A randomized trial of lesson study with mathematical resource kits: Analysis of impact in teachers' beliefs and learning community. In J. Middleton, J. Cai, S. Hwang (Eds.), *Large Scale Studies in Mathematics Education* (pp. 133-158), New York, New York: Springer International Publishing Switzerland.

Lewis, C., Perry, R., Friedkin, S., & Roth, J. (2012). Improving teaching does improve teachers: Evidence from lesson study. *Journal of Teacher Education*, 63(5), 368-375.

Lewis, C., Perry, R., & Hurd, J. (2009). Improving mathematics instruction through lesson study: A theoretical model and North American case. *Journal of Math Teacher Education*, 12, 285-304.

Lewis, C., Perry, R., & Murata, A. (2006). How should research contribute to instructional improvement? The case of lesson study. *Educational Researcher*, 35(3), 3-14.

Lewis, C., & Tsuchida, I. (1999). A lesson is like a swiftly flowing river: How research lessons improve Japanese education. *Improving Schools*, 2(1), 48-56.

Little, J. (2007). Teachers' accounts of classroom experience as a resource for

- professional learning and instructional decision making. In P. Moss (Ed.), *106th Yearbook of the National Society for the Study of Education Part I* (pp. 217-240), Malden, Massachusetts: Blackwell Publishing.
- Little, J. (1986). Seductive images and organizational realities in professional development. In A. Lieberman and L. Miller (Eds.), *Rethinking school improvement: Research, craft and concept* (pp. 26-44). New York: Teachers College Press.
- Makinae, N. (2010) The origin of lesson study in Japan. In Y. Shimizu, Y. Sekiguchi, K. Hino (Eds.), *The 5th East Asia Regional Conference on Mathematics Education: In Search of Excellence in Mathematics Education, Tokyo, 2010* (Vol. 2, pp. 140–47). Japan Society of Mathematics Education.
- Marzano, R. (2007). *The art and science of teaching: A comprehensive framework for effective instruction*. Alexandria, VA: Association for Supervision and Curriculum Development.
- McMillen, S., & Ortiz Hernandez, B. (2008). Taking time to understand telling time. *Teaching Children Mathematics*, 15(4), 248-256.
- McNiff, J. (2017). *Action research: All you need to know*. Thousand Oaks, CA: Sage Publications.
- National Commission on Teaching & America's Future, New York, NY. (1996). *What matters most teaching for America's future. Report of the National Commission on Teaching & America's Future*. S.l.: Distributed by ERIC Clearinghouse.
- Nye, B., Konstantopoulos, S., & Hedges, L. (2004). How large are teacher effects? *Educational and Evaluation Policy Analysis*, 26(3), 237-257.
- Ogden, N., Perkins, C., & Donahue, D. (2008). Not a peculiar institution: Challenging students'

- assumptions about slavery in U.S. History. *History Teacher*, 41(4), 469-488.
- Ono, Y., & Ferreira, J. (2010). A case study of continuing teacher professional development through lesson study in South Africa. *South African Journal of Education*, 30, 59-74.
- Pareja Roblin, N., & Margalef, L. (2013). Learning from dilemmas: Teacher professional development through collaborative action and reflection. *Teachers and Teaching*, 19(1), pp. 18-32.
- Penuel, W., Fishman, B., Yamaguchi, R., & Gallagher, L. (2007). What makes professional development effective? Strategies that foster curriculum implementation. *American Educational Research Journal*, 44, 921-958. doi: 10.3101/0002831207308221
- Post, T. (1981). The role of manipulative materials in the learning of mathematical concepts. In M. Lindquis (Ed.), *Selected issues in mathematics education* (109-131). Berkeley, CA: McCutchan Publishing Corporation.
- Puchner, L., & Taylor, A. (2006). Lesson study, collaboration and teacher efficacy: Stories from two school-based math lesson study groups. *Teaching and Teacher Education*, 22(2006), 922-934.
- Robinson, V., Lloyd, C., & Rowe, K. (2008). The impact of leadership on student outcomes: An analysis of the differential effects of leadership types. *Educational Administration Quarterly*, 44(5), 635-674. doi: 10.1177/0013161X08321509
- Saldana, J. (2016). *The Coding Manual for Qualitative Researchers*. Thousand Oaks, CA: Sage Publications.
- Sarkar Arani, M., Keisuke, F., & Lassegard, J. (2010). "Lesson Study" as professional culture in Japanese schools: An historical perspective on elementary classroom

- practices. *Japan Review*, 22, 171-200.
- Scribner, J., Sawyer, P., Watson, S., & Myers, V. (2007). Teacher teams and distributed leadership: A study of group discourse and collaboration. *Educational Administration Quarterly*, 43(1), 67-100. doi: 10.1177/0013161X08321502
- Shuilleabhain, A. (2016). Developing mathematics teachers' pedagogical content knowledge in lesson study: Case study findings. *International Journal for Lesson and Learning Studies*, 5(3), 212-226. doi: 10.1108/IJLLS-11-2015-0036
- South School District. (2015). Teaching and Learning Cycle. Unpublished document.
- Spillane, J. (2015). Leadership and learning: Conceptualizing relations between school administrative practice and instructional practice. *Societies*, 2015(5), 277-294. doi: 10.3390/soc5020277
- Stepanek, J., Appel, G., Leong, M., Turner Managan, M., & Mitchell, M. (2007). *Leading lesson study: A practical guide for teachers and facilitators*. Corwin Press: Thousand Oaks, CA.
- Stigler, J. & Hiebert, J. (1999). *The teaching gap*. New York, NY: Simon & Schuster Inc.
- Vrikki, M., Warwick, P., Vermunt, J., Mercer, N., & Van Halem, N. (2017). Teacher learning in the context of lesson study: A video based analysis of teacher discussions. *Teaching and Teacher Education*, 61(2017), 211-224.
- Wahlstrom, K., & Louis, K. (2008). How teachers experience principal leadership: The roles of professional community, trust, efficacy, and shared responsibility. *Educational Administration Quarterly*, 44(4), 458-495.
- Warren Little, J., Gearhart, M., Curry, M., & Kafka, J. (2003). Looking at student work

for teacher learning, teacher community, and school reform. *Phi Delta Kappan*, 85(3), 184-192.

Watanabe, T, Takahasi, A., & Yoshida, M. (2008). *Kyozaikenkyu*: A critical step for conducting effective lesson study and beyond. In F. Arbaugh, & P. Taylor (Eds.) *Inquiry into mathematics teacher education* (pp. 131-142), San Diego, CA: Association of Mathematics Teacher Educators.

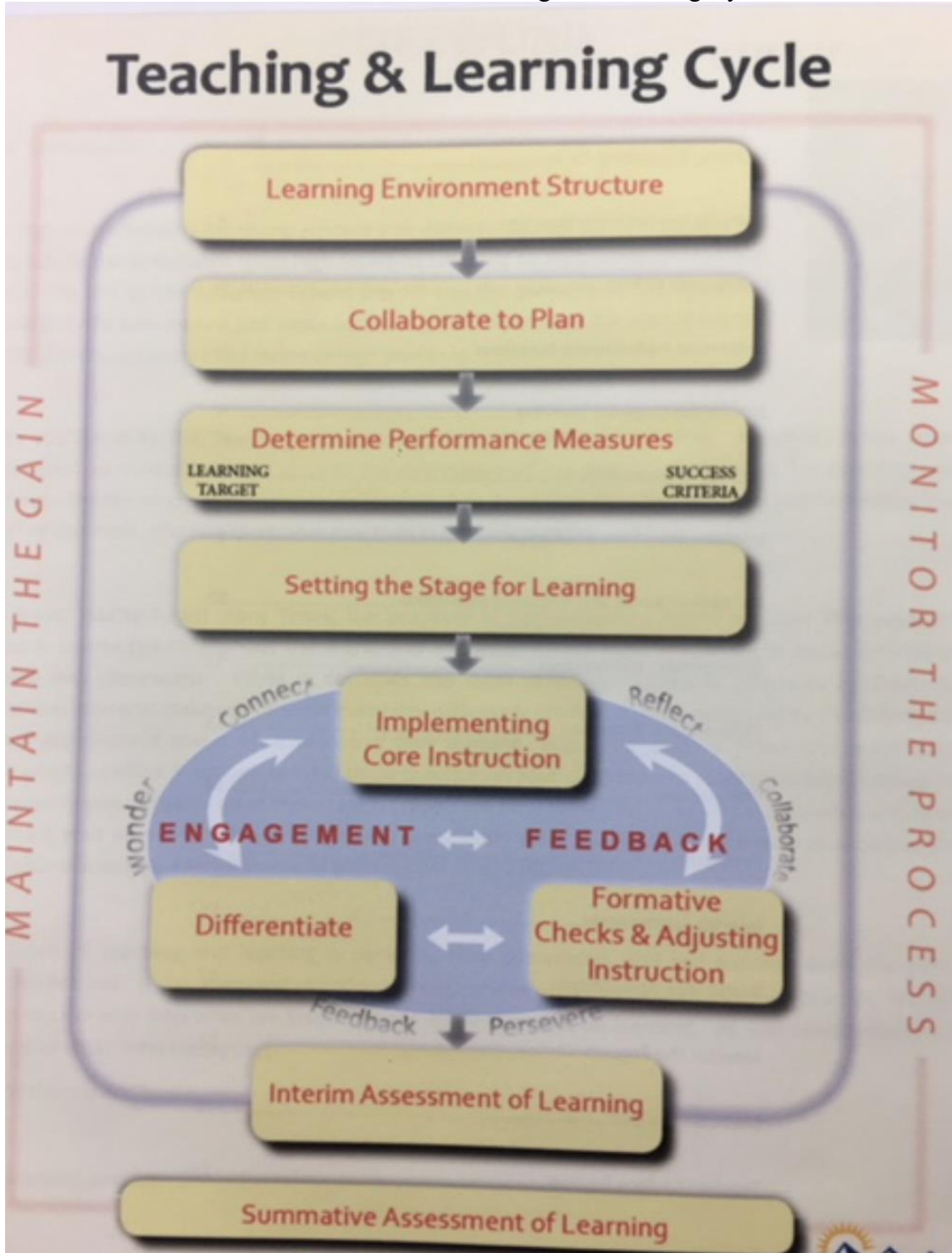
Yarema, C. (2010). Mathematics teachers' views of accountability testing revealed through lesson study. *Mathematics Teacher Education Development*, 12 (1), 3-18.

Yoshida, M. (2012). Mathematics lesson study in the United States: Current status and ideas for conducting high quality and effective lesson study. *International Journal for Lesson and Learning Studies*, 1(2), 140-152.

Youngs, P., & King, M.B. (2002). Principal leadership for professional development to build school capacity. *Educational Administration Quarterly*, 38(5), 643-670.

Zeichner, K. (2003). Teacher research as professional development for p-12 educators in the USA. *Educational Action Research*, 11(2), 301-326. doi:
10.1080/09650790300200211

Appendix A
South School District's Teaching and Learning Cycle



Appendix B
Pre-Lesson Study Questionnaire

Purpose: The questionnaire will be used prior to the start of the lesson study process to provide baseline information about how teachers plan and collaborate to deliver instruction. Google Forms will be used to administer the questionnaire.

Question	Connection to Conceptual Framework
Please describe your understanding of the lesson study process.	Stages of lesson study: investigate, plan, research lesson, reflection Teachers’ professional community: focus on improving instruction to increase student achievement, shared ownership of student learning, shared student learning goals
Why are you interested in participating in lesson study?	Teachers’ knowledge and beliefs: improved content and pedagogy knowledge Teachers’ professional community: improved collaboration with colleagues Teaching and learning resources: resources to support and enhance student learning
What are your beliefs about teaching and learning?	Teachers’ knowledge and beliefs: content knowledge, students’ conceptual understanding of content, pedagogy, beliefs about student learning (behavior, factors external to classroom, work ethic) Teachers’ professional community: time to collaborate with colleagues, shared ownership of student learning Teaching and learning resources: district approved curriculum resources, assessment tools, tools that promote dialogue and collaboration between teachers
How do you and your colleagues plan and collaborate?	Teachers’ knowledge and beliefs: pedagogy and content knowledge Teachers’ professional community: shared process for developing lessons, shared goals for student learning Teaching and learning resources: collaboratively developed lesson plans
Describe how you plan individually?	Teachers’ knowledge and beliefs: pedagogy and content knowledge, student learning goals, student thinking and learning Teaching and learning resources: lesson plans that detail what students will know and be able to do, assessments of student learning

<p>What barriers do you encounter as you plan for and deliver instruction?</p>	<p>Teachers’ knowledge and beliefs: content knowledge, students’ conceptual understanding of content, pedagogy, beliefs about student learning (behavior, factors external to classroom, work ethic) Teachers’ professional community: time to collaborate with colleagues, shared ownership of student learning Teaching and learning resources: district approved curriculum resources, assessment tools, tools that promote dialogue and collaboration between teachers</p>
<p>What are you hoping to gain from participating in lesson study?</p>	<p>Teachers’ knowledge and beliefs: content and pedagogy knowledge, shared goals for student learning, focus on improving students’ conceptual learning Teachers’ professional community: shared ownership of student learning, collaborative focus on improving instruction, shared language and framework for planning and analyzing instruction Teaching and learning resources: lesson plans that promote student thinking and learning, tools to analyze student learning, instructional strategies that promote student thinking</p>

Appendix C
Interview Protocol- Lesson Study Participants

Purpose: This interview is being conducted to understand how teachers experienced the lesson study process. It will provide the teacher’s perspective of the process to include what went well, what needs to be improved, how their beliefs may or may not have changed as result of their participation. Do teachers prefer lesson study over more traditional forms of professional development.

Interviews will be conducted in teacher’s classrooms at a time specified by the teacher. Each interview will be audio-recorded with the teacher’s permission.

Question	Connection to Conceptual Framework
Please describe your understanding of the lesson study process?	Stages of lesson study: investigate, plan, research lesson, reflection Teachers’ knowledge and beliefs: content and pedagogy knowledge, focus on student thinking, shared goals for student learning Teachers’ professional community: focus on improving instruction to increase student achievement, shared ownership of student learning, shared student learning goals, processes for analyzing and improving instruction Teaching and learning resources: lesson plans that promote student thinking and learning, tools to analyze student learning, instructional strategies that promote student thinking
What have you learned about student thinking and learning?	Teachers’ knowledge and beliefs: improved understanding of students’ conceptual knowledge, connection between content/pedagogical knowledge and student learning Teachers’ professional community: inquiry focused on improvement, shared ownership of student learning, analysis of impact of instruction on student thinking Teaching and learning resources: tasks that promote and reveal student thinking
What have you learned about your content and the teaching of your content?	Teachers’ knowledge and beliefs: content and pedagogy knowledge, students’ conceptual understanding Teachers’ professional community: shared language, and process for analyzing instruction

<p>What are your beliefs about teaching and student learning? Describe any changes.</p>	<p>Teachers’ knowledge and beliefs: content knowledge, students’ conceptual understanding of content, pedagogy, beliefs about student learning (behavior, factors external to classroom, work ethic) Teachers’ professional community: time to collaborate with colleagues, shared ownership of student learning Teaching and learning resources: district approved curriculum resources, assessment tools, tools that promote dialogue and collaboration between teachers</p>
<p>How has the engagement of your colleagues impacted your learning?</p>	<p>Teachers’ knowledge and beliefs: pedagogy and content knowledge Teachers’ professional community: shared process for developing lessons, shared goals for student learning Teaching and learning resources: collaboratively developed lesson plans, tools that promote dialogue and collaboration between teachers</p>
<p>Describe any changes to your work patterns and collaboration.</p>	<p>Teachers’ knowledge and beliefs: pedagogy and content knowledge Teachers’ professional community: shared process for developing lessons, shared goals for student learning Teaching and learning resources: collaboratively developed lesson plans, tools that promote dialogue and collaboration between teachers</p>
<p>Describe any changes to student learning.</p>	<p>Teachers’ knowledge and beliefs: students’ conceptual understanding, connection between pedagogy and students’ conceptual understanding Teaching and learning resources: instructional strategies/tools that make student thinking visible</p>
<p>What barriers did you encounter during the lesson study process?</p>	<p>Teachers’ knowledge and beliefs: content knowledge, students’ conceptual understanding of content, pedagogy, beliefs about student learning (behavior, factors external to classroom, work ethic) Teachers’ professional community: time to collaborate with colleagues, shared ownership of student learning</p>

	<p>Teaching and learning resources: district approved curriculum resources, assessment tools, tools that promote dialogue and collaboration between teachers</p>
<p>What is your biggest take-away or learning from the lesson study process?</p>	<p>Teachers’ knowledge and beliefs: content and pedagogy knowledge, shared goals for student learning, focus on improving students’ conceptual learning Teachers’ professional community: shared ownership of student learning, collaborative focus on improving instruction, shared language and framework for planning and analyzing instruction Teaching and learning resources: lesson plans that promote student thinking and learning, tools to analyze student learning, instructional strategies that promote student thinking</p>
<p>What would you differently? Why?</p>	<p>Teachers’ knowledge and beliefs: content, pedagogy, students’ conceptual understanding, impact of instruction, making student thinking visible Teachers’ professional community: inquiry focus, connection between instructional strategies and student learning, long-term goals for students, shared ownership of student learning Teaching and learning resources: lesson plans, tools for collecting data regarding student thinking, norms focused on inquiry, sharing of ideas between teachers</p>
<p>If there was one thing that you could share with your peers about the lesson study process, what would it be? Why?</p>	<p>Teachers’ knowledge and beliefs: improved understanding of students’ conceptual understanding, connection between content/pedagogical knowledge and student learning Teachers’ professional community: inquiry focused on improvement, shared ownership of student learning, analysis of impact of instruction on student thinking Teaching and learning resources: tasks that promote and reveal student thinking, lesson plans, district approved curriculum resources</p>
<p>What about this processed should be sustained or replicated?</p>	<p>Stages of lesson study: investigate, plan, research lesson, reflection</p>

	<p>Teachers' knowledge and beliefs: content and pedagogy knowledge, focus on student thinking, shared goals for student learning</p> <p>Teachers' professional community: focus on improving instruction to increase student achievement, shared ownership of student learning, shared student learning goals, processes for analyzing and improving instruction</p> <p>Teaching and learning resources: lesson plans that promote student thinking and learning, tools to analyze student learning, instructional strategies that promote student thinking</p>
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Appendix D Norm Setting Guide

Purpose: The lesson study process engages teachers in deep reflection of the impact of their teaching practices on student thinking and learning. Through these discussions, teachers' values and beliefs about teaching and learning will be visible and may be called into question. It is important to establish norms that will promote a safe environment in which teachers are willing to take risks. This guide was taken from Lewis and Hurd (2011).

1. The following prompt will be given to the team: What would make this lesson study group a supportive and productive site for your learning?
2. Write a list of the characteristics that are important to you. Think about experiences you have had with professional groups that have been positive and that have been not so positive. What characteristics are important for you to engage in dialogue about academic content, expressing agreement/disagreement, and explaining your thinking.
3. Each person in the group will share their characteristics, taking care to identify and discuss any possible contradictions. For example, if one person asks for "safe" and another person asks for "challenging my thinking," how will the group meet both of these needs?
4. Synthesize the key ideas to about five norms that everyone supports.
5. Record the finalized norms and make the norms available to all group members. (Google File for each team will be created in Google Drive to store norms, lesson plans, and any other artifacts generated during the lesson study process.)
6. The team will select a different norm to focus on for each meeting.

Appendix E Lesson Study Roles

Purpose: Establishing group roles holds every team member accountable for actively engaging in the lesson study process. It also provides opportunities for teachers to contribute to the process in a role that they feel comfortable with. These roles were taken from Lewis and Hurd (2011).

Facilitator: Keeps the conversation focused and moving forward. Ensures all participants have a voice and that norms are adhered to. Develops and follows the agreed upon agenda. Secures coverage for teachers to observe the research lesson.

Note Taker/Typist: Takes the minutes from the meetings and shares the minutes for all group members to review prior to the next meeting. Types up the lesson plan and any other documents they group may need.

Recorder: Records on chart paper, where all can see, important decisions of the group. This is especially helpful when the group is determining student learning goals and planning the lesson.

Member: Supports others in their roles, actively contributes to the meetings and the lesson study process.

Appendix G Research Lesson Protocol

Purpose: The Research Lesson Protocol was used to ensure that each team included the necessary components of a lesson. This protocol made the team's thinking visible. It established a clear learning outcome for students, which was important for the debriefing and analysis after the research lesson was taught. The protocol also provided an opportunity for teachers to think about the skill and/or concept from the students' perspectives so that they could plan for potential misconceptions that students may have. This protocol was adapted from Lewis and Hurd (2011) and Stepanek et al. (2007).

Title of the Lesson

Team Members: Teacher 5, Teacher 6, Teacher 7, and Teacher 8

Research lesson teacher: Teacher 8

Date: March 18, 2019

Grade Level/Subject:

1. Learning intention: (What will students know and be able to do as a result of this lesson?)

Students will be able to tell time to the nearest five minutes.

2. Success Criteria: (How will we know the students have achieved the learning intention?)

Students will complete problems 6 and 10 to demonstrate writing the time to the nearest five minutes. Students will transfer the time from a digital clock to an analog clock, as well as transfer the time from an analog clock to a digital clock. This will demonstrate their understanding of telling time to the nearest five minutes.

3. Lesson Rationale: (Why we chose to focus on this topic and goals? What was difficult about learning/teaching this topic? What do we notice about students currently as learners? Why we designed the lesson as shown in the lesson design?)

- We chose this topic because second graders constantly struggle with telling time from year to year.
- This topic has been difficult in the past because the students have a lack of background knowledge. Students are only taught three lessons in first grade. This does not allow them to master the topic.
- Students are still struggling to tell time to the nearest hour and half hour. They continue to mix up the hour and minute hand. They do not always understand that there needs to be two digits on the minute side of the clock. They do not understand what section of the clock belongs to which hour.

- We chose to design the lesson as shown in order to create a lesson that can be used in other classrooms where Pearson math curriculum is also used. This is a lesson that is within the normal district curriculum. We looked back at how past students have performed on this lesson, as well as how current students are performing. We used this to identify where students have the most misconceptions and will need further instruction.

4. How does students’ understanding of this topic develop? (How does this lesson fit within a unit? How does it fit within students’ experiences in prior and subsequent grades?)

This lesson is a lesson that is a part of our district math curriculum. It is taught in Topic 8, Lesson 6. In 1st grade, students only receive three math lessons on telling time. In 2nd grade, there are only three math lessons taught on telling time. After 2nd grade, students do not receive any math lessons on telling time.

5. Lesson Design:

Lesson Steps: Learning Activities and Key Questions	Role of the Teacher(s)	Expected Student Reactions/Responses	Teacher’s Response to Student Reactions	Points to Remember/Checks for Understanding (Assessment)
<p>1. “I can…” statement.</p> <p>2. Students will independently complete the Solve and Share on page 473. (2 minutes)</p>	<p>1. Teacher will read the “I can…” statement so students can echo.</p> <p>2. Teacher is moving around the classroom to check for understanding and grading answers.</p> <p>2. Teacher shows exemplar(s), depending on variety of answers, to review</p>	<p>1. -</p> <p>2. Students should draw the hour hand at/past the 3 and the minute hand pointing at the 3(:15) to represent 3:15.</p> <p>-Misconceptions: (1) Students will draw the hour hand between the 2 and 3. (2) Students will draw the minute hand incorrectly. (3) Students will make the hour and</p>	<p>1. -</p> <p>2. What space belongs to the 3 hour (refer to chart)? What do the clock minutes count by? What number represents 15 minutes? Which hand is the hour hand? Which hand is the minute hand?</p>	<p>1. -</p> <p>2. Circulating room to check for correct/incorrect answer and giving students feedback.</p>

<p>3. Students turn to page 474 to follow top section with the Visual Understanding video and show video on board.</p> <p>4. Do You Understand? on page 474.</p> <p>5. Guided Practice on page 474.</p>	<p>correct answer.</p> <p>3. Teacher gives students ~10 seconds of think time then directs students to whisper to their shoulder partner the answer. Students give a whole group answer. (Throughout video questions)</p> <p>4. Teacher will model the questions with the whole group, while demonstrating with a Judy clock. Students will record answers.</p> <p>5. Teacher will model 1 and 2 for the students. Teacher will prompt students with questions to</p>	<p>minute hands the incorrect sizes.</p> <p>3. Misconceptions: (1) Students will think it is asking about moving tick to tick (1 min.), rather than number to number (5 min.). (2) Students may struggle to tell elapsed time.</p> <p>4. Students will respond with answers and record the times in their workbook.</p> <p>5. Misconceptions: (1) Students will incorrectly draw the hands on the clock. (2) Students will write the numbers in the incorrect order. (3) Students will incorrectly identify the minutes.</p> <p>6. Misconceptions-</p>	<p>3. If incorrect, students will repeat think time, sharing, and answering until correct answer is given.</p> <p>4. -</p> <p>5. Reteach according to misconception(s)</p> <p>6. (1-3)Reteach according to misconceptions about the parts</p>	<p>3. -</p> <p>4. -</p> <p>5. Whole group responses, which will guide teacher actions.</p> <p>6. Students will complete problems 6 and 10, independently, to show their understanding on</p>
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<p>6. Independent Practice on page 475</p>	<p>solve 3 and 4.</p> <p>6. Teacher will have students work on problems 5 and 7 with a partner for 1-2 minutes before going over. Teacher will then do the same for problems 8,9, and 11 with work time adjusted, as needed. The same will be done for 12, 13, and 15. Students will independently work on 14 and will share with a partner.</p>	<p>(1) Students will incorrectly draw the hands on the clock. (2) Students will write the numbers in the incorrect order. (3) Students will incorrectly identify the minutes. (4) On problem 12, students will not understand what the problem is asking them to identify. (5) Students will not read the problems and write the time shown, rather than the elapsed time. (6) Students will incorrectly draw the clock on problem 14.</p> <p>7. Misconceptions- (1) Problems 4-7 are riddles about clocks. Students will have not completed</p>	<p>and meanings of the clock. (4) Have students identify the time shown on each clock and direct them to identify the time between them. (5) Before students begin working on problems 13 and 15, teacher will remind students to read the problems carefully, look for what it is asking, and underline the question. Teacher will give further redirection, as needed. (6) Teacher will remind students to look at the classroom clock to help them draw a clock on their paper.</p> <p>7. (1) The teacher will teach examples of clock riddles during math small groups to familiarize students</p>	<p>how to write time on both a digital clock and an analog clock.</p> <p>7. -</p>
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<p>7. Success Criteria (problems 6 and 10 on page 475)</p>	<p>7. Once all other problems have been completed, the teacher will have students independently complete problems 6 and 10. As the students complete these problems the teacher will have the homework assignments written on the board. Students who complete both problems correctly, will complete the on-level assignment (2-6, 8). Students who get either one problem wrong or both problems wrong, will complete the intervention</p>	<p>problems like this prior to the homework.</p>		
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	assignment (1-5, 8).			
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Appendix H
Research Lesson Observation Protocol

Purpose: One of the intended outcomes for lesson study is that teachers will be able to gather evidence about the impact of the research lesson on student thinking. The observation protocol provides a common focus for all members of the research team as they observe students while a teammate teaches the collaboratively developed lesson. This protocol was adapted from Donohoo, (2017, p. 93).

Date:

Content/Grade Level:

Learning Target	Questions to Think About	Success Criteria

Demonstrations of Learning	Student Misconceptions
Evidence of Student Thinking	Unanswered Questions

Appendix I
Revised Observation Protocol

Date: April 3, 2019

Content/Grade Level: AP Science Course

Learning Target	Questions to Think About	Success Criteria
Should we accept the value of g (9.8 m/s^2) based on the data we collected?	Can you explain how your data proves your claim? We can refer them to their equation list. Students need to make reference to the universal equation for gravitation on their own. Distance between masses impacts acceleration due to gravity	Students will develop a claim to answer the question using evidence (data collected from the lab) and support the claim with scientific reasoning (previously learned equations, universal equation for gravitation)

Demonstrations of Learning/Evidence of Student Thinking	Student Misconceptions
	<p style="text-align: center;">Unanswered Questions</p>

Appendix J
Norms for Observing the Research Lesson

Purpose: During the teaching of the research lesson, observers are focused on students and how they respond to the collaboratively developed instructional strategies. Even though the focus is on the students, the teammate who volunteers to teach the lesson is still taking a professional risk. It is important for the team to develop norms for the observation. The following guidelines were taken from Lewis & Hurd (2011, p. 58).

- 1. Respect the classroom environment:** (do not bring cell phone, do not engage in side conversations with other observers, be on time, stay for the entire lesson)
- 2. Do not help students or interfere with the lesson:** (do not provide hints or coaching to help students complete assigned tasks, be aware of your position in the classroom to ensure you are not blocking students' views)
- 3. Use the observation protocol to collect data requested and agreed upon by the team:** read over the lesson plan prior to the observation, make note of the "points to remember," bring lesson plan into the observation)
- 4. Focus on assigned area of the classroom:** (focusing on the same area or group of students for the entire lesson will provide rich evidence of student learning at each point in the lesson, observers will be able to see how student understanding develops as the lesson unfolds)
- 5. Ask clarifying questions:** (if the team agrees, observers can ask clarifying questions at times when the flow of the lesson and student learning will not be impeded)

Appendix K
Post Lesson Discussion Protocol

Purpose: Lewis and Hurd (2011, p. 60), make specific recommendations for the structure, flow, and guidelines for the post lesson discussion to ensure the conversation remains focused on the student thinking and demonstrations of student learning. The teacher who taught the lesson needs to feel safe and supported.

1. Facilitator begins the discussion: (provides a brief synopsis of the goal for the lesson and reminds participants that the lesson under discussion was collaboratively created, each team member assumes responsibility for the planning of the lesson, when referring to the lesson, remember to use “our”)

2. Research Lesson Teacher’s Reflections: (the teacher who taught the lesson shares his or her thoughts regarding how the lesson flowed, what went as expected, what was unexpected, any changes that had to be made to the original lesson plan and why these changes were necessary, and reflections on what was learned through planning and teaching the lesson)

3. Observers share data collected from the research lesson: (each team member shares what he or she observed during the lesson using the lesson observation protocol, what does the data tell us about the learning intention for the lesson, the instructional strategies we selected, and the impact on student thinking and learning)

4. Facilitator guides general discussion: (the facilitator asks questions that help the participants reflect on the overall lesson and make explicit connections between the instructional strategies that were used in the lesson plan and the impact of these strategies on student learning so that the team can make revisions to the lesson to prepare to teach the lesson again to a different group of students, the “points to remember” may be used to help teachers make these connections)

Appendix L
Team Log- Post Debriefing

Purpose: At the end of the debriefing meeting, the team will respond to these questions and the note-taker will record the team's responses. The completed log will help the team make revisions to the current research lesson or plan for a new research lesson . This protocol was taken from Stepanek et al. (2007, p. 100).

Lesson Title:

Lesson Date:

Debriefing Date:

- 1. Describe participants' observations of student learning. Include details of what students said, did, and wrote/produced.**
- 2. Were there any unanticipated student responses? Explain.**
- 3. To what extent were the goals of the lesson achieved? Please provide supporting evidence.**
- 4. Which instructional decisions might have contributed to helping students meet these goals? Explain.**
- 5. What aspects of the goals were not reached? Please provide supporting evidence.**
- 6. Which aspects of the lesson plan should be reconsidered based on this evidence.**

Appendix M
Lesson Study Reflection Protocol

Purpose: Each team member will complete this log prior to the final reflection meeting. This will help team members gather their thoughts regarding the lesson study experience. Team members will share their thoughts at the final reflection meeting to help them generate a report of their findings. This protocol was taken from Stepanek et al. (2007, p. 139).

Name:

Date:

Lesson Title:

1. What did you learn through this cycle of lesson study that can be applied to other areas of your work? What learning can be generalized to other situations?

Student learning:

Pedagogy:

Lesson Study Process:

2. In what ways can you improve your lesson study work?

3. What questions would you like to explore in your next cycle of lesson study?

Appendix N
Lesson Study Final Report

Purpose: The final report documents the team’s learning and the impact of the learning on student thinking. It makes the thinking of the team visible for other educators. While the team’s results may not be directly applicable to the work of other teams, their results may help to inform the work of the other teams. The report also provides evidence of professional learning that can be shared with administrators, board members and other educational stakeholders to support the need for job embedded professional learning that is directly connected to teachers’ classrooms and students. This outline was taken from Stepanek et al., (2007, p. 135).

Lesson Title

Team Members’ Names: Teacher 9, Teacher 10, Teacher 11, Teacher 12

Dates of Lesson Study: January 2019-May 2019

Grade Level/Content: High School Science

Introduction	To help students communicate in a clear concise scientific manner through their writing. This goal was chosen because students have a difficult time analyzing data, interpreting evidence to support claims and justifying their reasoning. Assessed previous CER lesson study, found the rubric lacking, and added in graphic organizer with prelab questioning to scaffold student CER writing. NSTA site was used to gather sample rubrics, flow charts and graphic organizers to construct our lesson study tools. https://learningcenter.nsta.org/mylibrary/collection.aspx?id=GBdqFKABrOU_E
Lesson I	This lesson was taught in an AP Physics class where the students had to investigate the effect of the length of a pendulum compared to its period. See attached pendulum lab. For the specific CER portion the question was provided to them write their claim. “Should the value of g 9.8 m/s ² be accepted based on the data we collected?” At the beginning of the lesson post data questions were provided and discussed, then we discussed the rubric and explained, provided an exemplar of a CER, provided sectioned think, pair, share time as we worked through the graphic organizer. See attached graphic organizer and exemplar.
Results of Lesson I	Based on the results of Lesson 1 the suggested flow should be: introduce the rubric, provide an exemplar graphic organizer and then how take the information from the graphic organizer to complete a written CER paragraph.
Application of Revision	One teacher took these suggested revisions and implemented them with her biology students to write a CER on therapeutic and reproductive cloning. The results of the CER showed better reasoning and they included the language from the graphic organizer and rubric in the writing of their reasoning piece.

	<p>This shows that the additional questions enhanced their understanding and they were better able to justify their evidence and reasoning.</p> <p>Additionally, another teacher added the pre-lab questions to the graphic organizer so students have that resource provided up front so they know what to focus on in the CER and lab.</p>
Conclusion	<p>Our final thoughts on the lesson study are that the tools we created helped to promote and illicit student thinking to achieve goal of having our students communicate in a concise and clear scientific manner.</p> <p>The rubric we created resulted in clearly defined proficiency levels with a clear path to reaching an advanced level leaving room for student growth. Which allows us to differentiate for the ability levels in the classroom and is also malleable and versatile making it accessible across content areas.</p> <p>The graphic organizer worked as a tool to help students really structure their evidence and reasoning. Providing them post data/pre lab questions on the graphic organizer helped guide and structure their thinking and allowed them to very clearly justify and explain both their evidence and reasoning.</p> <p>Allowing them to collaborate on the graphic organizer is a good way to encourage higher-level thinking and gave us better CER results than we expected. Additionally, the structure of the graphic organizer allows for additional support, scaffolding and differentiation for all levels of learners.</p>

Appendix O
Pre-Lesson Study Questionnaire/Final Interview Response Matrix

Purpose: The participants responses to the Pre-Lesson Study Questionnaire and the final interview were arranged in a spreadsheet to track changes in teachers’ knowledge, beliefs, professional community, and teaching resources. This is an excerpt from that table that illustrates how the data were organized to facilitate qualitative coding.

Participant	.Questionnaire Q3: What are your beliefs about teaching and learning?	Interview Q3: What you learned about your content and the teaching of your content?	Interview Q4: What are your beliefs about teaching and learning? Describe any changes.	Questionnaire Q4: How do you and your colleagues plan and collaborate for instruction?	Questionnaire Q5: Describe how you plan for instruction individually?	Interview Q5: How has the engagement of your colleagues impacted your learning?
Teacher 1	No response	I’ve learned that even after 17 years of teaching, there’s still concepts that I need to work on that I don’t grasp fully, and if I am not grasping it fully, it’s reflecting on my students. They’re not getting it. So the teaching would be that I don’t know my content, I’m not going to be able to give the kids the proper instruction to help them get better.	So definitely there’s things that are different in my mind now because I have always kind of taught in a way of thinking that my kids are in eighth grade, they should know this, and I realized that they don’t always know it. So I’ve got to figure out where di the break down come from.	When time permits, we sit down and “outline” what we will teach for the week. However, it is seldom that we talk about particular strategies that we will of have used while teaching a lesson.	I plan where I should be in the content by the end of each week and then decide what will be taught each day. Sometimes I try to type up notes to give my students to fill in during the lesson. I try to make sure I have something interesting to capture their attention at the beginning of the lesson and keep the momentum going...	The lesson study group certainly made me more responsible because I don’t want to let my teammates down. I held myself more accountable for getting things done. It was great to work with colleagues and learn that other people have the same struggles or to bound

						ideas off each other.
Teacher 2	Teaching is what is presented and learning is what is taken away from the lesson by the learner.	To be more prepared for... Oh, my gosh. What would you call them. The discrepancies that... <i>Facilitator states: misconceptions ? Yes, misconceptions . Yeah, to be more cognizant of what they might think and what I am going to answer.</i>	Definitely the scaffolding up to the goal lesson that we need to kaje sure that we're getting all of the background knowledge that they need, including the misconception s. What I learned about the content, ratios and proportions are not the same thing or could be.	We meet once per week for 45 min as a 6 th grade team to plan the standards. Then, we meet "on-the-go" at other times to adjust and provide feedback to each other.	I look for/create lessons first that will active interest in the standards that our team has decided to present for that week. I also have to make adjustments since I have the alternative class for re-teaching and gap filling.	I think the belief that my kids can do more than what I initially thought. Maybe not more but quicker than I originally thought, because I had a deadline. I had to be ready on that day so I had to make that happen.
Teacher 3	I think that it is important that we teach to the students' level of learning.	I want to be more intentional about having that exit or something written for me to see. A lot of times.. <i>Facilitator asks: some feedback from students?</i> Yeah, even if it's just on a whiteboard. Just some kind of written feedback, not just verbal, not just thumbs up, thumbs down.	You know? I really think its beneficial overall how we're thinking about our lessons. It changes the way you think about teaching your lessons. Yesterday, we did 5-7. I must have thought ten times during that lesson, "Oh, next time I'm going to do this. You reflect a lot more I think.	Yes, everyday.	I watch the video that Pearson provides for the students and then look at the teacher questions that go with the video. I then look at the standards to see if it goes with the curriculum.	Well I think that they all had fantastic ideas. For example, like I said, we needed to teach it one day and then practice it two different ways. And Teacher 2 said to flip it, teach it in two days and then practice it in one...

Appendix P
Axial Coding Spreadsheet: Combining of Provisional and In Vivo Codes

Purpose: Axial coding was used to bring the provisional codes (developed from the conceptual framework) and the in vivo codes together. Google Sheets was used to create a multi-tab workbook with pages for each theme that emerged from the axial coding. There were a total six tables that mirrored this table. This table includes an excerpt from the Collaboration Theme.

Collaboration Theme- Teachers developed a shared sense of responsibility as the focused on content and pedagogical issues connected to their classrooms.					
Collaboration through lesson study helps teams of teachers delve deeper into content and pedagogical issues than traditional forms of professional development provide.	Teacher 2 Interview- Then just our team, the three of us generally plan and we plan together like that, but just not that deeply.	Team A, Feb 4, 2019- Teachers are not currently using their common plan time to discuss their conceptual understanding of content. Teachers explained that they meet once a month as a math department. "Teacher 1 leads that and go through and does the meetings so we can all be on the same page. We don't get into things like that." Referring to discussion of their conceptual understanding of content).	Team B, Jan 9- teachers were struggling to get students to make the connection between play and the skill of telling time. Teacher 6 states, "Its interesting. You were talking about candy ad sharing things equally. But when you go putting things on paper to help them make that connection. If they were having friends over and they were sharing something equally in their play, in its natural form, and then you bridging that, or making that connection, helping them...	Teacher 10 Interview- What I'm getting from that is what's the most important core aspects of this. And that is an observation, like a meaningful observation that's well planned out. I think the time that we spent really going over the lesson, were fundamental because of the conversations we were able to get out of them were that much better.	Team A, February 27- Teachers struggled with differentiating between learning targets and success criteria. See pp 10-12 in transcript). Teacher 3 mentions learning as an important component of her learning over the course of the lesson study process.
Provides a voice for new teachers	See Teacher 7 and Teacher 5 interview transcripts for responses.	Team B, Feb 27- Teacher 7 suggested using one of the strategies from the article I provided to help build	Teacher 5 interview- Well I really like listening to Teacher 7 and 8 talk, because they're such new teachers. Teacher 7 was real quiet	Teacher 7 identifying students' lack of conceptual understanding and connecting this to the activities in the article led the team to create a	

		<p>students’ conceptual understanding of the minutes on the clock. “I read it a while ago but they said that they had cubes or something. Correct me cause you read it too. But they would place cubes and then they would say, how many are in this group and there would be five so...</p>	<p>at first. And then she started putting it in...”</p>	<p>mini lesson that mirrored the strategies in the article to help students build their conceptual understanding of the tick marks on the clock. After teachers implemented the strategy, they shared how it impacted student thinking.</p>	
<p>Teachers feel more accountable and responsible to each other.</p>	<p>Teacher 1 Interview- So it made me more accountable. I held myself more accountable for getting things done, but it was also great to work with colleagues and learn that other people have the same struggles or bounce ideas off of each other.</p>	<p>Teacher 2 Interview- So I think it was the biggest piece was that accountability piece. It held me more accountable to making sure it happened. The lesson, that it happened on time, because I personally tend to apparently over teach things and I probably ... it would probably have taken me another week to get to that lesson if I had been doing it on my own.</p>	<p>Teacher 8 Interview- We’ve always worked together collaboratively but, I feel like maybe holding each other a little more accountable, instead of I forgot, or something like this but, we have deadlines with other things as well. I feel like as a group we are just walking away from this a little bit better at what we’re doing...</p>	<p>Teacher 12 Interview- Because we can all work together, we see different flaws and different holes in our rubric, or in our research outline. And then also having different levels of education. So Teacher 10 with his AP Physics and Teacher 9 with her AP Biology and Honors Biology, having people who are creating more rigorous expectations for their kids, and having that voice to help me create more rigorous expectations for my freshmen..</p>	