ELEMENTARY TEACHERS' ENGAGEMENT IN THE PROBLEM-SOLVING PROCESS FOR RESPONSE TO INTERVENTION IN MATHEMATICS

by

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An executive position paper submitted to the Faculty of the University of Delaware in partial fulfillment of the requirements for the degree of Doctor of Education in Educational Leadership

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DEDICATION

This project is dedicated to my wonderful husband, Rich, and my two boys, Thomas and AJ, who gave unconditional support and gave up countless hours with me over the last several years. Without the three of you, my life would be incomplete.

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ABSTRACT

For this study, I investigated elementary teachers' engagement in the Response to Intervention (RTI) problem-solving process, which included examining the nature of their talk, their productiveness in the stages of the process, and the resources they turned to as they planned for intervention instruction. There were three research questions that guided my study: 1) How did teachers in each of two professional learning communities (PLCs) engage in the Response to Intervention problem-solving process? 2) To what degree do the teachers' self-reported perceptions of their uses of the UST and their engagement in the RTI problem-solving process align with the researcher's PLC observations? 3) How do teachers use resources to plan for targeted instruction aligned with students' mathematical thinking? I used a qualitative research design to collect data from teachers who participated in two PLCs within one school. First, PLC meetings were observed for two teams of teachers, a third grade team and a fourth grade team, as they engaged in the RTI problem-solving process. Second, all four teachers from each of the teams and the mathematics coach participated in a one-on-one interview. My research revealed four significant findings: 1) Teachers in this study used different types of more, less, and non-descriptive talk as they engaged in the different stages of the problem-solving process; 2) When teachers used primarily more descriptive talk during Stages One and Two of the problem-solving process as they analyzed and described students' thinking, it appeared that they were more productive in the overall RTI problem-solving process because these teachers were

more successful at designing interventions targeted to students' thinking; 3) Teachers' self-reported perceptions mostly aligned with my observations of their PLC meetings, and teachers in each PLC talked in ways that were similar to types of talk they used during observed PLC meetings; 4) Teachers sought out resources for planning interventions that were not surprising, and teachers in PLC1 talked more descriptively about the resources linking the resources to their students' thinking, while teachers in PLC2 talked less descriptively about the resources while planning.

Keywords: response to intervention, RTI, Problem-solving model, mathematics, professional learning communities, PLCs, descriptive talk,

Chapter 1

INTRODUCTION

Since the reauthorization of the Individuals with Disabilities Education Act (IDEA) in 2004, Response to Intervention (RTI) has been a major topic of discussion in schools nationwide. Although it has been ten years since RTI has been included in Federal regulations, there has been little research conducted to analyze and evaluate how it is being implemented in classrooms, especially for mathematics. Much of the research surrounding RTI has been centered on reading (Brown-Chidsey & Steege, 2005; Hall, 2008; Mellard & Johnson, 2008; Duffy 2007) because RTI was implemented for reading much sooner than for mathematics. RTI for reading also has many prescribed assessments and resources with a set structure for teachers to follow; however, fewer prescribed assessments, resources, and structures exist for teachers to use for RTI in mathematics. The purpose of this study is to contribute to a greater body of knowledge and research regarding the implementation of RTI for mathematics, specifically how teachers engage in the problem-solving process as part of an RTI framework. A greater awareness of how teachers engage in the stages of the RTI problem-solving process can provide insights for how to better support them in this endeavor.

Research Questions

The goal of my study was to qualitatively examine ways in which teachers engage in the RTI problem-solving process for mathematics. I developed three research questions that facilitated this investigation.

1. How did teachers in each of two professional learning communities (PLCs) engage in the *Response to Intervention* problem-solving process?
    a. To what degree did teachers in each PLC use more and less descriptive talk, based on their own students' data from the Universal Screening Tool (UST), and how did teachers' talk in each PLC vary by purpose of the PLC meeting?
    b. To what degree did teachers in each PLC move productively through the stages of the RTI problem-solving process?
2. To what degree do the teachers' self-reported perceptions of their uses of the UST and their engagement in the RTI problem-solving process align with the researcher's PLC observations?
3. How do teachers use resources to plan for targeted instruction aligned with students' mathematical thinking?
    a. What resources do teachers seek out and use to plan for intervention instruction targeted to students' thinking in more and less descriptive ways?

The purpose of Research Question One was to gain insights into how teachers engaged in the problem-solving process during their PLC meetings. I wanted to observe teachers as they engaged in a cycle of the process to better understand their interactions with the Universal Screening Tool (UST) as they analyzed and described students' thinking, designed targeted interventions aligned to students' thinking, and reflected on the implemented interventions. The UST is an assessment designed to help teachers gain insights into their students' thinking about essential number concepts in the elementary grades. Teachers use this assessment to identify and understand students' conceptions and misconceptions about those number concepts in order to provide targeted interventions aligned to their students' thinking. I anticipated that understanding the nature of teachers' talk within those PLC meeting discussions would provide new insights for how productively they engaged in the problem-solving process.

Research Question Two was designed to investigate teachers' perceptions of their engagement in RTI problem-solving process. I wanted to determine if what I observed in PLC meetings aligned with teachers' perceptions about their engagement in the problem-solving process during those meetings, as the teachers reported during one-on-one interviews with me about their experiences in their PLC meetings. I anticipated that teachers' self-reported perceptions about their engagement in the problem-solving process would not always align with my observations of their PLC meetings because teachers may not realize that the nature of their talk might impact how productively they engage in the problem-solving process.

Finally, the purpose of Research Question Three was to better understand what resources teachers consulted as they planned interventions. I anticipated that these insights about teachers' use of resources for planning would help me understand what resources these teachers were aware of and valued. This information would help me (and others who work with these teachers) make informed decisions in the future. In order to set the stage for this research study, the rest of the introduction includes background information for the reader on RTI, a broader context for this study including the status of RTI implementation in Delaware and in Edgewood School District for mathematics thus far, the problem I investigated, and a brief preview of the chapters in this report.

Background Information for Response to Intervention

Response to Intervention (RTI) is the process utilized by schools nationwide to improve student learning through evidence-based instruction, using a variety of assessments with progress monitoring, and implementing research-based interventions (Riccomini & Witzel, 2010). RTI is a different instructional process than the discrepancy model, also known as the *wait to fail*[1] model, that was previously utilized to identify students with special needs (McCooke, 2006). Students could not receive additional educational services unless there was a discrepancy between their achievement and their intellectual ability, and this often occurred too late, which was

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[1] The phrase *wait to fail* is a common term used for to describe the discrepancy model for identifying students with special needs.

one of the most troubling criticisms of this model (Hall, 2008). This also created a long period of time before students could actually receive special education services, creating even more gaps in their learning. Another feature distinguishing RTI from the discrepancy model is that RTI is an instructional model for all students in general education. In contrast, the discrepancy model was used for identifying students in needs of special education services. For general education, students are to be screened within the first few weeks of the school year. Any students who are having difficulty can receive intervention in core instruction (Tier 1) right away. The discrepancy model does not help to predict the specific needs of students or the type or frequency of the intervention needed (Brown-Chidsey & Steege, 2005).

The Delaware Department of Education (DEDOE) defines RTI as “a process that utilizes components of good instruction ensuring that scientifically research-based instructional practices, matched to individual student instructional and behavioral needs, occurring in general education” (Delaware Department of Education, 2009). Based on the Federal law that drew attention to these practices for providing early intervention to struggling students, Delaware regulation embeds the RTI process across all schools as a part of general education. According to DEDOE, “RTI is a means to incorporate best practices and a data-driven system that informs instruction for closing the achievement gap in Delaware’s classrooms” (Delaware Department of Education, 2008). Key Principles of RTI include:

1. Effective administrative leadership to include support, prioritization of resources, and active participation.

2. Evidence-based instructional practices occur across multiple tiers using a scientifically research-based core curriculum aligned to Delaware Content Standards and are available to all students, all staff, in all settings all year.
3. High-quality instruction matched to individual needs is accessible to all students across all tiers.
4. Formative assessment data is collected to document student progress and analyzed to inform instruction.
5. Data-based decision-making within a team problem-solving model provides the foundation that guides instruction, interventions, and transitions between tiers.

Tiered instruction refers to different layers of instruction that students receive based on their needs as identified by assessment results. Tier 1 refers to core instruction that all students receive daily. Tier 2 instruction is a more intensified layer of instruction that occurs in addition to the core instructional time. Tier 3 is another layer of instruction that is even more intensified than the first two layers. Students are monitored regularly to determine which layers of instruction are most appropriate for meeting their needs. One option for identifying and meeting the needs of students through the tiers of an RTI framework is through teachers' engagement on a problem-solving process (which is described in greater detail in the literature review chapter).

The Broader Context for this Study

Most Delaware elementary schools are new to utilizing the RTI model for mathematics, but they are familiar with the model for reading. The State RTI regulations have been in place since 2007; however, the implementation of these regulations was to be phased in with elementary reading being put into place first. Districts in Delaware were provided an extension for implementing this RTI model for mathematics at the elementary level and for both reading and mathematics at the secondary level. This was to allow the secondary schools to learn from the experiences at the elementary level with reading. Implementing the RTI model for mathematics is quite new not only in the State of Delaware, but also nationally. Consequently, there is little research available regarding RTI for mathematics, best practices for implementation, or how to select resources to help guide schools and districts as they begin to unpack and understand how this model can work for mathematics, and Delaware schools received little additional monetary or human resources to help support the new regulations.

Since all Delaware public schools were to be in compliance with the RTI regulations for mathematics as of the 2013-14 school year, educators in Edgewood[2] School District have been trying to experiment with different aspects of the model. As the Supervisor of Curriculum and Instruction for Mathematics, I am responsible for

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[2] All names for the school district, school, and teachers have been changed to pseudonyms to protect the confidentiality of those involved.

assisting with RTI implementation at all grade levels K – 12. Because reading RTI regulations have been in place for several years, teachers have had lots of time to improve their implementation of the RTI model, to develop appropriate assessments, to have materials in place, and to learn how to match interventions to students' needs in reading. However, these same teachers have not had similar opportunities for mathematics. With my background in overseeing curriculum and instruction for mathematics at the state level, including work with RTI across many districts, I have seen the need for a study that delves into how the RTI model for reading might be adapted for mathematics. Now that I am working within a single school district, I found it important to engage teachers who were already engrossed in this work to help me study this process.

Elementary teachers in Edgewood School District are already informally experimenting with RTI for mathematics. They use data obtained from a screening tool as part of the process for informing instructional decisions while planning collaboratively in their PLCs. They have been provided with several tools, resources, and strategies to plan, design, and implement instruction based on their students' thinking; however, there is not a prescribed program or roadmap that lays out the mathematical paths for teachers and students as they engage in the RTI model. To continue supporting teachers as they implement RTI for mathematics, I had to first understand how they were engaging in this model at a deeper level, gain insights into their perceptions about how they were engaging in RTI, and determine the types of resources they turned to as they designed interventions targeted to students' thinking.

The Problem Under Investigation

Through this study, I investigated the ways in which teachers engaged in the RTI problem-solving process as part of the RTI model for mathematics. The problem I attempted to solve is how to improve mathematics RTI implementation at the elementary school level by gaining deeper insights into how teachers engaged in the problem-solving process, learning about what teachers' perceptions were about their engagement in the process, and understanding the resources teachers sought out and used to plan targeted intervention instruction for their students. By gaining a better understanding of these aspects of teachers' implementation of RTI for mathematics, I can provide better support and guidance for teachers in the future.

This study provided insights into the current situation in one school, and specifically within two grade levels, with regards to their engagement in the RTI problem-solving process for mathematics. The purpose of this project was to use these new insights to provide additional guidelines and structure for teachers to better support their implementation of RTI for mathematics. For this research study, I focused on the elementary grades, specifically third and fourth grade teachers in one elementary school, because elementary teachers began experimenting with implementing the RTI model much sooner than middle or high school teachers. Additionally, I wanted to find a school that had some components of the RTI model in place, including the problem-solving process, to be able to better understand what is happening in that school to draw some conclusions and make recommendations for how to improve it. The middle and high schools are in a very different place in their implementation of RTI because of the decision to phase it in by grade cluster. Fewer structural components of the RTI process are in place, there is not a screening tool that teachers are trained to use that provides the types of data that may be useful for informing instruction, and there has been no training for teachers to help them understand what RTI is and how the process can help student learning at those levels.

Preview of Upcoming Chapters

The presentation of this study includes 7 additional chapters and appendices. In Chapter 2, I will share relevant literature regarding essential number concepts to be addressed at the elementary level, RTI, the problem-solving approach, early screening measures/assessments, the mathematical knowledge needed for teachers, and the role of professional learning communities in the RTI model. In Chapter 3 I will provide the research design and methodology for this study. This will include the data collection and analysis process. Chapters 4, 5, 6, and 7 include the results and findings for each of the three research questions. Finally, Chapter 8 includes a discussion about my findings and implications for practice. The implications for practice include a newly designed resource guide for teachers for implementing RTI for mathematics.

Chapter 2

LITERATURE REVIEW

This literature review will focus on a few key ideas that informed this study. Since this study focuses on teachers' engagement in the RTI problem-solving process to better understand students' thinking about essential number concepts, the first section will highlight the current research base about important mathematics concepts at the elementary level. Next, I will share research that supports the use of Response to Intervention (RTI) in schools as a support system for students in their learning of reading and mathematics. I also present a problem-solving approach as part of the RTI framework, as this turned out to be an essential part of my study. Additionally, assessments, especially early screening measures, are a key component of the RTI framework, and I will present research regarding the use of these assessments in the elementary grades. Also, I describe research regarding the mathematical knowledge needed by elementary teachers, as their knowledge of mathematics is fundamental to being able to assess students' understandings and use that information for instruction. Lastly, I share research about the role that professional learning communities (PLCs) play in the RTI framework, including data analysis and planning in the problem-solving model.

Important Number Concepts in the Elementary Grades

Over the past several decades, researchers have tried to discern and assess the most essential mathematics concepts in the elementary grades, such as number and operations, to improve future learning. There is some evidence that suggests students' confidence in mathematics and success in later elementary grades may be affected by the successes or failures with early number concepts (Jordan, 1995). Clements & Sarama (2009) also agree "children's knowledge of math during pre-school and early elementary years predicts their mathematics achievement for years later – throughout their school career" (p. 6). According to the National Mathematics Advisory Panel (NMAP) Report, *Foundations for Success* (2008), fluency with number sense and operations is crucial to students' later success in algebra and higher-level mathematics. Riccomini & Witzel, (2010) believe that students must develop a good sense of numbers in the early grades to achieve in mathematics.

So what are the key early number concepts that are crucial to later mathematics learning? In general, educators call it 'number sense' with some commonalities in what is implied by this term. Good number sense as defined by Kalchman, Moss, and Case (2001) includes fluency in estimating magnitude, assessing reasonableness, and flexibility between representations along with using the most appropriate representation (p. 2). The ability to compare the magnitude of numbers and to decompose numbers to solve problems is often cited as a key component of number sense (Berch, 2005).

Some researchers situate fluency with whole numbers within the larger concept of Number Sense. For example, Mcintosh, Reys, and Reys (1992) present a framework for considering Number Sense (p. 4). They define number sense as “a person’s general understanding of number and operations along with the ability and inclination to use this understanding in flexible ways to make mathematical judgments and to develop useful strategies for handling numbers and operations” (p. 3). They go on to describe the framework in which several components directly relate to this study regarding operational fluency such as knowledge of facility with operations, applying the knowledge to computational setting, utilizing efficient strategies and representations, and understanding the relationship between operations. Some educators think of ‘basic facts’ when referring to fluency, but Sherry Parrish, the author of *Number Talks* (2010), describes fluency as much more than fact recall. Her definition is what I envision fluency to be: “Fluency is knowing how a number can be composed and decomposed and using that information to be flexible and efficient with solving problems” (p. 38).

The Common Core State Standards (CCSS) quote the National Research Council (NRC, 2009) when deciding which concepts will be the focus of the elementary grades:

> Mathematics experiences in early childhood settings should concentrate on (1) number (which includes whole number, operations, and relations) and (2) geometry, spatial relations, and measurement, with more mathematics learning time devoted to number than to other topics. (p. 1)

The CCSS focus on number in K – 5 supports Carpenter, Franke, and Levi's (2003) notion that developing mathematical thinking provides a foundation for algebra occurs over an extended period of time, starting in the early grades (p. 1). With many number concepts being a foundation for success in algebra, the National Math Panel created the *Critical Foundations of Algebra* and developed specific benchmarks for each of the critical foundations. The first critical foundation of algebra is "Fluency with Whole Numbers" meaning that students should have a "robust sense of number" by the end of grades 5 or 6 (p. 17). Included in this robust sense of number is understanding place value, decomposing numbers, the meaning of operations, computational fluency, applying operations to problem solving and estimation (p. 17-18). In *Adding It Up* from the National Research Council, "proficiency" with whole numbers is described as relational knowledge of basic number combinations without an emphasis on memorization (p. 182). In *Making Sense*, Hiebert et al. (1997) describe balancing skill and understanding (p. 6) with understanding as relationships and connections to what we already know (p. 4).

Similarly, NCTM's *Curriculum Focal Points* for grades 3 – 5 note understanding and fluency with whole number relationships and operations, and fluency with addition and subtraction of decimals and fractions (p. 27-29). The CCSS extend a step further stating that students should 'finalize fluency' with whole number operations, add and subtract fractions and decimals and extending multiplication and division to understand the meaning of multiplying and dividing fractions by the end of grade five. These new standards encompass higher expectations for teachers and students than prior standards.

Response to Intervention as a Comprehensive Assessment System

How do we ensure all students have the conceptual understanding and number sense needed in the elementary mathematics that is so crucial to their later success in mathematics? We need a comprehensive assessment system that supports high quality learning (Darling-Hammond, 2010) and engages teachers in looking at student work to make instructional decisions that meet the needs of all learners in the classroom. A relatively new framework for meeting these needs is federal and state mandated regulation called Response to Intervention (RTI). Hall (2008) believes RTI is a school-wide collaborative effort in which all of the educators take responsibility for all students' learning (p. 17).

RTI is a process that teachers utilize to ensure that the needs of all students are met through a "systematic and data-based method for identifying, defining, and resolving students' academic and/or behavior difficulties" (Brown-Chidsey & Steege, 2005). Another, more academic, definition of RTI is the process utilized by schools nationwide to improve learning through evidence-based instruction, a variety of assessments and progress monitoring, and research-based interventions (Riccomini & Witzel, 2010). Clearly, assessment is a common key component of the RTI process. Brown-Chidsey & Steege (2005) call it an assessment-intervention model (p. 2) because assessment should be used frequently throughout learning to make instructional decisions and possibly provide intervention to students before they fail. This approach is more proactive, rather than the previous "wait to fail" methods in which students must make poor progress, or fail, for long periods of time before they can receive additional support. Hall (2008) calls RTI a "dynamic problem-solving process" that helps to determine if instruction has been effective by utilizing data to determine students' weaknesses and to make instructional decisions (p. 17).

Some educators prefer to call RTI a framework rather than a model, because framework feels like a flexible process and a model sounds more like a set, rigid approach (Hall, 2008). There are two common approaches to RTI, a protocol or problem-solving approach (Hall, 2008; Mellard & Johnson, 2008). The protocol approach is more prescribed, using one intervention program that all students below the benchmark receive (Hall, 2008). Conversely, in the problem-solving approach (often called a problem-solving model), different students' needs are recognized and instructional decisions are made on a student-by-student basis (p. 70). Students receive different interventions based on their individual needs (Hall, 2008). Several schools have acknowledged that following one approach or simply using one intervention program does not necessarily meet the needs of all struggling learners and blend the two approaches finding several programs to place students in intervention groups based on their needs through problem-solving (Hall, 2008).

The first step in the process of a tiered RTI model is assessing all students' mathematics abilities through a universal screening that is administered within the beginning weeks of school. Students falling in the lowest 25%, or other designated benchmark, should be carefully monitored for up to six weeks and then re-evaluated. A universal screening tool is to be given to students three times per school year (fall, winter, and spring) as a broad measure of students' progress towards mathematical proficiency. This is the first layer of assessment to identify the students who may be at risk of not being successful in their core instruction. Once the students who may be struggling are identified, teachers are to monitor their progress regularly. Hall (2008) believes that progress monitoring is the heart of RTI as the data is used to inform instruction and make decisions about students based on how they are progressing in an intervention (p. 29, 82). Using progress monitoring data, teachers can determine if students should continue with an intervention, if they need increased intensity with that intervention or if they have made enough progress to be placed in another tier or intervention.

Problem-solving model. A problem-solving approach for analyzing data to determine students' needs for intervention has been widely recognized in research for RTI (Tilly, 2008; Hall, 2008; NASDSE, 2005; Brown-Chidsey & Steege, 2005). Although many researchers recommend a problem-solving model for identifying and meeting students' needs, there are slight variations in the models proposed. For example, Brown-Chidsey & Steege (2005) recommend a "data-based problem-solving model" that includes 5 steps (p. 6), while Tilly (2008) provides a similar, but slightly different, 4 step problem-solving model. Table 1 below compares the stages for each of these two models.

Table 1 *Examples of Two Problem-solving Models*

	Brown-Chidsey & Steege	Tilly
Stage 1	Problem identification	Is there a problem and what is it?
Stage 2	Problem definition	Why is the problem happening?
Stage 3	Designing intervention plans	What can be done about the problem?
Stage 4	Implementing the intervention	
Stage 5	Problem solution	Did the intervention work?

One distinction between these two models is the wording of each step, or stage. The model shared by Brown-Chidsey & Steege (2005) is a list of steps with overarching directives, while Tilly's (2008) model has a question to guide each stage, or step, of the model. Although Brown-Chidsey & Steege (2005) state that this model can be used continuously, the last step implies that there is a solution to the problem. In contrast, the problem-solving model presented by Tilly (2008) includes a cyclical graphic where each stage leads to the next (See Figure 1 below).

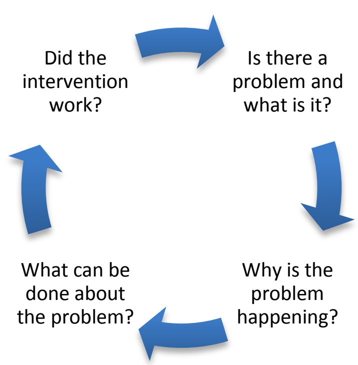

Figure 1 Tilly's Problem-solving Model

The last stage points to the first stage to show that the problem-solving model is continuous. The questions in Tilly's model are unpacked even further with additional guiding questions for each step that help to facilitate the discussions that should occur.

To begin the problem-solving model, teachers must select assessments that determine students' understandings in ways that measure more than just whether the student was right or wrong or serve to do more than simply grading and sorting them into categories (Mirra, 2008; Stiggins, 2006). Assessment has two driving themes, according to Stiggins (2006), to assess accurately and use the results to benefit students (p. 13). Although achievement scores give educators one overall data point, these scores do not provide the kind of information that teachers need to improve student learning (Stigler & Hiebert, 1999). To inform classroom instruction, we need assessments *for* learning rather than assessments *of* learning (Stiggins, 2006). Stiggins (2006) describes assessments *for* learning as those that provide information for students about their progress, to teachers to help diagnose and address students' needs, and to parents about students' progress over time (p. 33). This differs from assessment *of* learning as it is more summative and may be too late to meaningfully inform instruction. Wiliam & Black (1998) also advocate for analyzing student work for the purpose of understanding students' thinking rather than for grades as the grades negatively impacts student achievement (p. 5). There is little research about how teachers use classroom assessments versus external assessments and even less about how teachers use assessments to guide mathematics learning (NRC, 2001).

Assessment as Early Screenings

To begin the problem-solving model we need assessment data that is useful for identifying students' thinking that is meaningful and informs instruction (Clarke & Shinn, 2004). As part of an RTI framework, this would include a universal screening that helps to identify students who are at risk of not being successful in their core math classes. Clarke and Shinn (2004) state that students who are at risk must be identified as soon as possible to maximize the effectiveness of early intervention (p. 234). Prior research also suggests that these early intervention assessments, or screening tools, focus on number sense because number concepts are crucial for later mathematics learning (Lago & DiPerna, 2010; Clarke & Shinn, 2004).

With these ideas in mind, a locally-created and innovative *Universal Screening Tool for Number Sense* (UST) was designed to be a part of a three-tiered model of instruction for RTI in Delaware schools. The teachers at Turner Elementary School began using this new tool in its entirety during school year for which this study took place (2013-14). This tool has a dual purpose: to determine which students are struggling with number concepts and at risk for not being successful in the core math class, and to diagnose their needs in order to provide targeted intervention as appropriate.

Gersten, Clarke, and Jordan (2007) state that utilizing a brief fluency measure in early grades will enable schools to identify those students who are at risk and provide intervention (p. 10). 'Brief' is key word here because time has been a real concern for teachers. Assessing students often takes time away from instruction so finding an assessment that provides information about students' mathematical understanding in a brief timeframe is crucial. Although this new assessment tool is brief, about 9-11 items, and assesses only key number concepts, the implementation and data analysis can be time-consuming for teachers. This is because they must observe students as they work, ask clarifying questions, and carefully analyze the students' work to understand their thinking. This is a key part of an assessment system that engages teachers in the assessment process with close examination of students' work and collaboration with others to review, score, and use the results (Darling-Hammond, 2010).

Teachers can gain valuable insight into students' mathematical thinking and understanding by looking carefully at their representations (NCTM, 2000) and using these representations as clues to how students are making sense of the mathematics (Perry & Atkins, 2002). Often, a correct answer does not always reflect understanding. Better understanding of students' thinking can enable more descriptive talk as teachers are identifying strengths and weaknesses for intervention planning. Tapper (2012) suggests using flexible interviews, a quick and focused interview through questioning, to better understand students' mathematical thinking (p. 36). Using flexible interviews can help teachers gain important insights that can be used to inform instruction, but does take time and active involvement by the teacher. The Delaware-designed UST consists of one-on-one interviews with students in kindergarten and first grade, and then flexible interviews for 1-2 of the assessments items in grades 2 – 5. Some key questions Tapper (2012) suggests for the interviews are: "Why did you do that? How did you come up with that? I noticed you paused just now, what were you thinking? Why did you change your mind just then?" (p. 37).

The idea of flexible interviews aligns well with the structure of the new assessment tool as the teacher administers it within his/her classroom, observing students carefully as they are working. The guidelines for administering the assessment describe specific items (assessment tasks) for which the teachers should pay close attention. Teachers are provided with a recording sheet to use as they observe students working and to make notes about students' thinking, and/or the strategies they are using. If the teacher is unclear about the student's thinking from simply observing, he/she can ask the student about it. A major benefit of implementing the assessment tool is that teachers will deepen their knowledge of students' mathematical understandings. This will allow them to use the information gleaned from the assessment tool to inform mathematics instruction in ways that will meet the needs of all learners within their classroom. Swafford, Jones, and Thornton (1997) argue that the more teachers know about their content and the ways in which students learn, they will be more effective in fostering mathematical understanding.

Important Knowledge for Teachers

Tilly (2008) suggests that those administering the screening assessments to students must have significant knowledge of that domain (p. 21). In this case, the assessors would need to have a "broad and deep knowledge" of mathematics, according to Tilly (2008). The important knowledge of mathematics for teachers is described below and will include two main components, pedagogical content knowledge and knowledge of learning trajectories, each of which is essential for teaching and assessing mathematical concepts. First, if teachers are to teach students important mathematical concepts, then they should also have the specialized knowledge to do so. Shulman (1987) introduced the term *pedagogical content knowledge* as the type of knowledge that blends content and pedagogy so that teachers can organize and teach in a way that is purposeful for that particular content (Shulman, 1987; Ball, Thames, & Phelps, 2008). For mathematics, it is important for teachers to understand the concepts they are teaching including the models, tools, representations, and strategies that are effective and knowing when they should be introduced, and when they are more or less efficient for a particular concept. In NCTM's *Focus in Grades 3 – 5*, Mirra (2008) suggests a variety of teaching skills specific to mathematics:

> Knowing which concepts are typically difficult for students and how to address those difficulties; Being able to select and model effective representations for mathematical ideas; Selecting good problems; Examining students' work and being able to pinpoint and analyze sources of errors; Being flexible in thinking about alternative ways to solve a problem as described by students; Assessing students in order to make important instructional decisions related to the content, such as when to provide additional instruction or when to move on; and Deciding which student ideas to call attention to during class

discussions. (p. 19)

All of these are important for those teaching mathematics, and especially for intervention. Teachers must be able to anticipate difficult concepts and students' possible misconceptions, assess students to determine who has these misconceptions, and have knowledge of different strategies or representations to help students learn. This is especially true for teachers who must provide interventions for struggling students. Some teachers may have difficulty identifying or using the most important concepts and mathematical understandings because they may have been taught with an emphasis on procedures rather than conceptual understanding (NRC, 2005).

Teachers must have an understanding of the concepts that come as prior learning for students, where the current concepts fit into the overall trajectory, and how the students will extend this learning later. Learning progressions over time define the paths or tracks of knowledge that students may be on (Daro, Mosher, & Corcoran, 2011). This is more commonly known in mathematics as learning trajectories (Daro et al., 2011). Mirra (2008) states that this broader view of mathematics enables teachers to better explain the topics being taught and provide problems or tasks that illustrates that learning (p. 19). Teachers must have the expertise and in-depth content knowledge to interpret and use that data from assessments to inform instruction and guide instructional decisions. Many elementary teachers lack the depth of mathematics understanding to know how to intervene with students, and they rarely feel like 'experts' in mathematics. This mathematics content knowledge must be broader than the content being taught (Tapper, 2012). Knowing the meaning behind mathematical concepts and the connections between them helps teachers to discover the knowledge underpinnings that build particular concepts. When teachers assess key mathematical concepts, they can help support students that have misconceptions.

This knowledge of learning trajectories will enable teachers to become skilled at developing and using assessment information to meet learners' needs (Darling-Hammond, 2010). Cognitively Guided Instruction (CGI) helps teachers to focus on analyzing student thinking through professional development on how students solve problems and their strategy development (Franke, 2009). Teachers can use this information to guide instruction by posing problems that support student learning and probe student thinking (Franke, 2009).

Professional Learning Communities (PLCs)

One essential stage of the RTI problem-solving process includes planning targeted instruction. Wiliam and Black (2004) describe planning as an important part of the learning process (p. 19). They say that careful forethought is essential if learning is to improve in the classroom. Teachers must plan activities that that provide opportunities for students to share their thinking and for the teacher to provide feedback. Tapper (2012) advocates that teachers do this planning together in small groups that he calls a 'collaborative study' (p. 72). The goal of the collaborative study is to work together to better understand student thinking, and use that knowledge to support students in future learning opportunities. We have these groups in Delaware called professional learning communities (or PLCs) that have been mandated in our state for teachers to meet together for at least 90 minutes per week. Teachers can plan for differentiated learning for students to meet their needs using small groups or centers. They are to utilize data from multiple sources in these PLCs to ensure that the instructional decisions are data-driven. Tapper (2012) suggests three questions teachers can ask themselves when analyzing student work during planning: "Is there a recognizable pattern in the student's work? How realistic is the student about his understanding? What don't I understand about what the student has done? (p. 37)." Tapper's questions can help teachers understand students' thinking as they are analyzing data. In Wayman and Jimerson's (2013) study of the skills teachers need to analyze data effectively, teachers reported that they could identify a student's need, but struggled with what to do with that information (p, 5). Working in a PLC to analyze data and describe students' thinking can be more beneficial than doing so independently. In prior research regarding effective data analysis, collaboration was identified as a key factor for teachers' engagement in analyzing data effectively (Wayman & Jimerson, 2013).

DuFour, DuFour, Eaker, & Karhanek (2004) describe the basic structure of a PLC as a "collaborative team whose members work interdependently to achieve a common goal" (p. 3). They also suggest three questions that are critical for PLCs to address: "Exactly what is it we want all students to learn? How will we know when each student has acquired the essential knowledge and skills? What happens in our school when a student does not learn?" (p. 21).

The last question is considered to be a major distinction between schools that are committed to learning for all students and those that are not because it can impact the success of a school's implementation (p. 25). True PLCs "embrace the notion that the fundamental purpose of school is learning, not teaching" (DuFour et al., 2004). Frequent formative assessment is what guides the learning in PLCs to address the needs of students who have not learned (p. 24). In their research on PLCs, Nelson, Slavit, & Deuel (2012) argue that teachers should analyze student learning data individually and collectively to support a deeper understanding of students and to provide opportunities to reflect on learning goals, instructional techniques, and curriculum (p. 3). They also argue that how teachers interact with this data and their beliefs about what constitutes valuable data are significant in how they interact with each other. Additionally, their views about the relationship between data, instruction and learning are essential to how teachers interact with student learning data (p. 3).

Part of the conceptual framework developed by Nelson, Slavit, & Deuel (2012) includes the work of Charalambous and Silver (2008) which distinguishes between a proving and improving stance of teachers related to analyzing student data. Teachers having a proving stance are focused on proving the effectiveness of their practice. In the conceptual framework, Nelson, Slavit, & Deuel (2012) describe this as teachers generalizing learning goals, focusing on isolated facts or skills, and using broad categories or generalizations about students such as "get/don't get it" (p. 14). In contrast, an improving stance is described as using student learning data to reflect on practice to make changes or improvements. In the conceptual framework, teachers link learning goals to sub-concepts in a big idea, focus on connecting related concepts in a big idea, and focus on uncovering a range of student understandings to be used for improving instruction. The conceptual framework includes a continuum from proving to improving across four categories: general (proving), teacher-focused, learning-focused, and nuanced (improving).

Fisher and Frey (2005) call this aspect of using data to inform teacher practice the 'Feed Forward' component of their feedback system (p. 21). Their feedback system has three components, 'Feed Up', 'Feed Back', and 'Feed Forward'. The feed-up component describes clarifying the learning goals for students so they know that instruction has an established purpose. The feed back component is for teachers to provide meaningful feedback after a formative assessment to students individually that directly relates to the learning goals. Finally, the feed forward component is to modify instruction based on what is learned from the formative assessment. Teachers must take time to plan ahead, use their mathematical understanding to plan for effective instructional opportunities for students, and include flexibility when lesson planning (Fisher & Frey, 2005).

Information Still to be Learned

There is still much to be learned about the ways teachers engage in RTI and the problem-solving process during PLC meetings. First, we need to better understand how teachers interact with assessment data to gain insights into students thinking, including how descriptively they can describe students' mathematical thinking. This would be essential information to have because if we can better understand how teachers specifically and descriptively identify students' conceptions and misconceptions, we can then help them to plan interventions targeted to students' thinking.

Second, it is important to learn more about how teachers can engage productively in the RTI problem-solving process as they attempt to identify students' conceptions and misconceptions and plan targeted interventions aligned to students' thinking. Insights regarding teachers' productiveness in the problem-solving process would be useful to school/district leaders and to professional developers because better understanding how teachers engage productively (or not productively) can help inform the types of support that is needed in the future. School/district leaders can use this information to better understand how teachers in their own schools engage in the process and how to improve their productiveness in the process, if needed. Professional developers can use this information to design learning opportunities that enhance current practices regarding teachers' engagement in the RTI problem-solving process.

Third, the elementary mathematics community needs additional research and literature to help teachers understand the ways that different intervention resources address students' thinking within the learning trajectories for important number concepts. Teachers are provided with various instructional resources to help address students' thinking during intervention instructional, but they struggle with understanding how different resources address different conceptions/misconceptions within a learning trajectory. Additional information that provided guidance for teachers would help them as they plan targeted interventions aligned to students' thinking.

This study was designed to address some of these gaps in the literature by observing teachers in real time as they engaged in RTI. This study investigates the types of talk that teachers use as they engage in the RTI problem-solving process by analyzing the talk teachers used during their discussions in PLC meetings. It also investigates how productively different groups of teachers engage in the RTI problem-solving process by carefully studying teachers' interactions as they move through each stage of the process. Finally, this study investigates the types of resources that teachers turn to as they plan intervention instruction targeted to their students' thinking by analyzing the types of resources they referenced and how they connected the resources to students' understanding about a concept.

Chapter 3

METHODS

To address the research questions, I have adopted a qualitative research design with a case study approach. Qualitative design should be selected when a complex and detailed understanding of the issue is needed, when we want a better understanding of the context or setting in which the participants interact with the issue, and when quantitative measures do not fit the problem (Creswell, 2007). These are just a few of the reasons proposed that align with the purpose and context of this study. Creswell (2007) defines qualitative research:

> Qualitative research begins with assumptions, a worldview, the possible use of a theoretical lens, and the study of research problems inquiring into the meaning individuals or groups ascribe to a social or human problem. To study this problem, qualitative researchers use an emerging qualitative approach to inquiry, the collection of data in a natural setting sensitive to the people and places under study, and data analysis that is inductive and establishes patterns and themes. The final written report or presentation includes the voices of participants, the reflexivity of the researcher, and a complex description and interpretation of the problem, and it extends the literature or signals a call for action. (p. 37)

He also describes five approaches to qualitative research: narrative research, case study, grounded theory, phenomenology, and participatory action research (p. 239). “Case study research involves the study of an issue explored through one or more cases within a bounded system (i.e., a setting, a context)” (Creswell, 2007). Case study research is appropriate for in-depth, descriptive research questions that aim to gain a deeper understanding about different cases and how they can provide insight about an issue (Creswell, 2007). My stated research questions seek to understand the ways in which two particular cases of teacher PLCs can provide insight into how teachers make instructional decisions, as a group, regarding assessments and resources as part of the RTI process for mathematics. These results will support the development of insights that can be used to better support teachers’ professional work within the RTI process. Each PLC comprised of 4 - 5 teachers is a ‘case’. Of the three case study types recommended by Creswell (intrinsic, instrumental, and collective), a collective study that utilizes more than one case to illustrate and understand an issue is the best fit for my study because it includes two cases (i.e., two PLCs) with replicated procedures (p. 74).

I conducted a pilot study in the fall prior to this study focused on one component of the RTI process: the use of the screening tool for planning instruction. This pilot study helped to inform and shape the current study of teachers’ engagement in the RTI problem-solving process and their use of resources while planning instruction targeted to students’ thinking. I learned that focusing solely on teachers’ use of the screening tool did not help me to understand how they engage in the different stages of the process. The pilot study did not consider that teachers may use different types of talk as they engage in different stages of the RTI problem-solving process based on different purposes for the PLC meetings. I believe that understanding these different types of talk is crucial to gaining additional insight into how teachers make sense of and engage in RTI for mathematics.

Data Collection

Context and participants. The sample for this study includes two teams of teachers at Turner Elementary School in the Edgewood School District. One team was a group of four third-grade teachers and the other team was a group of four fourth-grade teachers. There were also two special education teachers who were consulting members of the fourth-grade team, but do not participate in their meetings regularly based on the variance in their teaching schedules.

This school was selected after a hired consultant and I visited each elementary school in the district and observed every professional learning community (PLC) meeting, kindergarten through fifth grade at each elementary school in Edgewood School District. This consultant was hired to assist the teachers with understanding the purpose of our mathematics screening tool, the research behind it, and to provide ideas for interventions based on the types of student responses. This initial visit to each PLC meeting at each elementary school provided me with an opportunity to gather an overall profile of all PLC teams across each of the elementary schools. This enabled me to understand the ways in which teachers were experimenting with implementing the RTI Framework for mathematics based on the data from the Universal Screening Tool (UST). I was most interested in teams of teachers who were attempting to engage in using the problem-solving approach to identify and meet the needs of their students based on students' thinking.

I selected a school that I conjectured would provide the greatest insights into the ways in which teachers were experimenting with using the UST as a data source for engaging in the RTI problem-solving process. Turner Elementary was chosen because the teachers had already begun to experiment with an RTI process for mathematics and they have a mathematics coach who supports the grade-level teams in reflecting upon and improving this process. This was different from many of our other elementary schools because they were in various stages of experimentation. Some schools built a time frame into the schedule for RTI and were beginning to explore the uses of that block of time, some were not ready to experiment with grouping students for intervention, some did not have a mathematics coach for support, and some still did not have a block of time set aside for intervention yet. Because they made initial attempts to implement math RTI before the other schools, the Turner teachers had the most experience with one use of the RTI time called the "walk to" model. The "walk to" model for the intervention block is when students are placed in groups based on their needs, and they walk to the teacher who will provide the targeted interventions. Additionally, this school is in close proximity to the district office, there is a supportive principal, and a knowledgeable and supportive mathematics coach. All of these factors provided easy access to the teachers in this school and helped me to select the school that would provide the most valuable insights for the purpose of the study.

It was also essential that I selected a school with grade level teams that were experienced with working as a PLC to improve teaching and learning. This has been a focus of Turner Elementary for several years, and they have been recognized within the district because of their previous success in working well together as a community. After observing the six grade-level PLCs in this school and consulting with the mathematics coach at this school, I selected the third and fourth-grade teams as the focus for my study. The nature of the conversations that ensued during the initial PLC for the third grade demonstrated that this team showed some signs of implementing the ‘walk to’ model. This is a strong team that had already begun to use the math screening tool data to plan for intervention and regroup students. They were also very receptive to information and suggestions provided by the consultant during the PLC meetings. This team was eager to try to meet the needs of their students through the use of the RTI framework. The fourth-grade team was selected because they had been trying to implement the walk-to model for the intervention block and was receptive to the conversation with and suggestions made by the consultant during PLC meetings.

For each of these two grade-level teams, I noticed a shift in the teachers’ thinking after they engaged in the conversations with the consultant. Those PLC meeting conversations with the consultant seemed to spark an interest in looking at the screening data differently. The teachers in each of these teams asked relevant questions, took notes during the PLC meetings, and engaged in conversations with the consultant. Many teachers in other PLCs simply sit and listen politely to the consultant, and they rarely take notes or ask questions about using the data to improve their instruction.

For the last two and a half years, I have been working as the Supervisor of Curriculum and Instruction for Mathematics in the Edgewood School District. I spent time getting to know the elementary teachers through school visits, professional development opportunities, and district collaboration meetings. I have worked specifically with these two particular grade-level PLCs in two ways. First, I have observed and/or participated in their PLC meetings 2-3 times for data gathering regarding district initiatives and to help them better understand the use of the screening tool as part of the RTI process. Secondly, I worked with the third-grade team when studying the use of the screening tool as a pilot study for previous coursework. I positioned myself as an observer during their PLC meetings as part of the data collection process for this study. This was to gather as much information as possible about the ways in which teachers engaged in the stages of RTI problem-solving process.

Data sources. The data sources for this study consisted of a series of PLC observations and one-time interviews. Because one of the characteristics of qualitative research is that it is to be done in a natural setting for the participants (Creswell, 2007), data was collected at the elementary school and in the same setting where the normal activity occurred. According to Creswell (2007) another characteristic of qualitative research is the use of multiple sources for collecting data such as observations, interviews, and documents (p. 38). This study included two of these types of data sources, each of which is described in greater detail below.

PLC meeting observations. The first source of data collected was PLC meeting observations for each of the grade-level teams. The teachers at Turner Elementary School met twice per week to collaboratively plan together, after school on Tuesdays for approximately 45 minutes and during the day on Thursdays for approximately 75 minutes. Although there was not a specific schedule, one PLC meeting per week was usually dedicated to reading and one PLC meeting per week was dedicated to math. It was during these time frames that the teachers analyzed the student data and planned for instruction together as a grade-level team. The mathematics coach also participated in the math PLC meetings when she was available. For this study, each grade-level PLC meeting was observed approximately 1-2 times per week over a two month time period. Only the PLC meetings for which mathematics was the focus were observed.

The purpose of the PLC observations was to better understand how teachers engaged in the stages of the RTI problem-solving process using the UST data as the basis for their analysis. The time period for PLC meeting observations was two months so that I could observe the teachers as they engaged in at least one full cycle of the RTI problem-solving process. A full cycle of the RTI process would include all five stages so I could observe how teachers define and analyze a problem (Stages One and Two), how they design a plan for intervention (Stage Three), implement the intervention (Stage Four), and reflect upon the effectiveness of the intervention (Stage

Five). During the two-month time frame, the third-grade team engaged in all five stages of the RTI problem-solving process, and the fourth-grade team engaged in Stages One and Two only.

My observations of the PLC meetings were conducted as an observer, rather than a participant in the PLC. They were scheduled in advance through email and I observed each PLC meeting that pertained to mathematics during the data collection time frame, from the end of March through the end of May (approximately 2 months). This totaled 14 PLC meeting observations, seven observations of the third-grade team and seven observations of the fourth-grade team. The observed PLCs were videotaped, digitally recorded, and then transcribed for analysis. There were two PLC meetings during which I was not present for the fourth-grade team. Although they videotaped the PLC meeting for me, I did not include it as part of my study because I did not directly observe the PLC meeting. During the PLC meeting observations I also took written notes using an observation protocol to keep track of the nature of the teachers' conversations, to keep myself focused on the purpose of the observations, and to record my initial interpretations of my observations. This protocol can be found in Appendix A.

Interviews. The second source of data collected for this study was interviews of the teachers and math coach. Interviews were conducted at the end of the two-month data collection time frame. Each regular education teacher on both grade-level teams was interviewed, as well as the mathematics coach at this school. The two special education teachers were not interviewed as they only partially participated in one of the observed PLC meetings.

The purpose of collecting data through interviews was to gather information from the teachers individually about how they engaged in the RTI problem-solving process. Alignment between the researcher's perceptions and the teachers' perceptions for how they gained insights into students' thinking in order to plan targeted interventions provided another level of insight to the researcher. I was interested in determining if the teachers' perceptions aligned with what I observed during their PLC meetings to determine if we viewed their engagement in the RTI process in similar ways. The interviews also provided insights into the types of resources that teachers consulted while planning.

To collect the interview data, an interview protocol was developed for each type of participant, teacher and coach, which can be found in Appendix B. I elected to also interview the mathematics coach because she had been working with the grade-level teams since the beginning of the year to support the RTI process for mathematics. The interviews of the teachers and coach were conducted at their school, were digitally recorded, and lasted approximately 45-60 minutes. These were semi-structured interviews that included follow-up or clarification questions as needed. Turner (2010) calls this "standardized open-ended interviews" in which all participants are asked the same questions worded so that responses are open-ended and the researcher can ask probing question to follow-up (p. 756). I typed notes on a laptop while the participant responded to the questions. The recordings were then transcribed for analysis. Table 2 below shows the alignment between my research questions and the data sources for each question.

Table 2 *Alignment of Research Questions and Data Sources*

Research Question	Data Sources
1. How did teachers in each of two professional learning communities engage in the Response to Intervention problem-solving process? a. To what degree did teachers in each PLC use more and less descriptive talk, based on their own students' data from the Universal Screening Tool, and how did teachers' talk in each PLC vary by purpose of the PLC meeting?) b. To what degree did teachers in each move productively through the stages of the RTI problem-solving process?	PLC Meeting Observations PLC Meeting Observations
2. To what degree do the teachers' self-reported perceptions of their uses of the UST and engagement in the RTI problem-solving process align with the researcher's PLC observations?	Interviews PLC Meeting Observations
3. How do teachers use resources to plan for targeted instruction aligned with students' mathematical thinking? a. What resources do teachers seek out and use to plan for intervention instruction targeted to students' thinking in more and less descriptive ways?	PLC Meeting Observations Interviews

Data Analysis

The data analysis process for qualitative research tends to be inductive, moving from using specific details and information to gain deeper understanding, and then using your interpretations to develop a larger meaning of the data (Creswell, 2009). Creswell recommends the following six steps for analyzing qualitative data:

1. Prepare the data for analysis by organizing the data, ensuring all notes are typed, all transcribing is completed, etc.
2. Read through all the data to get a general sense of the big picture and reflect on the overall meaning.
3. Complete a detailed analysis with a coding process. Cluster together similar topics and continue to refine until your major themes emerge.
4. Use the coding process to provide a context to describe the setting and the participants and to describe the emerging themes.
5. Describe in a narrative the emergent themes and the context in which they were embedded.
6. Make an interpretation of the meaning of the data. Describe any lessons learned, recommendations, or calls for action or reform. (p. 185)

Some qualitative researchers suggest that the data analysis process is interactive and should not be separated from the data collection process (Creswell, 2007). I believe this was true for my study as well. I utilized the data analysis structure set forth by Creswell, but was mindful that it was an interactive process. I was guided by the data and continually refined my thinking throughout the data collection process based on the data that was collected from participants. When the data collection process was completed, I revisited the data to continue to analyze emerging themes and even made changes during the analysis process. All of the data and emergent themes were interpreted for the larger meaning, including lessons learned and recommendations.

First, I prepared the data by organizing my notes and ensuring all PLC observations and interviews were transcribed. Next, I read through all of the transcriptions to gain an overall sense of the data and determine if there were any noticeable trends within the big picture. From this big picture lens, I was able to narrow the scope of my study by reflecting on which pieces of data most aligned with my research questions and purpose of the study. Although I had observed seven PLC meetings for each team of teachers, I elected to focus on a subset set of these meetings. Because the purpose of my study was to gain insights into how teachers used the screening tool and engaged in the RTI problem-solving process, I focused only on the PLC meetings during which these types of activities occurred. For the third-grade team, this included four PLC meeting observations. For the fourth-grade team, this included three PLC meeting observations. This narrowed focus provided an opportunity for me to complete a more in-depth analysis of this subset of PLC meetings. Similarly, I elected to narrow the scope of the interview questions to be further analyzed based on the purpose of the study and nature of the research questions. Descriptions of my detailed analyses are presented below in two sections, one for each data source.

Analysis of PLC meeting observations. The analysis of PLC meeting observations included two levels of analysis. The first level included an initial analysis of each of the transcripts in which I looked for emergent themes. The level one analysis revealed that there were two overarching ways in which teachers talked during the PLC meetings as they analyzed and described students' thinking. I developed a set of codes and criteria for each of these themes: more descriptive (MD) talk, less descriptive (LD) and talk. In order to review and refine my initial themes, codes, and criteria, I coded each PLC meeting transcript using these criteria and then separated the pieces of the transcripts into different documents for each main code. Having the instances of more and less descriptive talk separated into different documents enabled me to move to the next level of analysis and refine my themes, if needed. Each of these overarching codes (and the sub-codes referenced below) is described in greater detail in the results section for Research Question One because the further analysis led to interesting findings in the ways teachers talked during the PLC meetings.

The second level included a more refined and detailed analysis for each PLC meeting transcript and coding documents. After analyzing the first transcript for each PLC team and the separated coding documents, I found that teachers talked more and less descriptively in different ways, thus needing another layer of codes and criteria to describe the variances for each type of talk. I developed a set of sub-codes for the different types of more, less, and non-descriptive talk. Again, each of these sub-codes and the occurrences within the transcripts were placed in a different document to develop criteria for each sub-code. In Table 3 below, an example is provided for one overarching type of talk, more descriptive, and its sub-codes, nuanced and strategy-oriented. This is just one example for the variances of each type of talk. Each type of talk was further analyzed and described with criteria as part of this level two analysis. I also asked a second reviewer to code a small sample of my data for reliability.

Table 3 *Examples of Analyzing & Describing Students' Thinking in More Descriptive (MD) Ways*

Code	Description	Example
Nuanced (MD-N)	Name the specific strategy a student (or group of students) might be using or can articulate the mathematics the student is struggling with using descriptive language	Kerri: Well, considering most of them are in my math class, I'm looking at the screeners. They are still not able to look at 65 as 60 and 5 and be able to put the tens together and the ones together. Now they can do it if you're sitting next to them, and you're telling them. Not telling them, but saying, 'Ok, break this up into tens and ones.' They can do it, but if you just give them the problem, they can't. But then again, but see that's why it's hard for me because if you're giving them their accommodations where they can use um, cubes and stuff, they can do it. But they don't understand that it's 60, 5. Six tens – do you know what I mean?
Strategy-Oriented (MD-SO)	Teachers focus on the efficiency of the strategies the students are using or how many strategies the students are able to use successfully rather than focusing on correctness or getting the answer.	Jessica: … but what if it's a kid who only does the break apart, like my other- like the kids are doing, that the kids who are drawing strips and singles, like they're doing it one efficient way and then they're resorting back to strips and singles. The kids who are doing it one efficient way and have no strategy, what I'm saying is do you want us to put them in with this group?

This level two analysis also revealed two additional and important changes in the coding schemes. First, another main category or theme was discovered, non-descriptive (ND) talk, to be included with the first two overarching themes of more and less descriptive talk. During the level one analysis, this non-descriptive talk was a part of the less descriptive category or theme. However, upon a deeper analysis, it was determined that non-descriptive talk was much different from less descriptive talk and needed a different main category and code with criteria.

Second, the level two analyses revealed another challenge within the coding scheme. I had planned to code all of the PLC meetings using the same set of sub-codes for each overarching types of talk. However, the different PLC meetings for each team had different purposes for their talk. These different purposes required different sub-codes for each type of talk because the teachers talked more, less, and non-descriptively in different ways based on the purpose of the PLC meeting. This means that teachers used more descriptive talk in different ways for each different purpose of the PLC meeting. Therefore, I developed criteria for each of these different sub-codes for each different purpose of their PLC meetings. These different purposes of the talk, the codes, and sub-codes are described in greater detail in the results section for Research Question One.

Analysis of the interview data. The analysis of interview transcripts included two levels of analysis. The first level included an initial analysis of each of the transcripts in which I looked for emergent themes. This level one analysis enabled me to narrow the focus to a subset of the interview questions. I selected four interview questions to further analyze those that were most relevant to both my research questions and the results from the analysis of the PLC meeting observations. Next, I completed a level two analysis in which I first placed all responses for each of the four questions in a separate document. These separated documents allowed me to read through each teacher's response to the same question to determine if there were themes across all of their responses. This level two analysis also helped me to determine if teachers' perceptions of their engagement in the RTI problem-solving process aligned with my observations of their PLC meetings. These themes and their alignment with my PLC meeting observations were described in narrative form and are presented in the results section for Research Question Two.

Overall, more details about how observations and interviews were analyzed can be seen as I describe my conclusions and which type of data was used to support those conclusions throughout my results chapters. My results chapters will follow, organized in response to each research question. In the spirit of qualitative research, I provide a range of quotations from my participants, from interviews and PLC meeting observations, to support my findings.

Chapter 4

TEACHERS' USE OF DESCRIPTIVE TALK

Introduction

Research Question One: How did teachers in each of two professional learning communities engage in the *Response to Intervention* problem-solving process?

a. To what degree did teachers in each PLC use more and less descriptive talk, based on their own students' data from the Universal Screening Tool, and how did teachers' talk in each PLC vary by purpose of the PLC meeting?

b. To what degree did teachers in each PLC move productively through the stages of the RTI problem-solving process?

In this chapter I will present the findings for research question one. Based on my observation and analysis of teachers' PLC meetings, I have three significant findings that I will briefly describe as an overview. Later in the chapter, I will present them in more detail with supporting data. First, as teachers in professional learning communities interacted with the Universal Screening Tool (UST) data, they engaged in the Response to Intervention (RTI) problem-solving process using more descriptive (MD) talk, less descriptive (ND) talk, and non-descriptive (ND) talk. The ways in which teachers talked more, less, and non-descriptively included variations that appeared to be connected to teachers' purpose for the talk during the PLC meetings. This means that the ways in which teachers' conversations were "more descriptive", “less descriptive”, and “non-descriptive” varied and adapted to the purpose of the PLC discussion based on which stage of the RTI problem-solving process in which the teachers were engaging in.

Second, comparing the talk in each PLC revealed ways in which teachers in PLCs could engage more and less productively in the RTI process. As teachers in professional learning communities engaged in the RTI problem-solving process using more, less, and non-descriptive talk, the PLC that predominantly talked more descriptively moved more productively through the stages of the process. In contrast, the PLC that used predominantly less and non-descriptive talk moved less productively through the stages of the RTI problem-solving process. Specifically, grade three teachers (PLC1) were more productive than grade four (PLC2) as each group of teachers engaged in the RTI problem-solving process.

The teachers who moved more productively through the stages of the RTI problem-solving process, PLC1, tended to use mostly more descriptive talk and they focused on one particular concept for analysis using one specific question from the UST. This group of teachers moved through the stages of the RTI process to define a problem area, analyze the data to describe students’ thinking, design a plan for intervention, implement the interventions, and reflect on the effectiveness of the implemented interventions using mostly more descriptive talk. Although teachers in PLC1 did have some less descriptive talk, most of the conversations included more descriptive talk for each PLC meeting and purpose.

The teachers who moved less productively through the stages of the RTI problem-solving process, PLC2, tended to use mostly less and non-descriptive talk and they focused on one mathematical idea for analysis using three questions from the UST. This group of teachers did not move through all of the stages of the RTI problem-solving process, and the stages they did engage in were done so using mostly less descriptive talk. Although teachers in PLC2 had some parts of their conversations that were more descriptive, most of their talk was less descriptive for each PLC meeting and purpose.

In the following sections of this chapter, I will elaborate upon each of these findings in greater detail. Supporting evidence for each of these findings will be provided. I will present the findings in the same order described above to address each of the subquestions for this research questions.

Findings

Research Question 1a: How did teachers in each of two professional learning communities engage in the *Response to Intervention* problem-solving process?

a. To what degree did teachers in each PLC use more and less descriptive talk, based on data from the Universal Screening Tool, and how did teachers' talk in each PLC vary by purpose of the PLC meeting?

My first finding is based on research question 1, specifically, 1a noted above. As teachers in professional learning communities interacted with the Universal Screening Tool (UST) data, they engaged in the Response to Intervention (RTI) problem-solving process using more descriptive (MD) talk, less descriptive (LD) talk, and non-descriptive (ND) talk. The ways in which teachers talked more, less, and non-descriptively included variations as based on the teachers' purpose for the talk during the PLC meetings. When teachers met for different discussion purposes as necessary for engaging in the different stages of the RTI problem-solving process, the ways in which their conversations were "more descriptive", "less descriptive", and "non-descriptive" varied and adapted. In Table 4 below, you will see an overview of each observed PLC meeting, its purpose and stage in the RTI problem-solving process, and the varied ways in which the teachers' talk was more, less, and non-descriptive. For some meetings, there were types of talk not observed. This is noted in the table when appropriate.

Table 4 *Alignment of PLC Meetings, Purposes of the Talk, & the Stages of the Problem-solving Process*

PLC Meeting Observed	Stage of the RTI Problem-solving Process	Purposes of the talk in the PLC Meeting	Type of Talk	Subcategories with Variations of Talk
PLC1a PLC1b PLC2a PLC2b	Stage 1 – Define the Problem Stage 2 – Analyze the Problem	Analyze & Describe Students' Thinking	More Descriptive	-Nuanced -Strategy-Oriented
			Less Descriptive	-General -Answer-Oriented
			Non-Descriptive	-Avoidance
PLC1c	Stage 3 – Design a Plan	Plan Interventions Targeted to Students' Thinking	More Descriptive	-Targeting Interventions -Understanding the Interventions -Revisiting Students' Thinking
			Less Descriptive	-General Interventions -Revisiting Students' Thinking
			Non-Descriptive	Not observed for this PLC meeting
PLC1d	Stage 5 – Reflect/ Evaluate	Reflect on Implemented Interventions	More Descriptive	-Reflecting on the Interventions -Reflecting on Specific Students -Discussing Next Steps
			Less Descriptive	-Generalized Reflecting
			Non-Descriptive	Not observed for this PLC meeting
PLC2c	Stage 2 – Analyze the Problem	Group Students for Intervention	More Descriptive	Not observed for this PLC meeting
			Less Descriptive	-Generalized Grouping Decisions -Generalized Attempts -Grouping Students using Scores
			Non-Descriptive	-Avoidance

As noted in the table above, the first two PLC meetings for each grade level encompassed the first two stages of the RTI problem-solving process, and the purpose of the talk in those meetings was to analyze and describe students' thinking. After each PLC held these two initial meeting, the purposes for the remaining PLC meetings differed, and therefore encompassed different stages of the RTI problem-solving process. These different purposes also warranted variations for the more, less, and non-descriptive talk. The purpose of the third meeting for PLC1 (PLC1c) was to plan interventions targeted to students' thinking and was part of stage three of the RTI problem-solving process that requires teachers to design a plan. The purpose of the fourth meeting for PLC1 (PLC1d) was to reflect on the implemented interventions, which aligned to stage five of the RTI problem-solving process as this stage includes reflection and evaluation of whether students have a better understanding of the concept after experiencing the intervention. Finally, the purpose of the last meeting for PLC2 (PLC2c) was to group students for intervention. This purpose aligned with stage two of the RTI problem-solving process as the teachers were still analyzing the data as they grouped students.

The evidence for this finding will be presented in the next section and will be organized according to the purpose of the talk in the PLC meetings. Each purpose, type of talk, and variations will be fully elaborated to highlight the ways in which teachers talked more, less, and non-descriptively as they interacted with the UST data and engaged in the RTI problem-solving process at different stages.

Purpose 1: Analyze and Describe Students' Thinking

The first two observed PLC meetings for each team were focused on analyzing and describing students' thinking. This aligned with stages one and two of the RTI problem-solving process because each team's first meeting included an overall analysis of their data with a consultant. That overall analysis helped the teachers to begin to define a problem, stage one, for further investigation. Each team's second meeting included a deeper analysis of their data, which is stage two of the RTI problem-solving process, analyze the problem.

As teachers analyze and describe students' thinking, their talk was more descriptive, less descriptive, and non-descriptive in a several ways. These ways differed from ways in which their talk was more, less, and non-descriptive when engaging in other purposes. The relationships between the nature of their descriptive talk and the different purposes of the PLC meetings was an interesting finding as my original plan was to use the same sub-codes for all of the observed PLC meetings in this study. I gained new insights into how teachers do or do not use detailed language in varied ways as they are in different stages of the RTI problem-solving process. The following sections provide a detailed presentation of the ways in which teachers' talk was more, less, and non-descriptive while analyzing and describing students' thinking.

More descriptive. There are two ways in which teachers were more descriptive in how they analyzed and described students' thinking using the UST data. First, teachers used descriptions in their PLC conversations that are more *nuanced* about the different layers of student thinking providing details about the conceptions or misconceptions held by the students. Second, more descriptive talk while analyzing and describing students' thinking included *strategy-oriented* talk in which teachers focused on the efficiency of the strategy students were using to solve a problem rather than correct or incorrect answers. Table 5 below provides an overview of these two types of talk followed by a detailed description.

Table 5 *Examples of Analyzing & Describing Students' Thinking in More Descriptive (MD) Ways*

Code	Description	Example
Nuanced (MD-N)	Name the specific strategy a student (or group of students) might be using or can articulate the mathematics the student is struggling with using descriptive language	Kerri: Well, considering most of them are in my math class, I'm looking at the screeners. They are still not able to look at 65 as 60 and 5 and be able to put the tens together and the ones together. Now they can do it if you're sitting next to them, and you're telling them. Not telling them, but saying, 'Ok, break this up into tens and ones.' They can do it, but if you just give them the problem, they can't. But then again, but see that's why it's hard for me because if you're giving them their accommodations where they can use um, cubes and stuff, they can do it. But they don't understand that it's 60, 5. Six tens – do you know what I mean?
Strategy-Oriented (MD-SO)	Teachers focus on the efficiency of the strategies the students are using or how many strategies the students are able to use successfully rather than focusing on correctness or getting the answer.	Jessica: … but what if it's a kid who only does the break apart, like my other- like the kids are doing, that the kids who are drawing strips and singles, like they're doing it one efficient way and then they're resorting back to strips and singles. The kids who are doing it one efficient way and have no strategy, what I'm saying is do you want us to put them in with this group?

Nuanced. As teachers analyzed and described students' thinking in nuanced ways, they articulated students' understandings, named the specific strategy a students utilized while problem-solving, and used detailed descriptive language to talk about the students' conceptions or misconceptions for a particular mathematics concept. Below is one way a teacher, Kerri, used nuanced talk as she described a specific group of students who were struggling to decompose numbers into place value parts in order to add those numbers together for a sum. She was referencing student data from a specific question on the UST where students were to add 65 and 87.

> Kerri: Well, considering most of them are in my math class, I'm looking at the screeners. They are still not able to look at 65 as 60 and 5 and be able to put the tens together and the ones together. Now they can do it if you're sitting next to them, and you're telling them. Not telling them, but saying, 'Ok, break this up into tens and ones.' They can do it, but if you just give them the problem, they can't. But then again, but see that's why it's hard for me because if you're giving them their accommodations where they can use um, cubes and stuff, they can do it. But they don't understand that it's 60, 5. Six tens – do you know what I mean? (Line 696-703)

Kerri explicitly stated that these students struggled to connect the numeral to its place value demonstrating nuanced talk. This is considered nuanced talk because Kerri was focused on students' understanding of the concept of place value. She was referencing the 'break apart' strategy for adding, but the purpose of her comment was to describe students' struggle with this strategy because they did not hold strong conceptions about place value. This is why Kerri's comment was nuanced rather than strategy-oriented.

In the conversation below Molli and Cathy demonstrated nuanced talk because they tried to determine which strategy a particular student used successfully in order to decide which strategy should be his next step during the intervention period. Towards the end of this conversation thread Cathy named the specific strategies the student utilized as she talked with Molli.

> Cathy: No, no. He wasn't here, Ricky, he's my kid who was in the hospital with cancer and everything like that. He wasn't here for any addition or subtraction in any school. But, he did it with the U.S. algorithm and strips and singles. He obvious- he does break apart in other things. You know what I mean, but in this particular one…
>
> Molli: Where do you think he should go?
>
> Cathy: I'm not sure. That's why I'm asking.
>
> Molli: Ok, What can- what is he showing you that he can do?
>
> Cathy: He can do break apart. Um, he has not shown me number line, so… I would think number line would be where to start. Ok. (Line 573-585)

Here Cathy was nuanced in how she specifically named the strategy the student utilized, while in the previous example Kerri was nuanced in how she described the students' understanding of place value for addition. Cathy's comment was not strategy-oriented because she was not explicitly articulating how this student was using a strategy with efficiency, rather her purpose was to determine what group placement he needed based on the strategy he used.

Strategy-oriented. As teachers analyzed the UST data and described students thinking in PLC meetings, they were strategy-oriented in their descriptive talk. They focused on the efficiency of the strategies or the number of strategies students' utilized while problem-solving. Part of fluency development is for students to be flexible in their thinking and to use multiple strategies (Parrish 2010). Strategy-oriented talk is in contrast to answer-oriented talk in which teachers' descriptions focus on the correctness of the answer or the solution. Here, Jessica used strategy-oriented talk because she described the efficiency of the different strategies that students used while solving the addition problem 65 + 87.

> Jessica: … but what if it's a kid who only does the break apart, like my other- like the kids are doing, that the kids who are drawing strips and singles, like they're doing it one efficient way and then they're resorting back to strips and singles. The kids who are doing it one efficient way and have no strategy, what I'm saying is do you want us to put them in with this group? (Line 402)

She talked about a specific set of students who used one efficient strategy, but did not have a second strategy that was also efficient. This type of talk demonstrates a focus on strategy efficiency rather than a focus on the correctness of the solution. Jessica was more descriptive as she talked about how students solved the problem. This comment was different from nuanced talk in that the focus was on the number of strategies students used to solve the problem and the efficiency of their strategies rather than articulating the strategies in detail. Below Rachel used strategy-oriented talk as part of the discussion where the teachers decided to focus on the addition question for further analysis.

> Rachel: The first thing I thought was obviously, anybody who still doesn't have at least one efficient strategy. The kids who could not add. I mean like, to me, to be able to add efficiently. (Line 15-17)

Her comment was strategy-oriented because she referred to the number of efficient strategies students could use successfully while adding. She did not refer to correctness or whether students "got it" or "didn't get it." This demonstrates more descriptive talk that is focused on students' strategy use.

Strategy-oriented talk is important to notice as teachers analyze and describe students thinking because this means they are focused on more than just whether students are getting the answers correctly or incorrectly. In my district, we want teachers to focus on the process of problem-solving rather than focusing solely on the solutions students get. When teachers use strategy-oriented talk, it helps observers to gain insights into what teachers value about the students' thinking, whether it's students' use of efficient strategies or just getting the right answer.

Additionally, teachers' use of nuanced talk demonstrate that teachers value the layers and nuances in students' thinking over whether students "get it" or "can do it" in order to target specific conceptions and misconceptions. If teachers can verbalize the nuances in students' thinking and the efficiency of their strategies, then they may be able to design interventions that are aligned to students' thinking. Teachers' understanding of and use of these two types of more descriptive talk might ultimately help students move further along in the learning trajectory for a particular concept of focus.

Less descriptive. There are two ways in which teachers used less descriptive talk as they analyzed and described students' thinking using the UST data. First, teachers used descriptions in their PLC conversations that were more *general* about students' thinking providing much less specificity and articulation regarding students' conceptions or misconceptions. Second, less descriptive talk while analyzing and describing students' thinking included *answer-oriented* talk in which teachers focused on the correctness of the answer or solution rather than the efficiency of the strategy students were using to solve a problem. Table 6 below provides an overview of these types of talk followed by a detailed description.

Table 6 *Examples of Analyzing & Describing Students' Thinking in Less Descriptive (LD) Ways*

Code	Description	Example
Generalized (LD-G)	Teachers might discuss students (or groups of students) having strategies, but never actually name the specific strategy a student might be using or do not fully articulate the mathematics the student is struggling with using descriptive language. It is much less nuanced and more generalized.	Amy: Most of my kids did it that way. (points to paper) OR Matt: Which, he's doing that. It shows he has a pretty good comprehension of how it works.
Answer-Oriented (LD-AO)	Teachers focus on whether or not the students get it right (correctness), they use the "get it/don't get it" language, and use scores as a basis for their discussions rather than strategies or efficiency of strategies.	Amy: Right. When they were multiplying fractions and it was like 90 fifths or whatever it was. The question was, 'How many apples is that?' So right. You got 90/5, but you didn't get the correct answer. You didn't answer the question. So it… they have to know what their answer is. They have to take that next step. Or Kerri: I think that with a lot of those students, they get it. They can do it when they've been doing it over and over and over again. But when we don't do it for like 5 weeks, and you bring it back. So they're obviously not learning it 'cause they don't retain it for more than a week. 'Cause it's the same thing. They'll do it, do it, do it when we're doing it together and then we go sit down and say let's do it, but then when you give it to 'em a week, two, three later, it goes straight back to whatever they were doing before.

General. As teachers analyzed and described students' thinking in general ways, they used little specificity to talk about students' mathematical understandings, used broad language or generalities, and did not fully articulate students' conceptions or misconceptions using descriptive or nuanced talk. Matt used general talk as he referred to one student's response to a multi-step addition and subtraction problem from the UST.

> Matt: Which, he's doing that. It shows he has a pretty good comprehension of how it works. (Line 278)

This is general talk because he did not provide specific details about this student's understanding or the strategy that the student used to solve the problem. Matt used general language such as "doing this" and "how it works." This talk did not articulate nuances to describe the student's understanding of the mathematics concept.
General talk while analyzing and describing students' thinking included broad statements or generalities such as stating a student "can do it" without specifying what it is the student could or could not do. Other times, teachers generalized groups of students stating that students didn't get it right because "they are my low kids." Jessica used general talk to share that students "can do it" without specifying details about the mathematics or the students' strategies.

> Jessica: See these are the same way. They can do it in their head and they do one way. Kenny cannot do another way. (Line 212-213)

This is general talk because Jessica used broad statements about students' thinking and how they solved the problem stating that they can "do one way." This is not strategy-oriented because she did not articulate the strategy students used nor did she describe the efficiency of the strategy that was the “one way.” Finally, Amy used general talk as she referred to a strategy that most of her students used to solve one question from the UST.

> Amy: Most of my kids did it that way. (points to paper) (Line 210)

This is general talk because she used broad language stating that students “did it that way.” She was not detailed or nuanced in her description as she analyzed her students’ thinking, and she did not fully articulate the students’ understandings or the strategy they used to solve the problem. These three excerpts from the transcripts demonstrate how teachers talked in general ways as they analyzed student data from the UST and described students’ thinking.

Answer-Oriented. As teachers analyzed the UST data and described students thinking in less descriptive ways, they used answer-oriented talk. They focused on whether or not the students got the problem right (correctness), they used broad terms such as “get it/don’t get it” to describe students’ understandings, and they used scores as a basis for their discussions rather than students’ strategy use. Here, Amy is answer-oriented as she focused on whether students got the right answer when solving a problem.

> Amy: Right. When they were multiplying fractions and it was like 90 fifths or whatever it was. The question was, ‘How many apples is that?’ So right. You got 90/5, but you didn’t get the correct answer. You didn’t answer the

question. So it… they have to know what their answer is. They have to take that next step. (Line 360)

Matt: So maybe we should um, work on some sort of like, how to break down a story problem. Like what is this problem asking me?

This is answer-oriented talk because she described students thinking through correctness rather than using strategy-oriented talk. She did not describe the strategies students used to solve a problem of the students' efficiency with using particular strategies. Kerri used answer-oriented talk to describe students' thinking using broad terms.

Kerri: I think that with a lot of those students, they get it. They can do it when they've been doing it over and over and over again. But when we don't do it for like 5 weeks, and you bring it back. So they're obviously not learning it 'cause they don't retain it for more than a week. 'Cause it's the same thing. They'll do it, do it, do it when we're doing it together and then we go sit down and say let's do it, but then when you give it to 'em a week, two, three later, it goes straight back to whatever they were doing before. (Line 159-164)

Her comment was answer-oriented because she focused on whether students "get it" or not. She did not reference any strategies students used, she did not refer to the nuances of students' understanding of the concept, and she did not articulate the mathematics concepts that students "get."

One last way teachers used answer-oriented talk as they analyzed and describe students' thinking was to focus on students' scores rather than the students' work. In one PLC meeting, teachers used scores as they decided which questions on the UST would be their area of focus.

Jeanine: Wait. You're writing down your lowest…

Melissa: She gave me her lowest three and I just wrote 'em down. (Line 75-77)

This is answer-oriented talk because the teachers used only students' scores to describe their students' thinking rather than looking at the students' work and articulating the mathematics with which the students struggled. They decided upon their focus concept by recording the questions with the "lowest" scores rather than using students' work as evidence for the nature of their thinking. These teachers didn't discuss students' strategies, efficiency of strategies, or any nuance in students' levels of understanding.

Using these two types of less descriptive talk, general and strategy-oriented, was not as helpful to teachers as the more descriptive ways of talking because students' thinking was not fully articulated. More detailed ways of talking helped teachers to better describe their students' thinking in order to plan targeted interventions that aligned with the students' thinking. Less descriptive talk did not provide deep insights into how students were thinking about the mathematics leaving it more difficult to plan targeted interventions.

Non-descriptive. Finally, as teachers analyzed and described students' thinking based on the UST data, they used non-descriptive talk called *avoidance*.

Avoidance was talk that steered the conversation away from students' thinking about the mathematics. It included talk that detracted from the purpose of the PLC conversation and often hindered the discussion by adding extraneous information that was unrelated to the mathematical data (See Table 7).

Table 7 *Examples of Analyzing & Describing Students' Thinking in Non-Descriptive (ND) Ways*

Code	Description	Example
Avoidance (ND-A)	Some comments in the PLC discussion appeared to avoid meaningfully digging to the student work and data analysis. This type of talk hindered the conversation and did not help to move the PLC forward.	Lisa: And I chalk it up as the same thing as it's been a while since we've revisited it. OR Melissa: A different school, yup. That's how Andre… Jeanine: She loves math. Amy: She wasn't here last year? Jeanine: No. Amy: (says something inaudible) Jeanine: They're kind of in and out. I think they were gone for a couple of years, but they were here back in the day.

Avoidance. Teachers used avoidance talk as they analyzed and described students' thinking in non-descriptive ways. Avoidance talk occurred when teachers discussed topics that detracted their focus away from analyzing the UST data, looking at student work, and describing students' thinking. One example of avoidance talk shown here demonstrates how several teachers in PLC2 avoided the initial data analysis as they discussed the recorded data from the previous PLC meeting.

Lisa: So do we have the compilation of the data that she took, Jan?

Matt: No.

Lisa: ‘Cause she wrote them all down.

Jeanine: Molli wrote ‘em down. I didn’t write ‘em down. (Line 45-51)

This is avoidance talk because these teachers didn’t start the discussion because they couldn’t locate the compiled data. Lisa stated that Jan recorded all of the data from the previous meeting which was prevented them from getting started in this meeting. They were unable to immediately engage in discussions in which they analyzed and described students’ thinking. Another example of avoidance talk is Lisa’s comment below. She described a lengthy time interval between when concepts were revisited as part of her data analysis.

Lisa: And I chalk it up as the same thing as it’s been a while since we’ve revisited it. (Line 221)

This is avoidance talk because her comment did not contribute to the conversation about students’ thinking; rather it was a reason to not take a deeper look at the student work. There was no reference to students’ thinking, their strategies, or their overall understanding of the mathematics, as her avoidance talk did not help move the conversation move forward. Similarly, Amy also used avoidance talk as she described students’ thinking. She provided a reason for students’ misunderstandings that included their reading abilities.

Amy: They don’t read. They’re not reading. (Line 269)

Her comment here suggested that students’ struggles with reading the questions may have contributed to their inability to solve them. This is avoidance talk because she did not look at any student work to support her idea, she did not elaborate further as to why reading was a struggle for students and she did not include any discussion about students' thinking, their strategies, or their overall understanding of the mathematics. Her comment did not help to move the conversation forward.

One final type of avoidance talk was when teachers added extraneous information that actually hindered the progress the conversation. The extraneous information included aspects such as students' personal feelings or the amount of time a student spent in school. The conversation thread below is from the transcript of one of the PLC2 meetings.

Melissa: A different school, yup. That's how Andre…

Jeanine: She loves math.

Amy: She wasn't here last year?

Jeanine: No.

Amy: (says something inaudible)

Jeanine: They're kind of in and out. I think they were gone for a couple of years, but they were here back in the day.

(Line 286-299)

This is an example of avoidance talk because the teachers hindered the conversation by including information about a student's love of math and the transiency of the students between schools. Neither of these topics helped to move the conversation forward because there was no data analysis involved and teachers didn't describe students' thinking, their strategies, or their overall understanding of the mathematics.

These examples represent the type of teacher talk that is non-descriptive by avoiding a deeper look at the data and hindering the conversation by detracting from the purpose of the meeting which was to analyze and describe students' thinking as part of the RTI problem-solving process.

Purpose 2: Plan Interventions Targeted to Students' Thinking

The third observed PLC meeting for PLC1 focused on planning interventions targeted to students' thinking. This aligned with stage three of the RTI problem-solving process because stage three is the part of the process where teachers are to 'design a plan'. Because the purpose of the PLC meeting changed, it appears that the teachers talked more and less descriptively in different ways. The following sections provide a detailed narrative with evidence to support this finding about the variances in teachers' talk.

More descriptive. Talk that was more descriptive (MD) when teachers planned targeted interventions was similar to MD talk when they analyzed and described students' thinking. There were three ways in which teachers' talk was MD while planning interventions targeted to students' thinking. First, teachers used talk that was *targeting interventions* to specify what the intervention was, how it addressed students' misconceptions, and brainstormed how the intervention might be implemented. Second, teachers used talk that included *understanding interventions* to dig deeper into a suggested intervention to better understand it and determine if it is the best intervention to target a student's misconception. Third, teachers used talk that included *revisiting students' thinking* to continue discussing students' thinking in order to gain additional insights that may help to plan the intervention that best targets the students' needs. See Table 8 for an overview of these types of more descriptive talk as teachers planned interventions targeted to students' thinking.

Table 8 *Examples of Planning Interventions Targeted to Students' Thinking in More Descriptive (MD) Ways*

Code	Description	Example
Targeting Interventions (MD-TI)	The teachers could articulate how the suggested intervention would or would not target the specific need of the students. It might include discussion about the learning progression for the targeted concept and the specific understandings that precedes or stems from that concept.	Molli: And you can go more into second grade, too, if you want. 134 in second grade. And second grade will start with 10 + 10, 10 + 11, and really having those conversations. What happens to the number in the tens place? What happens to the number in the ones place? 12 + 13, 14 + 15. So that they can make those connections.
Understanding Interventions (MD-UI)	Teachers try to understand the purpose of an intervention for how it could target the students' misconceptions. They would also talk through how an intervention might be implemented to determine if it actually targeted the correct need or to determine what might be the next step for students.	Jessica: Ok. So you said start with these Number Talks here. Molli: The ones in kindergarten start at page 90. Jessica: Page 90. Molli: And it's just how many dots do you see? And how do you see them? (pause) And maybe you don't need them spread out. Maybe you just need to show three as three. Maybe we start with just the five frame. Jessica: Ok. Molli: And start with 3 and two missing. Jessica: And then from that you said go to the first grade ten frames? Molli: First grade double ones. Um, you can make teen numbers, too. Like I see ten and two. 10 plus 2 is 12 and that helps to get the place value. And to get them to not count the ten takes a lot, too. Jessica: Not start back at 1.
Revisiting Students' Thinking (MD-RST)	Teachers revisit students' thinking about a particular concept as they talk through an intervention and which aspect of a concept was an issue for students.	Rachel: So we talked about how they know what the number line looks like, but they don't know, like they'll find the difference when they're adding. They'll add on the number line when they're supposed to be finding the difference.

Targeting interventions**.** As teachers planned interventions aligned to students' thinking, their talk included targeting interventions as they named specific intervention tools, programs, or strategies and then elaborated why these might align to the students' thinking. Often times, the teachers could articulate how the suggested intervention would or would not target the specific need of the students. Teacher talk that was targeting interventions included discussion about the learning progression for the targeted concept and the specific understandings that preceded or stemmed from that concept.

The following excerpt from the transcript of PLC1c is one small piece of a conversation the teachers had about a group of students' understanding of place value. This group of students had been formed because they were struggling to add efficiently using the place value strategy, and the teachers had used the UST data to determine that this was due to students' lack of understanding of place value. They had bounced around a few intervention ideas that might help students to better understand what each digit means in a two or three digit number when Molli suggested that they take some lessons from a lower grade level in a specific resource, *Number Talks*.

> Molli: And you can go more into second grade, too, if you want. 134 in second grade. And second grade will start with 10 + 10, 10 + 11, and really having those conversations. What happens to the number in the tens place? What happens to the number in the ones place? 12 + 13, 14 + 15. So that they can make those connections. (Line 177-180)

Although the resource was not specifically named here because another teacher referred to it previously, Molli articulated specific ideas to follow through with a *Number Talk* to address the place value need. She shared a part of the learning progression for place value that started in second grade, “second grade will start with 10 + 10 + 10 +11” and she continued to provide questions the teachers could ask during the intervention to push students’ thinking further along in the learning progression.

***Understanding interventions*.** The second type of MD talk while planning was *understanding interventions* (MD-UI). Teachers in this PLC used MD talk as they tried to understand the purpose of an intervention for how it could target the students’ conceptions and misconceptions. They talked through how an intervention might be implemented to determine if it actually targeted the correct need or to determine what might be the next step for students. This excerpt from the PLC1c transcript, below, demonstrates an example of MD-UI as Molli and Jessica discussed one of the *Number Talk* lessons and possible next steps for this group of students.

> Jessica: Ok. So you said start with these Number Talks here.
>
> Molli: The ones in kindergarten start at page 90.
>
> Jessica: Page 90.
>
> Molli: And it’s just how many dots do you see? And how do you see them? (pause) And maybe you don’t need them spread out. Maybe you just need to show three as three. Maybe we start with just the five frame.
>
> Jessica: Ok.

Molli: And start with 3 and two missing.

Jessica: And then from that you said go to the first grade ten frames?

Molli: First grade double ones. Um, you can make teen numbers, too. Like I see ten and two. 10 plus 2 is 12 and that helps to get the place value. And to get them to not count the ten takes a lot, too.

Jessica: Not start back at 1. (Line 60-80)

Molli provided support to Jessica in understanding how to implement the *Number Talk* by articulating questions to ask and ways she could represent numbers within the intervention. Jessica tried to further understand the intervention suggestion by asking Molli a clarifying question about sequencing the intervention lesson. This conversation demonstrates how Molli and Jessica shared ideas and asked questions to better understand the intervention before implementing it. Anticipating questions to ask can better help teachers to ensure the intervention will target the students' thinking and push it further along the trajectory of learning of that concept.

Revisiting students' thinking. As teachers in PLC1 planned interventions, they used talk that included *revisiting students' thinking* (MD-RST). Teachers sometimes revisited students' thinking as they discussed an intervention idea and tried to clarify again how students were thinking about that concept in order to properly align the intervention.

Talk that included revisiting students' thinking provided discussion about a particular concept as they talked through an intervention. This code was also applied when MD talk was about which aspect of a concept was an issue for students and the teachers discussed the concept further. This MD-RST talk might lead to an intervention suggestion, but didn't always. This code was more about revisiting students' thinking to be sure teachers had a thorough understanding before they could plan an intervention. The excerpt below from PLC1c was an example of talk that was revisiting students' thinking.

> Rachel: So we talked about how they know what the number line looks like, but they don't know, like they'll find the difference when they're adding. They'll add on the number line when they're supposed to be finding the difference. (Line 354-356)

It was MD-RST talk because the teachers were trying to decide where to begin with students for an intervention involving the number line, and Rachel was clarifying what it was about using the number line that was a struggle for students. Rachel tried to pinpoint the specific issue students had with using the number line by stating, "They'll add on the number line when they're supposed to be finding the difference." Being clear about the students' thinking could help the teachers plan specific and targeted interventions for this group of students.

Using these three types of more descriptive talk as teachers in PLC1 planned interventions helped them to target specific intervention ideas and articulate how these ideas could be implemented with students. Understanding and clarifying intervention ideas helped teachers to anticipate what it might look like in the classroom and be prepared to move students' thinking further along in the learning progression. Revisiting students' thinking provided an opportunity to be sure that they were clear about the students' conceptions and misconceptions so that the intervention they discussed would indeed target the students' need.

Less descriptive. As teachers planned interventions, they used less descriptive (LD) talk that was similar to the LD descriptive talk that was used when they analyzed and described students' thinking. There were two ways in which teachers' talk in PLC1 was less descriptive as they planned interventions targeted to students' thinking. First, teachers used broad or generalized statements as they discussed intervention ideas, essentially talk that included *general interventions*. Ideas were not fully articulated or specific to the student's conceptions and misconceptions. Second, the teachers used talk that included *revisiting students' thinking* as they planned an intervention, but used broad terms that did not help them to fully articulate the thinking. They used phrases such as, "the kids can do it" rather than specifically stating students' struggle in order to address it. See Table 9 for an overview of these types of less descriptive talk as teachers planned interventions targeted to students' thinking.

Table 9 *Examples of Planning Interventions Targeted to Students' Thinking in Less Descriptive (LD) Ways*

Code	Description	Example
General Interventions (LD-GI)	Teachers discuss intervention tools, programs, or strategies but with much less specificity. An intervention idea may be suggested, or even named, but it is not fully articulated to describe the purpose of the intervention or how it might target the specific needs of the students.	Molli: I will also give you the um Number Core book from Do the Math. Jessica: Ok. Molli: Which will probably give you some ideas. You and I can sit down and talk about those needs. 'Cause that will, I love the way she puts the verbiage together and how you ask them and how you show them. Jessica: And that's all in the book? Molli: It's all in the book.
Revisiting Students' Thinking (LD-RST)	Teachers may plan an intervention and revisit students' thinking about a concept, but do so in a way that does not fully articulate the thinking. It may included phrases like, "they can do it" and "most can do that." The word 'it' was used to describe a strategy the students struggled with and the strategy may not be fully elaborated to determine a targeted intervention.	Molli: So if they're here right now. How do we get them to… How can we… Because they might come with this as an answer to start with. So how can we then jump them from here to here? (pointing n smart board) Jessica: Yeah, but most 'em can do that. Kerri: Well all the kids in this group- Molli: Well your kid's in this group can. So… Rachel: They can do adding by place 3 digit.

General interventions. Teacher talk that was more generalized when planning interventions included discussion about intervention tools, programs, or strategies but with much less specificity. Intervention idea were suggested, or even named, but were not fully articulated to describe the purpose of the intervention or how it targeted the specific conceptions or misconceptions that students held. Below is one example of talk that included general interventions as Jessica and Molli discussed an intervention module, *Number Core*, from a program called *Do the Math*.

> Molli: I will also give you the, um, *Number Core* book from *Do the Math*.
>
> Jessica: Ok.
>
> Molli: Which will probably give you some ideas. You and I can sit down and talk about those needs. 'Cause that will, I love the way she puts the verbiage together and how you ask them and how you show them.
>
> Jessica: And that's all in the book?
>
> Molli: It's all in the book. (Line 48-58)

Although Molli specifically named the intervention module, she did not provide insights into how this module would target students' thinking. There was no discussion about the conceptions or misconceptions this module would address, how it would address them, or why it might be the best fit to target the students' thinking. There were general phrases like "I love the way she puts the verbiage together" and "how you ask them and how you show them" that did not help the teacher to understand the connection between this intervention and the students' thinking.

Revisiting students' thinking. Teachers in PLC1 used another type of LD talk as they planned for interventions that included revisiting students' thinking (LD-RST). Revisiting students' thinking in a less specific manner included talk that did not fully articulate the thinking about the concept. Teachers used phrases such as, "they can do it" and "most can do that" when referring to students thinking about a concept. The word ‘it’ was used to describe a strategy the students used without it being fully elaborated. The following excerpt is an example of LD-RST talk as the teachers are tried to find an intervention that extended students’ use of the number line as a tool for adding. students to know.

> Molli: So if they’re here right now. How do we get them to… How can we… Because they might come with this as an answer to start with. So how can we then jump them from here to here? (pointing n smart board)
>
> Jessica: Yeah, but most ‘em can do that.
>
> Kerri: Well all the kids in this group-
>
> Molli: Well your kid’s in this group can. So…
>
> Rachel: They can do adding by place 3 digit. (Line 414-420)

This discussion was less descriptive as teachers were revisiting students thinking because the ideas were not fully articulated. Neither the coach nor the teachers specified the students thinking that they were revisiting. Broad comments were made about the students’ thinking such as, “if they’re here right now” and “how can we jump them from here to there?” that did not articulate the students’ conceptions or misconceptions. It was not clear what “here” and “there” meant in terms of students’ thinking. The teachers referred to students that “can do it” without specifying what the students could or could not do. Revisiting students’ thinking in less descriptive ways did not help teachers to plan interventions that targeted students’ thinking because it was discussed too broadly.

Using these two types of less descriptive talk as teachers in PLC1 planned interventions did not help them to target specific intervention ideas or articulate how these interventions might be implemented with students. Talk that included general interventions did not help teachers to connect the intervention with the students' thinking, thus leaving the intervention less targeted. Using general interventions talk and revisiting students' thinking in less descriptive ways did not provide teachers with the insights necessary to plan interventions targeted to students' thinking.

Purpose 3: Reflect on Implemented Interventions

The fourth observed PLC meeting for PLC1 focused on reflecting on the effectiveness of the implemented interventions. This aligned with stage five of the RTI problem-solving process because stage five is the part of the process where teachers are to 'evaluate' to determine if students better understand the concept. Because the purpose of the PLC meeting changed, it appears that the teachers talked more and less descriptively in different ways. The following sections provide a detailed narrative with evidence to support this finding about the variances in teachers' talk.

More descriptive. There were three ways in which teachers used more descriptive talk as they reflected on the implemented interventions. First they used talk that included *reflecting on the intervention* in which they discussed how a specific intervention was implemented and shared details about the intervention to help other teachers understand it. Second, they used descriptions in their reflections that included *reflecting on specific students*. Teachers described specific students' progress with the intervention and the addition strategies students used during the intervention. Third, teachers *discussed next steps* as part of their reflections as they described what they planned to do next as a result of the student learning that occurred from the intervention they had implemented. See Table 10 for an overview of these types of more descriptive talk as teachers reflected on the implemented interventions.

Table 10 *Examples of Reflecting on Implemented Interventions in More Descriptive (MD) Ways*

Code	Description	Example
Reflecting on the Interventions	Teachers reflected on how the intervention was implemented with students. They shared details about the intervention so that the others understood how it was implemented.	Cathy: Alright, so mine… We actually did not do a number talk this morning. We talked about what, um, expanded form is since it's place value. So… (Cathy gets up to go to the SMART Board.) Alright, so what we did was we started talking about expanded form. And I put up the number 29. And I told them, I said, "well how do you know that it's 29?' Like, what do you see? What can you tell me about it? So we talked about how 29 could be 2 tens and a 9. And a couple of them said it could be 4 fives and a nine. And we talked about how we could put those fives together and everything like that. Um, and then we kinda just went into, 'Well, what if I have 28?' 'What if I wanna combine them?' So one of my kids, um, one of 'em, actually it was your kid (pointing to Rachel), came up. 'Well if we keep all of our- if we use the expanded form, and keep all of our tens in one area, and all of our ones in one area, it will be easier to add them all together.' Because they wanted to do like the number strings and it wasn't working out because they didn't know their tens and ones. So we did that one first.

Table 10 (Continued)

Code	Description	Example
Reflecting on Specific Students	Teachers discussed the progress of the interventions they had implemented including how specific students in their groups learned the content and/or strategies specific students might have used.	Rachel: Then, Kayla was sort of on the right track. She said that she started out by thinking about 60 – 50. And it was ten. And she said that that was her estimate. And she knew that her answer would have to be close to that. But then she was one, she answered the other way. She answered 19. So she got to the ten, but then she moved one in the wrong direction instead of… so then she showed me that to check herself. She did it by, in parts. (60-50 = 10 estimate, 60-40 = 20, 20 – 9 = 11 on SMART Board). And then finally, I was like, 'Can somebody come up and do it on the number line?' So Lanay came up and did the number line and we talked about landmark numbers. So for the next one, I said, -
Discussed Next Steps	Teachers described what they planned to do next as a result of the learning from the intervention they had implemented.	Jessica: So tomorrow, we're moving up and we're gonna try to do… instead of just what number do we see, 'Ok, so we see a 6. How many more would I need to make it a ten?' Well, I see there's 6. And there's 4 empty. And we're gonna try to… We'll see how that goes.

Reflecting on the interventions. As teachers in PLC1 were evaluating the effectiveness of the interventions they had implemented, they used talk that included reflecting on the intervention (MD-RI). Teachers described details of the intervention so that the others understood how it was implemented. They were detailed about what they did with students during the intervention, they questions they asked of students, and the responses students provided. Below is a sample from the transcript of PLCd in which the talk was MD-RI. Cathy described the *Number Talk* she did with her intervention group to help the students decompose numbers and use expanded form to better understand place value.

> Cathy: Alright, so mine… We actually did not do a number talk this morning. We talked about what, um, expanded form is since it's place value. So… (Cathy gets up to go to the SMART Board.) Alright, so what we did was we started talking about expanded form. And I put up the number 29. And I told them, I said, "well how do you know that it's 29?' Like, what do you see? What can you tell me about it? So we talked about how 29 could be 2 tens and a 9. And a couple of them said it could be 4 fives and a nine. And we talked about how we could put those fives together and everything like that. Um, and then we kinda just went into, 'Well, what if I have 28?' 'What if I wanna combine them?' So one of my kids, um, one of 'em, actually it was your kid (pointing to Rachel), came up. 'Well if we keep all of our- if we use the expanded form, and keep all of our tens in one area, and all of our ones in one area, it will be easier to add them all together.' Because they wanted to do like the number strings and it wasn't working out because they didn't know their tens and ones. So we did that one first. (Line 91-104)

In this excerpt, Cathy articulated the intervention activity for the others and described the questions she asked along with some of the students' responses. She connected her intervention activity to the students' misuse of number strings as a strategy as her reasoning to use decomposing into place value parts, or expanded form, as a strategy for adding. Her detailed description helped her colleagues gain insights into what she did with students in order to reflect on the intervention's effectiveness.

Reflecting on specific students. The second way teachers were MD as they reflected on their implementation of the interventions was by *reflecting on specific students* (MD-RSS) to help determine the effectiveness of the intervention. As teachers in PLC1d discussed the progress of the interventions they had implemented, they included talk about how specific students in their groups learned the content or strategies specific students used during the intervention. One instance of reflecting on specific students is in the excerpt below from the transcript of PLC1d where Rachel shared the strategies of two students from her intervention group.

> Rachel: Then, Kayla was sort of on the right track. She said that she started out by thinking about 60 – 50. And it was ten. And she said that that was her estimate. And she knew that her answer would have to be close to that. But then she was one, she answered the other way. She answered 19. So she got to the ten, but then she moved one in the wrong direction instead of… so then she showed me that to check herself. She did it by, in parts. (60-50 = 10 estimate, 60-40 = 20, 20 – 9 = 11 on SMART Board). And then finally, I was like, 'Can somebody come up and do it on the number line?' So Lanay came up and did the number line and we talked about landmark numbers. So for the next one, I said, - (Line 281-288)

She described in detail what one of the students did and what her next move was as the teacher. Rachel shared Kayla's progress by articulating the details of the strategy Kayla used to solve the problem 60 – 49. She also described how she tried to make a connection to the number line as the intended outcome was for students to subtract efficiently using the number line. This was not a reflection about how the specific intervention was implemented, but rather how a specific student engaged in the intervention. This is why this comment was MD-RSS rather than MD-RI talk. By sharing these details with the other teachers, she provided insights about her student's progress in moving to the number line as a tool for subtraction.

Discussing next steps. The final way in which teachers were MD as they reflected on the implementation of the interventions was through their descriptions of next steps for their intervention groups. Teachers used talk that *discussed next steps* (MD-DNS) when they described what they planned to do next as a result of the learning from the intervention they had implemented. When teachers discussed next steps, they shared how it extended upon the intervention just implemented or why they would take that next step with students. The excerpt from transcript PLC1d below is one instance of MD-DNS talk as Jessica had just shared her intervention about students' use of the ten frame to make numbers.

> Jessica: So tomorrow, we're moving up and we're gonna try to do… instead of just what number do we see, 'Ok, so we see a 6. How many more would I need to make it a ten?' Well, I see there's 6. And there's 4 empty. And we're gonna try to… We'll see how that goes. (Line 85-

87)

Jessica described the next step she planned to take with the students. She articulated that she is going to connect the previous intervention to making quantities of ten by asking students how many more dots would be needed to make ten. This was more descriptive because Jessica provided a specific idea to connect students' learning from one intervention lesson to the next. This was not talk reflecting on the interventions or the specific students because she was not describing how the intervention was implemented or how students engaged with it. She described ideas for next steps for students to continue their learning about this concept.

Using these three types of more descriptive talk while reflecting on the implemented interventions enabled all the teachers to understand how interventions were implemented and how specific students engaged with the interventions so that they could decide upon next steps for students to continue their learning. When teachers shared their reflections, they asked questions of each other to better understand how the interventions were implemented. These types of talk provided an opportunity for all of the teachers in this PLC to gain different perspectives on the implementation of interventions and to provide feedback to each other.

Less descriptive. There was one way in which teachers reflected upon implemented interventions that was less descriptive, generalized reflecting. Generalized reflecting included talk that had broad statements or general claims without fully articulating the content of those claims. See Table 11 for an overview of this type of less descriptive talk as teachers reflected on the implemented interventions.

Table 11 *Examples of Reflecting on Implemented Interventions in Less Descriptive (LD) Ways*

Code	Description	Example
Generalized Reflecting	Teachers reflected on their implemented interventions using broad or general statements about how students were thinking or the strategies the students were using. The talk was not specific about what students might have understood or not understood after experiencing the intervention.	Cathy: I think they understand that negative number now a whole lot more. Rachel: Yes. Jessica: Because we actually focused on it a while lot more this year. Cathy: Right.

Generalized reflecting. The one way in which teachers were LD in their discussions while they reflected on their implemented interventions was generalized reflecting (LD-GR) which included broad or general statements about how students were thinking or the strategies the students were using. These statements or conversation threads were not specific about what students might have understood or not understood after experiencing the intervention. Below is one example from the transcript in which teachers were reflecting on students' understanding of negative numbers.

> Cathy: I think they understand that negative number now a whole lot more.

Rachel: Yes.

Jessica: Because we actually focused on it a whole lot more this year.

Cathy: Right. (Line 250-253)

Cathy stated that students understood negative numbers more, but did not elaborate what it is about negative numbers that students do or do not understand. Jessica's reasoning to support Cathy's claim was very broad as she simply stated that they "focused on it a whole lot more this year." Her comment did not provide insights into why students might understand it more what they did to focus on negative numbers in order to develop a deeper understanding.

More descriptive talk while reflecting seemed to help teachers gain insights into the specific ways in which an intervention was implemented and how students engaged with the intervention. Teachers were able to connect students' learning in the implemented intervention to possible next steps. Less descriptive talk while reflecting on implemented interventions did not provide specific insights to the teachers about students' learning and they did not share connections between students learning within the learning progression to determine next steps.

Purpose 4: Group Students for Intervention

The third observed PLC meeting for PLC2 focused on grouping students for intervention. This aligned with stage two of the RTI problem-solving process because teachers were grouping students as they analyzed the UST data using the students' scores. They set out to place students in groups based on the data. Because the purpose of the PLC meeting changed from analyzing and describing students thinking to grouping students, it appears that the teachers talked more and less descriptively in different ways. As teachers in PLC2 grouped students for intervention based on the UST data, they used almost all less and non-descriptive talk. There were no instances of more descriptive talk in PLC2c while teachers placed students in groups for intervention. The following sections provide a detailed narrative with evidence to support this finding about the variances in teachers' talk based on this new purpose.

Less descriptive. There were three ways in which teachers used less descriptive talk to group students for intervention. First, teachers used talk that included *generalized grouping decisions* in which reasons for grouping students in particular ways are not fully articulated or specific to the student's misconceptions. Second, used talk that included *generalized attempts* in which they attempted to make grouping decisions by suggesting a deeper look at student data, but did not specify what should be analyzed. Last, teachers used talk that included *grouping students using scores* in which they used scores or synonyms for the scores to place students into groups for intervention rather than stating why students would be grouped together using specific or nuanced language about the mathematics or the students' thinking. See Table 12 for an overview of this type of less descriptive talk as teachers grouped students for intervention.

Table 12 *Examples of Grouping Students for Intervention in Less Descriptive (LD) Ways*

Code	Description	Example
Generalized Grouping Decisions (LD-GGD)	Talk included ideas about using the score codes from the UST (Competent, Transitional, or Inefficient) to group students rather than looking at specific student misconceptions. It also included broad terms to describe students such as "high" or "low" rather then using the score codes from the UST.	Amy: Alright, I have my low, low. Is that how you wanna do it? You wanna do your high, highs first? And put 'em in a group? Jeanine: Yeah.
Generalized Attempts (LD-GA)	Teachers attempted to make grouping decisions by suggesting a deeper look at student data, but did not specify what should be analyzed. They used general terms such as "who missed number 5" instead of articulating what misconceptions students might have had for the mathematics in number 5.	Lisa: No, I meant like, would it matter if they missed one, but some of them 5 and some missed 9. Do we want those in the same group? I mean, not that we need… Jeanine: No. I think a story problem's a story problem. Lisa: Ok. I agree. Jeanine: Yeah. I don't think… I mean, we could look at the problems, but I don't know if that… Lisa: Ok, no, I agree.
Grouping Students using Scores (LD-GSS)	Teachers used the codes from the UST, or synonyms such as numbers (2, 1, 0) or colors (green, yellow, red), to break the students into groups for intervention.	Amy: Joe is yellow, yellow, green. He has one competent.

Generalized grouping decisions. As teachers in PLC2 grouped students for intervention, they used talk that included generalized grouping decisions (LD-GGD).

Before teachers actually grouped students they discussed ways to group them and made their decision using generalized talk. As the teachers were making these decisions, LD-GGD talk included ideas about using the scores or synonyms for the scores based on the UST data rather than looking at specific student misconceptions. There were also instances of teacher talk that included even broader terms to describe students such as “high” or “low” rather than using students’ thinking as the basis for forming the intervention groups.

This excerpt below from PLC2c transcript below is an example talk that included generalized grouping decisions. Jeanine asked her colleagues if they should group the students by first listing the students who were scored as “competent” for all three questions they had selected to analyze. (The term ‘Competent’ is a code from the UST referring to highest coding level meaning the students were accurate and efficient as they solved the problem.)

Jeanine: So, we’re going to list the kids that were competent in all three? (Line 121)

This talk is LD-GGD because Jeanine did not suggest that they use students’ thinking as the basis for grouping them. She suggested that they look at students’ scores rather than their work. Using scores to define student groups could place students in groups who have very different needs as they teacher would not know specifically why they received a particular score without looking at the work. This next example shows teacher talk that included broad terms to group students for intervention.

> Amy: Alright, I have my low, low. Is that how you wanna do it? You wanna do your high, highs first? And put 'em in a group?
>
> Jeanine: Yeah. (Line 454-457)

This is LD-GGD talk because the teachers did not look at student work or discuss any specific details about the mathematics the students did or did not know. They used broad terms to describe students such as "low, low" and "high, high" to place them in groups. Those broad terms do not provide insights into students' thinking so that teachers can be sure they are placed in the best group to target their thinking. Teachers were simply deciding to use codes or even more generalized terms to break up the students into intervention groups.

Generalized attempts. As teachers grouped students for intervention, they used talk that included generalized attempts (LD-GA) in which teachers attempted to use student work to create the groups, but did not acknowledge for follow through with a suggestion to do so. This type of talk occurred when a suggestion was made by a teacher to look deeper at the UST data, but the teacher did not specify what should be analyzed or they did not follow through with the suggestion. They used terms such as "who missed number 5" instead of articulating what misconceptions students might have had for the mathematics in number 5. Below is an excerpt from the PLC2c transcript in which Lisa attempted to dig into the data a little deeper to group students as she made a suggestion to her colleagues.

> Lisa: No, I meant like, would it matter if they missed one, but some of them 5 and some missed 9. Do we want those in the same group? I mean, not that we need…
>
> Jeanine: No. I think a story problem's a story problem.
>
> Lisa: Ok. I agree.
>
> Jeanine: Yeah. I don't think… I mean, we could look at the problems, but I don't know if that…
>
> Lisa: Ok, no, I agree. (Line 192-207)

This was LD-GA talk because Lisa suggested that they might want to look to see which question students struggled with in order to make the groups. Although she attempted to get her colleagues to look deeper at the data, it was less descriptive and generalized rather more descriptive because of the terms she used. She wondered if it mattered which questions students "missed" without articulating a suggestion for analyzing a specific mathematical idea. After a short discussion, they decide not to follow through with her suggestion, but it was an attempt at trying to take a deeper look at the data from the UST as they were making decisions about grouping students for intervention.

Grouping students using scores. The last type of less descriptive talk included the parts of the conversation in which the teachers were actually grouping of students using scores (LD-GSS). Teachers used the scores from the UST (2, 1, 0), or synonyms such as codes (Competent, Transitional, Inefficient) or colors (green, yellow, red), to break the students into groups for intervention. This was less descriptive talk because the students were not grouped based on similar thinking about a particular concept, but rather on a score that does not communicate anything specific about what students do or do not know about a concept. One example of LD-GSS is below in which Amy read the scores out loud while another teacher made the lists, placing students on the appropriate list based on the scores.

Amy: Joe is yellow, yellow, green. He has one competent. (Line 402)

This was less descriptive talk that included grouping students using scores because Amy made no reference to students' thinking or the mathematics that student understood. There was no discussion about mathematics and students were not grouped based on similar thinking. This was a different type of talk than the talk that included generalized grouping decisions because that talk occurred when they were still deciding how to group the students. This last type of talk, LD-GSS, occurred after teachers had made the decision to use scores and began to do so without looking at students' work.

Using these three types of less descriptive talk to analyze the data and group students for intervention led to the creation of groups based on generalities such as scores rather than based on students' thinking. Teachers did not analyze the data further to include students' work in order to better understand what those students would need as an intervention once they were placed in a group. It appears that these students would not get an intervention targeted to their specific needs as the needs of the students in a group could greatly vary. Students with a particular set of scores that were similar may still be thinking about the mathematics in very different ways and therefore might not get an intervention that is targeted to push their thinking further in the learning progression.

Non-descriptive. Finally, as teachers in PLC2 grouped students for intervention, they used one type of non-descriptive (ND) talk, avoidance. This occurred when teachers steered the conversation away from the mathematics and use of the UST data and used talk that detracted from taking a deeper look into the students' work. See Table 13 for an overview of this type of less descriptive talk as teachers grouped students for intervention.

Table 13 *Examples of Grouping Students for Intervention in Non-descriptive (ND) Ways*

Code	Description	Example
Avoidance (ND-A)	Teachers steer the conversation away from the mathematics and use of the UST data while teachers described how they would group students for intervention. This included talk that detracted from analyzing the UST data and avoided digging into the students' work.	Jeanine: …And she's very high in math, but it's reading. It's a reading issue.

Avoidance. I used the same term and code from the ND talk for describing students' thinking, *avoidance* (ND-A), because it was very similar to the *avoidance* talk teachers used as they grouped students for intervention. This was teacher talk that steered the conversation away from the mathematics and use of the UST data as teachers grouped students for intervention. Below is an example of ND-A talk that included discussion about a student's reading ability.

Jeanine: …And she's very high in math, but it's reading. It's a reading issue. (Line 541)

Jeanine's comment was avoidance talk because she discussed ideas other than the mathematics that do not contribute to the conversation. Her talk about the student's reading ability detracted from analyzing the UST data and avoided digging into the student's work in order to place the student into a group that would target the student's thinking. Avoidance talk did not help to move the conversation forward and it did not encourage the teachers to dig deeper into the students work to determine what specifically the student struggled to understand.

Summary of More, Less, and Non-descriptive Talk

Teachers in each of two PLCs engaged in different types of more, less, and non-descriptive talk as they interacted with the Universal Screening Tool (UST) data for different purposes. Table 14 below shows the different types of more, less, and non-descriptive talk correlated with the purpose for which the talk was used in each PLC meeting. Teachers in both PLCs used the same type of talk during their initial two meetings as they analyzed and described students' thinking. However, each subsequent PLC meeting included variances in their descriptive talk as the purposes of the meetings changed.

Table 14 *Variances in Teachers' Talk based on PLC Meeting Purpose*

Type of Descriptive Talk	**Purpose 1: Analyze & Describe Student's' Thinking**	**Purpose 2: Plan Targeted Interventions**	**Purpose 3: Reflect on Implemented Interventions**	**Purpose 4: Group Students for Intervention**
MD-Nuanced	PLC1a PLC1b PLC2a PLC2b			
MD-Strategy-Oriented	PLC1a PLC1b PLC2a PLC2b			
MD-Targeting Interventions		PLC1c		
MD-Understanding Interventions		PLC1c		
MD-Revisiting Students' Thinking		PLC1c		
MD-Reflecting on Interventions			PLC1d	
MD-Reflecting on Specific Students			PLC1d	
MD-Discussed Next Steps			PLC1d	
LD-Generalized	PLC1a PLC1b PLC2a PLC2b			
LD-Answer-Oriented	PLC1a PLC1b PLC2a PLC2b			
LD-General Interventions		PLC1c		
LD-Revisiting Students' Thinking		PLC1c		
LD-Generalized Reflections			PLC1d	
LD-Generalized Grouping Decisions				PLC2c
LD-Generalized Attempts				PLC2c
LD- Grouping Students using Scores				PLC2c
ND-Avoidance			PLC1b PLC2a PLC2b	PLC2c

Teachers in PLC1 used more descriptive (MD) and less descriptive (LD) talk in each of four PLC meetings and non-descriptive (ND) talk in only one PLC meeting. They became more nuanced in the ways they used descriptive talk in their PLC meetings as their purpose of the meetings changed. For example, their last two meetings each included three different types of MD talk whereas their less descriptive talk in last two meetings had two or less types of less descriptive talk (LD). When teachers in PLC1 planned instructional interventions, they used descriptive talk that enabled them to target an intervention idea, to discuss it further to understand the intervention and how it could be implemented, and to revisit students' thinking to ensure the intervention was aligned to the students' needs. Teachers in PLC1 also used three types of more descriptive talk as they reflected on their implemented interventions. They described the intervention so that their colleagues understood the intervention and how it was implemented. They reflected on a few specific students and the progress these students' made. Then they described the next steps they might take with their intervention group. Overall, teachers in PLC1 used eight types of more descriptive talk across the different purposes of their PLC meetings.

In contrast, teachers in PLC1 used only five types of less descriptive talk across their four observed PLC meetings. The first two meetings included talk that was generalized and answer-oriented as they analyzed and described students' thinking. When they planned targeted interventions, they used two types of less descriptive talk. They discussed interventions in general ways and revisited students' thinking in less descriptive ways. The teachers in PLC1 also had some instances of generalized talk as they reflected on the interventions. Teachers in PLC1 had very few instances of non-descriptive talk, and these occurred in only one PLC meeting. They used some avoidance talk in PLC1b as they were analyzing and describing students' thinking. Overall they had fewer types of less and non-descriptive talk across the observed PLC meetings and this type of talk was used much less than the more descriptive talk. Throughout the four PLC meetings their talk was mostly more descriptive as they interacted with the UST data.

Teachers in PLC2 used the same types of more descriptive talk during their first two PLC meetings that teachers in PLC1 had used. They had some instances of nuanced and strategy-oriented talk as they analyzed and described students' thinking. However, these were the only types of more descriptive talk used by teachers in PLC2. Their talk was mostly less descriptive during these two meetings and in their third PLC meeting. The types of less descriptive talk in the first two observed PLC meetings was again the same as the talk teachers in PLC1 had used. They used generalized and answer-oriented talk as they analyzed and described students' thinking. As they placed students in intervention groups during the third observed PLC meeting, the teachers in PLC2 used almost entirely less descriptive talk. They made grouping decisions in generalized ways, they attempted a deeper analysis of the data in generalized ways, and they grouped students using scores rather than analyzing students' work.

Although teachers in PLC2 also used only one type of non-descriptive talk, avoidance, they used it in all three observed PLC meetings. Overall, teachers used only two types of more descriptive talk across the PLC meetings, five types of less descriptive talk, and one type of non-descriptive talk. Their observed PLC meetings included mostly less descriptive talk with one meeting have no instances of more descriptive talk at all. I anticipate teachers in PLC2 would also use mostly less and non-descriptive talk if I had observed them planning or reflecting based on the types of talk I observed during these three PLC meetings. I believe it would be difficult for them to plan targeted interventions using more descriptive talk after they analyzed and described students' thinking in mostly less descriptive ways and grouped students based on their scores rather than looking at their work. Additionally, I am not sure how descriptive their reflections would be after observing mostly less descriptive talk for their different meeting purposes in this study.

Chapter 5

TEACHERS' PRODUCTIVENESS IN THE RTI PROBLEM-SOLVING PROCESS

Research Question One: How did teachers in each of two professional learning communities engage in the Response to Intervention problem-solving process?

b. To what degree did teachers in each PLC move productively through the stages of the RTI problem-solving process?

The next finding is in response to part b of research question one. Teachers in professional learning communities (PLCs) who used predominantly more descriptive talk engaged in the RTI problem-solving process more productively. In contrast, teachers in PLCs who used predominantly less descriptive talk engaged in the RTI problem-solving process less productively. Specifically, teachers in PLC1 were more productive than teachers in PLC2 as both groups of teachers engaged in the RTI problem-solving process. Simply engaging in and moving through each stage of the process does not alone mean that teachers are productive. I am defining "productive" here to mean when teachers in PLCs move through the stages of the RTI problem-solving process using more descriptive talk while focusing on an essential math concept as their focus of analysis.

Teachers in PLC1 moved more productively through the stages of the RTI process as they defined a problem area for students (Stage One), analyzed the UST data and described students' thinking (Stage Two), designed a plan for intervention (Stage Three), implemented the interventions (Stage Four), and reflected on the effectiveness of the implemented interventions (Stage Five). Table 15 below shows how the stages of the RTI problem-solving process align with the teachers' purpose for the talk in PLC1. There were two characteristics that appear to have affected this PLC's capacity to engage in and move productively through the stages of the RTI problem-solving process. First, these teachers used mostly more descriptive talk in their PLC discussions during each stage of the process. Second, they focused on one specific concept for analysis that was essential to students' future success using students work as a major part of their data analysis.

Table 15 *Alignment of PLC Meeting Purpose & Stages of the RTI Problem-solving Process for PLC1*

PLC1	Purpose	Stage of RTI Problem-solving Process
PLC1a	Analyze & Describe Students' Thinking	Stage 1 – Define the Problem
PLC1b	Analyze & Describe Students' Thinking	Stage 1 – Define the Problem Stage 2 – Analyze the Problem
PLC1c	Plan Interventions Targeted to Students' Thinking	Stage 3 – Design a Plan
PLC1d	Reflect on the Implemented Interventions	Stage 5 – Reflect/Evaluate

Teachers in PLC1 engaged in Stages One and Two of the RTI problem-solving process during the first two PLC meetings when they analyzed the UST data to define a problem and described students' thinking. The teachers' descriptive talk in the first two meetings enabled them to surface ways in which the students were thinking similarly about a specific concept as their talk was mostly nuanced and strategy-oriented. They grouped students together with similar mathematical thinking, and then brainstormed intervention ideas during these initial meetings. Verbalizing students' thinking using more descriptive talk helped teachers in PLC1 as they moved to Stage Three of the RTI problem-solving process and designed plans for intervention. During Stage Three, teachers used descriptive talk to plan interventions targeted to each group of students' thinking that was different from the talk in Stages One and Two. After students experienced the interventions, teachers in PLC1 reflected upon the effectiveness of the implemented interventions and again used descriptive talk that was different from the talk in the first three stages of the RTI problem-solving process. Teachers in PLC1 engaged in all five stages of the RTI problem-solving process using mostly more descriptive talk.

In contrast, teachers in PLC2 moved less productively through the stages of the RTI process as they defined a problem area for students and analyzed the UST data to describe students' thinking. There were three characteristics that appear to have affected this PLC's capacity to engage in and move productively through the stages of the RTI problem-solving process. First, these teachers used mostly less descriptive talk in their PLC discussions for each stage of the process that they engaged in. Second, they focused on one broad mathematical idea for analysis. Third, they analyzed the data without using students' work as a part of their analysis.

Although simply moving through the stages of the process does not alone mean that teachers are productive, not getting to some stages of the process could be because teachers are not engaging in the stages productively. The teachers in this PLC seemed to not get to the last three stages of the process because they engaged in the first two stages less productively. Table 16 below shows how the stages of the RTI problem-solving process align with the teachers' purpose for the talk in PLC2.

Table 16 *Alignment of PLC Meeting Purpose & Stages of the RTI Problem-solving Process for PLC2*

PLC2	Purpose	Stage of RTI Problem-solving Process
PLC2a	Analyze & Describe Students' Thinking	Stage 1 – Define the Problem
PLC2b	Describe Students' Thinking	Stage 1 – Define the Problem Stage 2 – Analyze the Problem
PLC2c	Group Students for Intervention	Stage 2 – Analyze the Problem

Teachers in PLC2 engaged in Stages One and Two of the RTI problem-solving process during the first two PLC meetings when they analyzed the UST data to define a problem and described students' thinking. The teachers' less descriptive talk in the first two meetings provided less nuance and specificity in how the teachers surfaced ways in which the students were thinking similarly about a concept. They continued their analysis of the UST data in their third meeting staying in Stage Two of the RTI problem-solving process. During this meeting, teachers grouped students together with similar scores rather than using students' thinking about the focus concept. Teachers in

PLC2 did not reach stages three, four, or five of the RTI problem-solving process during this cycle of analysis.

The evidence for this finding will be presented using two case studies, each with a different group of teachers that participated in district required professional learning communities (PLCs). These two PLCs differed significantly in how they engaged in the RTI problem-solving process. Teachers of grade three (PLC1) represented the case of a more productive PLC, while teachers of grade four (PLC2) represented the case of a less productive PLC. Each PLC will be described in separate cases detailing how the teachers were more or less productive as they engaged in the stages of the RTI problem-solving process.

Case One – The More Productive PLC

Case One will present the ways in which teachers in PLC1 interacted with the screening tool data and engaged more productively in the stages of the RTI problem-solving process. The description of this case focuses on the four observed PLC meetings during which the discussions focused on or stemmed from the teachers' analysis of the UST data. Each PLC meeting aligns with one or more stages of the process. In the sections below, I will describe each meeting, how it aligned with the stages of the process, and the productivity of the teachers as they engaged in those stages.

There were two characteristics highlighted throughout Case One that appear to have affected this PLC's capacity to engage in and move productively through the stages of the RTI problem-solving process. First, teachers used mostly more descriptive talk in their PLC discussions during each stage of the process. Second, they focused on one specific concept for analysis that was essential to students' future success using students' work as a major part of their data analysis throughout the stages.

PLC1a: Stage one – define the problem. The first observed PLC meeting encompassed Stage One of the RTI problem-solving process. Stage One, define a problem, is where a concept is identified for which students are struggling based on data. During this meeting, teachers used the UST for their source of data to gain insights into students' thinking. After identifying and defining the problem, they focused on this one essential number concept throughout the rest of the observed PLC meetings. This concept included students' understanding of place value in order to add and subtract efficiently.

Since the purpose of this PLC meeting was to analyze and describe students' mathematical thinking as part of defining the problem, the teachers focused their attention to a few of the big ideas emphasized in the screening tool, and then selected a few items as the focal points for interpreting the data and looking at student growth for these concepts across the year. Although a hired consultant led most of this specific PLC meeting, teachers would normally engage in this type of discussion as part of Stage One without the consultant to unpack the overall strengths and weaknesses of their students.

Stage One includes teachers analyzing the data to see the progress students make over time and to digging deeper into the data to determine an area of focus for intervention. Teachers approached the data analysis in two ways. First, they reviewed holistic data that included averages (item-by-item) from the first two administrations of the UST comparing the Winter data to the Fall data and also comparing their grade level averages to the district average for those assessments. They also gathered class averages for particular concepts and compared the Spring data to the Fall and Winter data to get a sense of their overall growth. This helped them to narrow their focus to a few essential concepts that could serve as the basis for further in-depth analysis in Stage Two.

The second way the teachers approached the data analysis occurred after they had gained an overall sense of the students' strengths and weaknesses and narrowed their focus. They would analyze some of their students' work for the narrowed set of concepts to further investigate and support their initial findings. The teachers honed in on one question that focused on addition and subtraction as they discussed their students' thinking. Their discussions about students' work included mostly more descriptive talk during this stage of defining a problem. Below is one example of a nuanced comment made by Jessica:

> Jessica: I had some kids who actually jumped to 50. They added two, got to 50, and then they did 40. And then they did the 5. (some others agree as she talks) But then I had some start back, they started at 95, and they jumped back to land on 48. I had kids do all different… (Line 38-42)

Her comment was nuanced as she further investigated her students' work because she included specific details about how students used the number line as a tool for adding. She described how students "jumped" on the number line differently from each other. To further investigate and define a problem area, Jessica described two students who didn't use a number line as part of their strategy.

> Jessica: All but two, only two did not do a number line. But the two that didn't, wrote down that it was subtraction, but then added it. Like, they wrote 95-48= ?, but then they added the numbers together… and they wrote subtraction. And I said, 'Janaya, what is that?' 'Oh, I'm subtracting.' (Line 54-57)

She used nuanced talk as she articulated the work of these two students who added instead of subtracting to get incorrect solutions. She also identified that these students did not connect their solution strategy to their equation. This type of talk helped the teachers to decide if this concept would be beneficial for further instruction during their intervention time.

This PLC meeting aligned with Stage One of the RTI problem-solving process because this was their first analysis of the Spring UST data. Teachers analyzed the data to determine students' overall strengths and weaknesses so that they could define a problem for further analysis. The teachers latched on to the concept of addition and subtraction and used this initial data analysis conversation to inform their focus in subsequent PLC meetings.

PLC1b: Stage one & stage two – define the problem & analyze the problem. This next PLC meeting (PLC1b) was more productive because it involved a deeper look at the Spring UST data including student work, which enabled teachers to surface ideas about how students were thinking. The purpose of this PLC meeting was to analyze and describe students' mathematical thinking, which aligned with Stages One and Two of the RTI problem-solving process, defining and analyzing the problem. The teachers used mostly more descriptive talk as they engaged in these stages of the process, they defined one essential number concept as the 'problem', and they analyzed and described students' thinking using the students' work. These three factors seemed to contribute to the overall productiveness as teachers engaged in these stages of the process.

This PLC meeting included three major components that helped to determine that they were engaging in Stages One and Two of the process and that they were doing so productively: 1) the teachers defined a problem as they selected an area of focus that included an essential number concept; 2) they analyzed the problem by describing students' thinking using the students' work; and 3) they created intervention groups based on students' similar thinking for the selected concept. Although the primary purpose was to analyze and describe the students' thinking, the teachers' discussion in this meeting led to the creation of four intervention groups of students with similar conceptions and misconceptions. The teachers in PLC1 engaged more productively in Stages One and Two of the RTI problem-solving process.

Selecting a focus concept to 'define a problem'. The beginning of this PLC meeting aligned with Stage One of the RTI problem-solving process because teachers defined a problem to be analyzed further. The team decided to focus on question six from the Spring UST which included adding efficiently with more than one strategy. This decision was based on two factors, the minimal growth students had made with this concept from the Winter to Spring and that it was essential for students to understand for the next grade level. The conversation thread below occurred just at the beginning of the PLC meeting as they were making the decision about the area of focus:

> Molli: Where would you like the focus to be for the end of the year? Like after sitting down with the screener and Kris, where do we need to go and what are still gonna need for the next grade level?
>
> Rachel: The first thing I thought was obviously, anybody who still doesn't have at least one efficient strategy. The kids who could not add. I mean like, to me, to be able to add efficiently.
>
> Molli: Looking at number 6 from the spring screener, we're about the same average as we were in the winter. (Line 11-20)

This initial part of the discussion was more descriptive because the teachers chose to focus on a particular concept based on whether the students had efficient strategies for adding. Specifically, Rachel's comment was strategy-oriented rather than answer-oriented in her reasoning for focusing on Question 6 for their deeper analysis. Question 6, was generally the same for each UST assessment, Fall, Winter, and Spring, for this grade level. Students had to solve an addition problem two different ways (See Figure 2 below).

Fall	Winter	Spring
35 + 27	35 + 27	65 + 87

Figure 2. Question 6 from the UST. This figure shows Question 6 for each administration for the UST, Fall, Winter, & Spring.

The teachers planned to look at the student work to determine which students were using efficient strategies to add. In the next part of this PLC meeting, the teachers engaged in Stage Two of the RTI problem-solving process. They analyzed the student work and elaborated on the specific conceptions and misconceptions students had that led to the struggles with adding efficiently. For the students that could add efficiently, the teachers discussed those students' ability to subtract efficiently.

Analyzing and describing students' thinking. The rest of the PLC meeting discussion encompassed Stage Two of the RTI problem-solving process, analyzing the problem. This is when teachers analyzed their students' work in order to surface ideas about their students' thinking for this concept. Although this conversation included some instances of less descriptive talk, most of the teachers' discussion was more descriptive. The more descriptive talk, nuanced and strategy-oriented, led to the teachers informally creating four intervention groups based on the students' thinking.

I say 'informally' because the PLC did not plan to create four intervention groups, rather their purpose was to analyze and describe students thinking in order to possibly group students who held similar conceptions and misconceptions. The following sections will present evidence for how the teachers' more descriptive talk paved the way to the creation of four specific intervention groups that included students with similar thinking.

Intervention groups. Each of the four intervention groups was named based on the teachers' discussion about the mathematics the students were struggling within the concept of adding and subtracting efficiently. The four intervention groups were: *Understanding Tens*, *Understanding Place Value*, *Using the Number Line as a Tool for Adding*, *Subtracting Efficiently*. This is a productive way of grouping students because it characterizes the nature of students' thinking in order to plan targeted interventions. In contrast, we could imagine ways teachers might group students based on more general criteria such as high, medium, and low that would not provide such insights into students' thinking. A brief description of each intervention group is below to support the finding that this PLC was overall more productive as they engaged in the RTI problem-solving process. Their analysis, description of students' thinking, and grouping of students using more descriptive talk contributed to their productiveness in Stage Two.

Intervention Group 1: Understanding Tens. As teachers analyzed and described students' thinking as part of Stage Two, the first misconception that surfaced in the discussion included students' understanding of ten. They discussed students' lack of understanding for what happens to the value of a number when a ten is added to it. Below are two examples for the ways in which teachers analyzed and described students thinking for Intervention Group 1. First, Jessica launched the conversation using more descriptive, nuanced talk as she described the struggle that students had when they counted up or counted back by tens.

> Jessica: And this adding up by tens, that is the big problem. My kids who are struggling with addition, cannot jump a ten... Oh if I'm at 90, and jump back ten, where will I land? They have to count it up. And I'll say, 'What do you say right before 90?' 80, 90. Like they don't even know like landmark numbers… Like, they can't jump this (motions with hands) because they don't know to jump, like if I'm at 15 and jump ten. Or even I'm at ten and I jump ten, it's like (motions counting on fingers). Oh 20. Like they can get to it, but it's still counting on their digits. (Line 24-32)

She was nuanced in the way she described how the students counted up or counted back with their fingers rather than just knowing what happens to a number when a ten is added or taken away. Later in the PLC1b meeting, the teachers grappled with distinguishing between the different layers and nuances of their students' thinking about adding ten as shown in the student work.

> Molli: But wait. I think we might be talking about two different things in this group, too. Because I think you've (points to Kerri) got a group who does not know what a tens and ones is. They know 14 has 14. They know 65 has 65. You're telling me- What I'm hearing you say is they don't know how to break it up. So they need to go back almost to-

Keri (interrupts): Not unless you give the, strips and singles. I mean, like if I give them- if I say draw strips and singles, they know that it's one strip and 4 singles. But they don't understand that it's a ten.

Jessica: That's Jasmine.

Kerri: I'm talking about the boys in our math class make strips and singles.

Rachel: Then I don't see that in this…

Kerri: Well I'm talking about when you give them, physically give them strips and singles (Rachel: Ok) , like they know that it- do you know what I'm saying?

Molli: Mmhmm.

Kerri: I know, it's just like, I'm just trying to make sure- they don't understand that that is a ten. Or it's two tens. They just know that it's two strips. (Molli nods) So that's what they're confused with.

Cathy: So they don't have a link between the manipulatives and what it is in words and numbers. (Line 724-749)

The teachers used nuanced talk as they discussed the reasons why their students struggle when adding tens to a number. They surfaced the notion that students struggled to make connections between the manipulatives they used to represent tens and ones and the quantities represented by numbers. It is nuanced talk because the teachers grappled with the different layers of students' mathematical understandings by verbalizing how the students were not connecting the manipulative to the value of the digits.

The conversation that led to the formation of Intervention Group 1 seemed to have contributed to the teachers' overall productiveness as they engaged in Stage Two of the RTI problem-solving process. Their conversation was mostly more descriptive as they described specific reasons students were struggling to add efficiently. Teachers based their data analysis for this intervention group on the students' work using specific examples to unpack the reasons for students' students' misconceptions.

Intervention Group 2: Understanding Place Value. The second misconception that surfaced in the discussion included students' understanding place value. As teachers analyzed students' thinking for this group, they noted that some students attempted to add numbers using place value strategies, but struggled with knowing the value of the digits. When adding 65 + 87, students used the 6 in 65 as having a value of 6 and the 8 in 87 as having a value of 8. Then students added 6 + 8 to get 14 instead of 60 + 80 to get 140. The teachers discussed the students' thinking about place value using mostly more descriptive talk to unpack this misconception. Below are two examples that demonstrate the teachers' engagement in Stage Two of the process as they formed this intervention group.

> Molli: Well, and if it's the same group that I think you're talking about, which is the group that I had a few weeks ago, and I (nods) apologize that DCAS has taken over, but are those numbers too high for them? I mean, even when I was taking them, numbers in the twenties were too high for them. 'Cause they still need to understand that 11 is 10 plus 1 and that 12 is 10 plus 2. (Line 173-177)

Jessica: That's where Lily is. She'll do like 6 + 8 and get 14 and 5 + 7 and put the 12, but she doesn't know that- she's just- It's like she's so close to having a break through. But she just needs that extra… (Line 187-189)

After the misconception about place value surfaced, Jessica recognized that this was how one of her students was thinking while adding 65 and 87. Jessica used nuanced talk as she shared how her student would solve it using the misconception about the value of the digits. She provided a more detailed description rather than simply stating that her student had similar thinking. This second example also demonstrates the ways in which teachers used the students' work to determine the underlying reasons that students struggled with adding efficiently. They analyzed and described students' work who were using the standard algorithm.

Molli: Ok, so can we- ok wait, we got- we have a pile of students who are doing the algorithm incorrectly.

Rachel: At least thinking of them as…

Kerri: - Them not doing it. That's 6 + 8.

Molli: Let's make a pile of those. Or at least break down the –

Jessica: So we're talking about, so these are students who are doing algorithm…

Molli: Well, like what Rachel was saying. They're taking it-

Rachel (interrupts): as all ones place instead of…

Molli: The 8 and 6 is 14… and…

Jessica: Is that where Lily would be because she's adding the 6 and the 8 and putting it as a separate number and then the 7 and the 5? (Line 215-235)

After the teachers discovered the initial misconception about place value, they started to group students who were thinking similarly (thinking of all digits as ones while adding). This slightly different idea surfaced about students "doing the algorithm incorrectly" and the teachers grappled with what this really meant and if these students share thinking that is similar to the students who held the misconception about place value. This grappling as teachers discussed the nuances of students' thinking was an indicator that teachers were engaging productively in Stage Two.

Teachers continually clarified their thinking about the students' mathematical thinking and how they could be grouped based on similar thinking as the conversation about the data evolved. As teachers discussed the formation of Intervention Group 2, they grappled with understanding and distinguishing between the different layers and nuances in students' thinking by surfacing a misconception and describing it using more descriptive talk. Their conversation about Intervention Group 2 seemed to have contributed to the teachers' overall productiveness as they engaged in Stage Two of the RTI problem-solving process because it helped them to further analyze the problem.

Intervention Group 3: Using the Number Line to Add Efficiently. The third misconception that surfaced in the PLC discussion included students' use of the number line as a tool for adding efficiently. As each intervention group was created throughout the discussion, the teachers continued to engage productively in the RTI problem-solving process because they continually clarified their own thinking along the way in distinguishing between the layers and nuances in students' thinking. Much of this conversation included discussion in which teachers grappled with distinguishing between students' thinking in the groups they had formed thus far. This clarifying and grappling were indicators that teachers were engaging productively in Stage Two of the process because they were further analyzing and investigating the problem to gain deeper insights into students' thinking.

This intervention group was formed based on the number of efficient strategies that students used to add 65 and 87. At this point in the school year, the teachers wanted to see the students moving away from using a less efficient strategy such as strips and singles (a base ten representation), and towards utilizing more efficient strategies such as break apart (adding by place value), algorithm, or the number line. This third intervention group included students that used one efficient strategy for adding, but resorted to a less efficient strategy, or no strategy, as their second method. All of the discussion involving this third idea about efficiency and grouping of students was more descriptive in nature.

There are three examples from the transcripts below that demonstrate the teachers' engagement of Stage Two in different ways as they created this intervention group. First, the teachers surfaced an idea to discuss based on students' work, then they clarified their thinking to determine how this group of students' thinking was different from the previous groups they had formed, and finally, they solidified their thinking about the needs of the students in this intervention group. Below is the first example in which Cathy shared a piece of student work that represented the thinking of a few students in her class that used the break apart strategy efficiently, but did not show a second efficient method for adding.

> Cathy: And I had a couple of kids who just, (looks for student work) Joy, so she starts breaking it apart. 80 and 60 and 5 and 7. She gets the 150, but ends up adding the 140 to the 12. But then her second was she wants to show me 50 + 50 + 10 + 10 – you know what I mean?
>
> Jessica: She's just looking for combinations.
>
> Rachel: She just needs another… She's got one efficient strategy.
>
> Cathy (looking through the work): I had another one who just came. He came from a whole other school. And he did the regular algorithm. And then his second way was the reverse, 87 + 65. (Line 196-207)

They discovered that some students who had only one efficient strategy usually used the break apart (or adding by place value) strategy, but resorted to a less efficient strategy, such as strips and singles, as their second method for adding. This is more descriptive, nuanced talk as Cathy articulated the student's thinking in how the problem was solved. She described how two of her students used an efficient strategy as their first method and then did not demonstrate a second efficient strategy.

In this second example, the teachers grappled with distinguishing this newly formed intervention group from the first two groups based on the differences in students' thinking as they added 65 and 87. Jessica clarified how this intervention group was different from the others.

> Jessica: Yeah she's saying to be specific as to what they need. Like we don't wanna put Katie here-
>
> Kerri (interrupts): What- they don't need strips and singles, or do they need it?
>
> Jessica: These are kids who are drawing strips and singles still.
>
> Molli: And don't have anything else.
>
> Kerri: That's the only way they can solve the problem.
>
> Jessica: No, these are the kids that have strips and singles with something else. Like, we were talking about the kids who solve it one way and then second way they automatically go to strips and singles 'cause you were saying they can't do that with big numbers. (Line 517-530)

This conversation thread is an example for the ways teachers would engage in Stage Two of the process because the teachers used more descriptive, strategy-oriented talk as they distinguished between the intervention groups. They also used strategy efficiency as the basis of their clarification and discussion rather than correctness or whether the students "get it." The teachers avoided using broad terms and articulated the specific strategies that students used.

In this final example, it shows teachers summarizing and solidifying their reasoning for why this intervention group is necessary. This is another way the teachers engaged productively in Stage Two. Jessica and Rachel confirmed that these students should experience adding on the number line as a next step in learning another efficient strategy.

> Jessica: We were saying that these were the kids who can do an efficient strategy, but then as soon as we ask them for a second way, they automatically resort back to drawing a picture.
>
> Rachel: So we have to look at what the strategy we have is and we need to put them in the other one that they don't have. Like if they did add by place, they should be in the number line group. If they did number line, they should be in adding by place.
>
> Jessica (interrupts): All of mine that are here did add by place, but they never went to a number line.
>
> Rachel: So they should be in the number line group.
>
> Jessica: But that's what I was saying- that's what I was asking. So I'm going to move all mine to number line. I don't know about anybody else's. Like Ricky, I don't know. But all of my kids here can do add by place, but none of them do number line. (Line 977-992)

This conversation thread includes strategy-oriented talk because the teachers focused on strategy efficiency as the basis for their decisions. They articulated and distinguished between the strategies students used to solve the problem. In contrast, we could imagine ways in which teachers might focus on correctness or which students "got it" to create intervention groups.

As teachers formed Intervention Group 3, they surfaced an idea to discuss, they grappled with distinguishing between the different groups based on the different layers and nuances in students' thinking, and they solidified their understandings of the intervention group formed. These ways of engaging in Stage Two seem to have contributed to the teachers' overall productiveness in RTI problem-solving process. Their talk about this intervention group was entirely more descriptive and they based their data analysis on the students' work with a focus on students' use of efficient strategies.

Intervention Group 4: Subtracting Efficiently. Of the four intervention groups that were formed during this PLC meeting, this is the group that teachers engaged with less productively as part of Stage Two. It appears that there were two reasons why this this part of the discussion may not have contributed to the overall productiveness in the RTI problem-solving process. First, this was the last group discussed during the PLC meeting and teachers were not as articulate in describing students' thinking or the strategies students' used efficiently. Second, the teachers' talk for this part of the discussion included a mix of more and less descriptive talk as the teachers had more instances of general and answer-oriented talk.

The final misconception that surfaced in the PLC discussion included students' errors in subtracting efficiently. Teachers struggled to determine an area of focus for this intervention group because students in this group had solved the addition problem using two efficient strategies. Although the teachers had been more productive as they analyzed and described students' thinking for the first three intervention groups, they were less productive as they discussed Intervention Group 4. The transcript below provides an example of less descriptive talk as teachers in PLC1 had an instance of engaging less productively in Stage Two of the process.

> Rachel: Since we're concentrating on number 6, are we grouping the kids who got number 6 perfect with the kids who got the whole test perfect? Is that gonna be the high group?
>
> Molli: We're doing these based on need so you take number 6. If they have two efficient strategies for number 6, we need to find another intervention for them. (Line 1067-1071)

In this excerpt, Rachel used less descriptive talk as she tried to clarify which students were in this last intervention group. This was answer-oriented talk because Rachel was focused on correctness and broadened the discussion to include the entire assessment instead just Question 6. She also used broad, general language such as the "high group" to distinguish these students from students in other intervention groups. She is less nuanced in her talk as she described the focus being on "the kids who got number 6" rather than their focus concept of adding and subtracting efficiently.

This second example from the transcripts shows how teachers surfaced the students' misconceptions for subtracting efficiently in a less productive way. They decided to focus on subtraction without using the UST data.

> Jessica: Yeah, we're only looking at 6, and even still, think about it, with landmark numbers and mental math, these are kids that can be pushed to that, too. You know, I've got 4 boxes of paper clips and she

> gives away 45, having them reason through. Well, I know it's gonna be around 350 because I'm rounding 45 to 50. You know what I'm saying, there's a lot we can do with that.
>
> Molli: And use the back of the Common Core book for the different types, too. 'Cause missing addends is huge. They don't know how to count up. They don't know when they subtract, how that they can add to do it. They're making simple mistakes in subtraction when all they need to is think about how it is finding the difference. 'Cause that's something we did struggle with. So maybe that's what your highs can do. Check out- 'cause that was something we scored low on. (Line 1032-1043)

They discuss focusing this intervention group on landmark numbers, mental math strategies, and subtraction. The team eventually decided to focus on subtraction for this intervention group but they did so based on what they knew about the students in general rather than using the UST data or students' work as evidence. As teachers formed Intervention Group 4, they appeared to struggle as they engaged in Stage Two of the process. They used less productive talk more frequently and did not surface students' thinking using their work. It seemed as if the conversation about Intervention Group 4 did not contribute to the overall productiveness as teachers engaged in Stage Two of the RTI problem-solving process.

Summary for PLC1b – teachers engagement in stages one and two of the RTI problem-solving process. Teachers in PLC1 were more productive overall as they engaged in this second PLC meeting. The purpose was to analyze and describe students' thinking as part of Stages One and Two of the RTI problem-solving process. This appeared to be a more productive meeting for three reasons. First, teachers defined a problem as part of Stage One. Their problem included a focus on an essential number concept that was crucial to students' success in later grades. Second, teachers talk in this meeting was mostly more descriptive in nature as they engaged in Stage Two to analyze and describe students' thinking. They further analyzed the problem using students' work to gain deeper insights into students' thinking about the focus concept. Finally, based on their analysis and new insights, teachers created four interventions groups. Students were placed in these four groups based on the similarities in their thinking.

PLC1c: Stage three – design a plan. The teachers' purpose of planning during this meeting (PLC1c) was aligned with Stage Three, design a plan, of the RTI problem-solving process. The teachers' purpose was to plan interventions targeted to students' thinking that was revealed in the previous meeting. This PLC meeting appeared to be more productive for three reasons. First, the teachers revisited each group they had formed to design a plan for intervention targeted to students' thinking. They asked clarifying questions using MD talk to ensure they understood the intervention and how it would target the students' thinking. Second, they revisited the students' work to re-clarify their understanding of students' thinking while planning the intervention. Third, the teachers made connections between the intervention and the students' thinking. The evidence from this PLC meeting will be presented to illustrate how the teachers designed instructional interventions that were targeted to each group of students.

Intervention Group 1: Understanding tens. The first intervention group for which the teachers planned was the group that struggled to understand tens, meaning they did not understand that ten ones combined together as a group of ten. Their intervention plan included sets of *Number Talks* using the ten-frame to help students visualize, identify, and understand various quantities. They would first build quantities up to ten. Once students understood the quantity of ten, then they would use the same ten-frame structure to understand teen numbers. Finally, they would connect the ten-frame representation to the written numerals by composing and decomposing numbers into place value parts. The following example is just one piece of the transcript that demonstrates how the teachers in PLC1 planned for this intervention group.

> Jessica: Ok. When you said they um, after they do their ten frames, you were saying, um, the expanded form. You know, seeing that. Do you want them to do…
>
> Rachel: Like she was saying the ten plus two is 12.
>
> Jessica: So you were talking about vocal expansion? Ok.
>
> Rachel: And write it.
>
> Molli: Well, write it.
>
> Rachel: And write it.
>
> Molli: Absolutely. That’s what’s gonna get it in their head.
>
> Rachel: Because they’re not ready for like the hundreds plus the tens

plus the ones. Because they still don't understand that like sixteen is 6 plus ten.

Jessica: They can do 2 digit like seventeen.

Molli: And talk about what those digits stand for.

Jessica: Ok.

Molli: I have a ten plus a 6. Oh, so let's look at the 16. I have one 10 plus 6 more. What do you notice about these? I mean it's explicit. It's standing here and talking about a ten. What are you noticing? What happens to these numbers as we're adding a ten? Um…

(Line 88-117)

This piece of the conversation demonstrates one example for the ways in which teachers revisited the intervention group they had previously formed to plan a targeted intervention. The planning discussion for Intervention Group 1 contributed to the overall productiveness of this meeting because Jessica used more descriptive talk (MD-UI) as she asked questions of Molli and her peers to ensure she understood the intervention. Molli and Rachel helped her to connect students' understanding of ten to using expanded form with teen numbers.

Intervention Group 2: Understanding place value. The next group struggled with understanding place value in terms of decomposing numbers into place value parts to add efficiently. The teachers planned an addition *Number Talk* intervention that was called "Breaking Each Number into its Place Value." They wanted to get the students to break the numbers into place value parts to add rather than using a less efficient strategy of drawing strips and singles (a base ten representation). The planning example provided here is one of the most interesting conversation threads within this PLC meeting. It portrays the ways in which the teachers and the math coach interacted around an intervention suggestion more productively. It was productive because they discussed the goal of the intervention, and they unpacked the intervention and asked clarifying questions of each other to understand it.

> Molli: Ok, so our first group is Cathy's group and they are right now drawing pictures. So your (points to Cathy) *Number Talk* is going to be… your goal of it we just said would be to be able to break apart, decompose these numbers, right? And add them by place. So if they're doing this, (draws strips & singles) how can we get them to see how this can be broken up by place? (Pause)
>
> Molli: How can we get them from this to numbers?
>
> Cathy: I always told 'em, when I had low, lower ones, to write it how you hear it. Twenty-eight.
>
> Rachel: That's what I do, too. 'Say it, write it'.
>
> Cathy: Now is that a jump from there to that?
>
> Molli: But is that allowing them to understand how to decompose numbers?
>
> Rachel: That that's a 20 and an 8?
>
> Molli: Do they know the 20 is two tens? If they're writing what they're saying, they're just doing something that's out of a- it's like a, an

algorithm, like telling them, ‘Hey do this ‘cause it will get you the answer.’ Are they truly understanding what the value of those digits are? They might hear 20 and write 20, but they might not understand that that 20 is 2 tens. So that just might create greater misconceptions… like that’s not allowing them to know the size of the number. It’s allowing them to know what the number’s name is.

Rachel: Ok. (Line 286-316)

This piece of the conversation seemed to contribute to the productiveness in planning for Intervention Group 2 because the they began with a goal, made a suggestion, and unpacked the suggestion to be sure it would align with students’ thinking. Additionally, this conversation thread was more descriptive because they discussed the purpose of the intervention that was suggested to determine if it actually targeted the students’ thinking. Molli helped the teachers to see that Cathy’s suggestion would not help with students’ understanding of place value, rather it might only help them understand the number name. She tried to help Cathy and Rachel understand that they wanted an intervention that would help students connect the digit in different place values to size of the number. This type of interaction while planning an instructional intervention is key to designing a plan in a productive way in Stage Three of the process. If the teachers had simply accepted the “say it, write it” suggestion as part of the *Number Talk* without unpacking it, they could have created additional misconceptions rather than understandings.

Intervention Group 3: Using the number line to add efficiently. At times, teachers planned differently for different intervention groups in order to be productive in Stage Three. The teachers planned for this group differently than the previous two groups because they revisited students' thinking in order plan a targeted intervention. As they formed Intervention Group 3 in the last meeting, they analyzed the data to determine that the next step for this intervention group would be using the number line as a tool for adding. The teachers revisited students' thinking as they planned for this group because they did not unpack students' thinking about the use of the number line in the previous PLC meeting. They planned to use the number line as an adaptation to a game the students already knew how to play called Capture 5.

The excerpt from the transcript below demonstrates how teachers revisited students' thinking order to plan a targeted intervention. Jessica and Rachel describe what students in this group already knew about using the number line and what they still struggled with when using the number line.

> Rachel: So we talked about how they know what the number line looks like, but they don't know, like they'll find the difference when they're adding. They'll add on the number line when they're supposed to be finding the difference.
>
> Jessica: That's what I was gonna say. They don't know how to use it efficiently, the number line as a strategy. And I don't think they know that they can use it for every other thing. Like, I think they look at it like, number line is when I see a subtraction. Like, They're not thinking

about number line as a resource I could use when I'm adding and subtracting and I can use it here, I can use it… (Rachel: multiplying, dividing…) I think they don't know how to use, just use a number line. (Line 354-362)

Here, Rachel and Jessica started the planning for Intervention Group 3 by clarifying what students' did or did understand regarding the use of the number line. Clarifying students' thinking about the number line was a good first step because the teachers did not get to discuss this in the previous PLC meeting. Beginning with revisiting students' thinking enabled the teachers to move forward with targeting intervention ideas for this intervention group.

When planning a targeted intervention, it is essential that teachers are explicit about connecting the intervention to the students' thinking. In the discussion that followed the conversation above, the teachers described the connection between students' use of the number line and their understanding of place value. Rachel referred to this as "practicing tens and hundreds on the number line." When teachers are more specific as they revisit students' thinking and suggest intervention ideas, it is more likely that the planned intervention will target students' thinking. Below is an example of an intervention the teachers planned that included a game with a number line adaptation. They selected this game and adaptation based on their previous discussions about students' thinking about the number line.

Molli: And now after listening to you talk, would that Capture 5 game be a good first step for this group?

Jessica: I would say so.

Molli: 'Cause in order to efficiently jump on this number line, they've gotta know how to add those tens and hundreds.

Rachel: We have to go back to tens from any number, twenties from any number. (Line 450-456)

Rachel immediately recognized that the Capture 5 game could be used to help students add using the number line to make connections to place value. This conversation thread contributed to the teachers' productiveness in planning for Intervention Group 3 because of the specificity in the intervention suggestion and the connection to the mathematics that students needed to better understand. Because the teachers had grappled clarifying what the needs of the group actually were in the previous PLC meeting, they didn't get to unpack the specific struggled that students had with using the number line for adding. This is an example for how teachers planned differently by revisiting the students' to be sure they would plan a targeted intervention.

Intervention Group 4: Subtracting efficiently. The planning for this group focused on subtracting efficiently using a *Number Talk* as the intervention. The team planned a *Number Talk* to help students use the relationship between addition and subtraction to subtract efficiently. The conversation for this intervention group was not as productive as the previous intervention groups because they did not revisit students' thinking or students' work. They also used both more and less descriptive talk as they discussed and planned the interventions. The variations in their talk appeared to affect the way that they planned an intervention for this group. For example, when the teachers used MD talk to suggest an intervention, they discussed it further in order to understand the intervention and how it could be implemented. When the group suggested an intervention using LD talk, the follow-up discussion was LD, and the teachers did not unpack the intervention to understand it better or how it could be implemented.

The planning for Intervention Group 4 also seemed to be less productive for the teachers because it was also very coach-led. Molli provided many of the specific intervention suggestions and the follow-up conversation that unpacked them. Below is one example of a specific intervention suggestion provided by Molli and her follow-up discussion.

> Molli: So maybe we look at subtraction *Number Talks*? (pause) And like these. These are all mixed adding and subtraction (holds up one of the spinners). Maybe we start with these and make them all subtraction? What happens when you subtract one of these numbers? Have those conversations. 'Oh, when we added them…' 'cause I feel like hundreds charts have been used still counting by ones. Kids aren't really understanding what happens when you add or subtract a ten. And that's why some of them are struggling with the subtraction 'cause they need to count back. But are there easier ways to help them with subtraction. Like the… Where we started in the beginning when we were doing the 20 - 15. (Writes it on SMART Board) I mean how many of your kids did 20 – 10 and the 10 – 5? And you're only 5 away. So

> really working on that counting up strategy. When the numbers are this close, they know how to add. Work on that relationship between them. Um… (Line 545-555)

She shared a *Number Talk* with a spinner game as intervention idea, and then elaborated on those ideas. She talked through her ideas to help the team understand how the intervention connected to the students' thinking and provided suggestions to implement it. Molli contributed to the teachers' productiveness in planning for Intervention Group 4 in two ways. First, it could be viewed as more productive she articulated how the intervention connected to the targeted concept with suggestions for implementation. Second, it could be viewed as less productive because there was little interaction with the teachers in discussing this intervention. If the teachers are not a part of the discussion, they may not fully understand it.

The next example is one that demonstrates how an intervention that is suggested using LD talk did not contribute to overall productiveness while planning for Intervention Group 4. Rachel decided to use a subtraction *Number Talk* as the intervention for this group based on Molli's earlier suggestion. However, she refers to a page in the book with several sets of *Number Talks* and decides to start "in the middle" without explaining why the "60 – 44" talk would target the students' thinking.

> Rachel: Yeah. (pause) Just kind of starting in the middle and seeing do I need to go forward or back. Or even that 60 – 44. Start with the center. (Line 720-721)

There was no discussion that included unpacking the intervention or understanding how it could be implemented with students. Rachel did not describe how this *Number Talk* would help students better understand the relationship between addition and subtraction to subtract more efficiently. When the intervention was not fully articulated or connected to the targeted concept, the follow-up discussion was minimal with little understanding.

Summary of PLC1c: Teachers' engagement in stage three – design a plan. Teachers designed a plan for each intervention group that was targeted to students' thinking. Overall, this PLC meeting was more productive as teachers engaged in Stage Three of the RTI problem-solving process. It appeared to be more productive for three reasons. The teachers revisited the intervention groups they created to ask clarifying questions, they revisited students' work to re-clarify their understanding of students' thinking, and they made connections between the targeted intervention and the students' thinking. Each of these may not have happened for each group, but occurred throughout the meeting as teachers planned targeted interventions. This was because the needs of each intervention group were different and required different types of planning. For example, while planning for Intervention Group 3, the teachers needed to revisit students' thinking because they did not get to do it at the previous PLC meeting.

Although there were instances of less descriptive talk (LD) while teachers in PLC1 planned interventions targeted to students' thinking, most of their talk was more descriptive (MD). When they suggested intervention ideas using MD talk, they unpacked it to understand it using MD talk. As can be seen when teachers planned for Intervention Group 4, their use of LD talk appeared to impact their productiveness for that group. When they suggested an intervention at a superficial level using LD talk, they did not unpack the intervention in order to understand the intervention or how it could be implemented.

PLC1d: Stage five – evaluate the plan. The teachers' purpose for the final PLC meeting (PLC1d) aligned with Stage Five of the RTI problem-solving process. Their purpose was to reflect on the how the interventions were implemented. This PLC meeting appeared to be productive for three reasons. First, the teachers revisited the plan they had designed for each intervention group to describe how it was enacted, they reflected on the progress that students' made, and they discussed next steps for the students. Second, teachers brought their recorded notes from their SMARTboards, they asked clarifying questions of each other, and some brought student work to demonstrate the intervention's effectiveness. Third, teachers' reflections about specific students helped them to determine if the intervention was effective. The evidence from this PLC meeting will be presented to illustrate how the teachers reflected upon the implemented interventions that were targeted to each group of students.

Reflecting on intervention group 1: Understanding tens. Teachers had planned to use set of *Number Talks* with the ten-frame to meet the needs of students in Intervention Group 1. They were productive as they reflected on this intervention group's progress because they shared how the intervention was implemented and then suggested next steps for these students. The teacher who implemented the intervention led the discussion. Jessica described details of the intervention so that the others understood how it was implemented in this first excerpt below.

> Jessica: … So then we were doing this… (puts 5 dots on the tens frame on the SMART Board). 'What number do we see?' 'We see 5.' 'How do we know it's a 5?' And the kids were like, 'I know it's 5 because I can take these two and move them up here and fill in one row and get 5.' 'Awesome. Well, how would we represent that in an equation?' '3 + 2 = 5.' I mean that's really what we did today. And the next one is the same thing. (Line 46-51)

Jessica shared that she had started with the basics of ten-frames and asked students to identify and represent quantities using a ten-frame and with equations. Her initial description here and her continued elaborations included more descriptive talk as she articulated the details of the intervention along with students' responses. Jessica also shared her ideas for possible next steps for these students in the example below.

> Jessica: So tomorrow, we're moving up and we're gonna try to do… instead of just what number do we see, 'Ok, so we see a 6. How many more would I need to make it a ten?' Well, I see there's 6. And there's 4 empty. And we're gonna try to… We'll see how that goes. (Line 85-87)

As a result of what the students learned from this intervention, Jessica described how she planned to extend their learning in the next lesson. She planned to help students make connections between the quantities they had represented in this lesson to making a group of ten. Describing these next steps for students demonstrates one example in which teachers in PLC1 seem to understand the problem-solving model as a continued process. This process did not seem to be viewed as a one-time intervention because Jessica shared her ideas for the next level of the learning progression for this group of students.

Reflecting on intervention group 2: Understanding place value. Teachers had planned to use a set of *Number Talks* with breaking numbers into place value parts to meet the needs of students in Intervention Group 2. They appeared to be productive as they reflected on this intervention group's progress for two reasons. First, they shared how the intervention was implemented including specific details about the sequence of the activity and the questions asked of the students. Second, the reflection discussion surfaced another possible misconception and the teachers identified a continued need for this intervention group. The example below demonstrates how the teachers verbalized the misconception. Since Cathy, provided the interventions for these students, she led the discussion for Intervention Group 2.

> Cathy: So this group's main issue is making sure they can group 'em correctly.
>
> Jessica: And some of 'em might struggle with moving that ten to the – you know what I mean? Because they're- I noticed on one of my problems, like Lili will do this and then she'd write 60 and 14 beside each other (Cathy: Yes.) and make it 6014 instead of moving the ten…
>
> Rachel: Or 614 because sometimes they take the zero away.

Cathy: Oh, this (pulls up one on the SMART Board).

Jessica: See she leaves it. And it's always 6 thousand something.

Cathy: That's how we ended up talking about it. I had a forty and a- 'cause we did this one first where they didn't have to carry. And I was like, 'Well, I have 40 and I have 17, that's not as easy as this one.' And somebody was like, 'no, this is a ten so we can just move that over with the-' And I said, 'Well how come we can't write it 4017 (forty-seventeen) or 417?' And they were like, 'Cause that 40's not a 100.' So that gave the idea that they do understand the difference in the place values and when to use it. So we just went to the operation itself. And that's what we got through today.

Rachel: That's good. (Line 144-166)

The teachers' reflection discussion surfaced another possible misconception. They identified students' struggles with notating and recording their final answers when adding by place value. Cathy shared how she initially addressed this misconception when it arose during the intervention. This seems to have contributed to the productiveness of this discussion because the teachers have uncovered another misconception that might have affected students' abilities to add efficiently. This provided an avenue for further intervention.

Reflecting on intervention group 3: Using the number line to add efficiently. The teachers planned an intervention for this group that used the number line as an adaptation to a game the students already knew how to play called Capture 5. They appeared to be productive as they reflected on this intervention group's progress for two reasons. First, they shared how the intervention was implemented including specific details about how the adapted game connected to the students' targeted need. Second, the students' work played an important role in the reflection for Intervention Group 3. They shared the students' work, which seemed to lead to teachers' own self-reflections about the mathematics. Looking at a piece of student work enabled the teachers to reflect on the ways in which they record students' strategies. This excerpt below was significant as it captured the teachers' self-reflections about their own practices.

> Rachel: The only thing I would say with him is he doesn't have the plus sign (looking at the student's' paper). Which I know I don't always do it and I don't always make my kids do it. But I have to remind myself next year to really stress that.
>
> Cathy: I make my kids do it only because then when it goes to, 'well I messed up somewhere', then they can go back and say well, that added ten-
>
> Rachel (interrupts): That this isn't a ten, it's adding ten to where you were before it. I think sometimes the fast, I just throw up ten, ten, ten , ten , ten, one, one, one, one, one, -
>
> Jessica: I do the same thing. I always forget the plus.
>
> Rachel: Instead of plus ten plus ten.
>
> Cathy: I always do plus tens only because when you go to check-

> 'cause sometimes a lot of kids with number line, they um, they um, mess up their count. Well then they can go back and see where they messed up their drawing at. You know what I mean? (Line 193-204)

Having the student work was an essential part of the conversation for Intervention Group 3. The student work sparked a self-reflection discussion from the teachers in how they represent and record strategies and solutions using the number line. This discussion seemed to contribute to the productiveness of their engagement in Stage Five because the self-reflection provoked a need for change in their practice. Rachel made an observation about the way students were recording their addition strategy on the number line. Students would leave off the plus signs on the jumps, which enabled the teachers to realize they often leave the plus sign off, as well.

Reflecting on intervention group 4: Subtracting efficiently. The teachers planned a set of *Number Talks* to helps students subtract efficiently using the relationship between addition and subtraction. They appeared to be productive as they reflected on this intervention group's progress for two reasons. First, they shared how the intervention was implemented including specific details about how the goal of the *Number Talk* connected to the students' need to subtract more efficiently. The goal was to get the students to think about the difference between the quantities in a subtraction problem using landmark numbers rather than counting back (using removal) or subtracting in parts.

Second, discussing the progress of specific students played an important role in the reflection for Intervention Group 4. Teachers highlighted the struggles of a few different students in this group including the one below for Kayla.

> Rachel: Then, Kayla was sort of on the right track. She said that she started out by thinking about 60 – 50. And it was ten. And she said that that was her estimate. And she knew that her answer would have to be close to that. But then she was one, she answered the other way. She answered 19. So she got to the ten, but then she moved one in the wrong direction instead of… so then she showed me that to check herself. She did it by, in parts. (Writes 60-50 = 10 estimate, 60-40 = 20, 20 – 9 = 11 on SMART Board). And then finally, I was like, 'Can somebody come up and do it on the number line?' So Lanay came up and did the number line and we talked about landmark numbers. So for the next one, I said, - (Line 281-288)

During the intervention Rachel used Kayla's wrong answer to help students make a connection to the number line representation. This example shows how teachers shared their reflections about specific students. This reflection enabled Rachel to share how she helped students make connections to the number line representation for subtracting efficiently. This reflection for Intervention Group 4 seems to have contributed to their overall productiveness as they engaged in Stage Five because discussing specific students helped to surface connections between different solution strategies and determine if the intervention was effective.

Summary of PLC1d: Teachers' engagement in stage five. The teachers in PLC1 appeared to be overall more productive as they engaged in Stage Five of the RTI problem-solving process. They seemed to be more productive for several reasons. First, teachers used mostly more descriptive talk in their reflection as they provided detailed accounts of their implemented interventions and possible next steps for students. Second, teachers used their notes and students' work to make connections between the intervention and the targeted need of the students, at times sparking self-reflections about their practice. Finally, they provided detailed reflections about specific students' progress to help them determine if the intervention was effective.

Summary of PLC1: The more productive PLC. PLC1 appeared to be more productive as they engaged in the RTI problem-solving process for two main reasons. First, they were able to move through the stages using more descriptive talk. Although each PLC meeting included some less descriptive talk, most of the talk was more descriptive in nature. Second, the teachers in PLC1 focused on one number concept that was essential to students' future success in mathematics. Additionally, each PLC meeting included some aspects of the teachers' interactions that contributed to the overall productiveness of the PLC.

In PLC1a, teachers engaged in Stage One of the process as they defined a problem area based on the UST data. Their purpose for this meeting was to use the UST data to gain insights into students' thinking by completing an overall analysis of the data. They looked at students' strengths and weakness based on trends in the data. They identified students' ability to add and subtract efficiently as an overall weakness, and then they briefly discussed students' work to analyze the data at a deeper level. This provided them with an overview of the their students' conceptions and misconceptions aligned with Stage One of the RTI problem-solving process.

In PLC1b, the teachers briefly continued in Stage One and then moved to Stage Two of the RTI problem-solving process. During their brief engagement in Stage One, they made a final decision about the problem they defined and then moved to Stage Two to analyze the problem further. As they engaged in Stage Two, teachers looked deeper at the Spring UST data including the students' work and were able to surface ideas about how students were thinking about the defined concept. The teachers appeared to be more productive as they engaged in these stages of the process for three reasons. First, they used mostly more descriptive talk as they defined one essential number concept as the 'problem'. Second, they analyzed and described students' thinking using the students' work rather than just the scores. Third, they created four intervention groups based on similarities in students' thinking for the selected concept.

In PLC1c, the teachers moved to Stage of the RTI problem-solving process to design a plan for each intervention group. This PLC meeting was productive because the teachers revisited each group they had formed to design a plan for intervention targeted to students' thinking, they revisited the students' work to re-clarify their understanding of students' thinking while planning, and they made connections between the planned intervention and the students' thinking. Although the teachers in PLC1 were mostly productive as they designed a plan for intervention for each intervention group, they did struggle to be productive while planning for the last intervention group.

In PLC1d, the teachers moved to Stage Five of the process after they had implemented the interventions as part of Stage Four. In Stage Five, they reflected on the interventions they had designed and implemented. The teachers appeared to engage more productively in this meeting for three reasons. First, the teachers revisited the plan they had designed for each intervention group to describe how it was enacted, they reflected on the progress that students' made, and they discussed next steps for the students. Second, teachers used their notes from their SMARTboards, asked clarifying questions of each other, and some brought student work to demonstrate the intervention's effectiveness. Reflecting on the students' work also inspired teachers to reflect on their practice. Third, teachers' reflections about specific students helped them to determine if the intervention was effective.

Each of these meetings that correlated with the stages appeared to contribute to the teachers' overall productiveness as they engaged in the five stages of the RTI problem-solving process. They used mostly more descriptive talk as they engaged in each PLC meeting and each stage of the process. They also focused their engagement in the process on one specific number concept that was essential to students' later success in mathematics using students' work as part of their analysis.

Case Two – The Less Productive PLC

Case Two will present the ways in which teachers in PLC2 interacted with the screening tool data and engaged less productively in the stages of the RTI problem-solving process. The description of this case focuses on the three observed PLC meetings during which the discussions focused on or stemmed from the teachers' analysis of the UST data. I will describe each meeting, how it aligned with the stages of the process, and the productivity of the teachers as they engaged in those stages.

There were two characteristics highlighted throughout Case Two that appear to have affected this PLC's capacity to engage productively in the RTI problem-solving process. First, teachers in PLC2 moved through the stages of the process using mostly less descriptive talk. Second, they focused on a broader mathematical idea for analysis throughout the three meetings rather than focusing on a specific, essential number concept. Using students' scores as the basis for their analysis rather than students' work.

PLC2a: Stage one – define the problem. The first observed PLC meeting encompassed Stage One of the RTI problem-solving process and aligned with the teachers' purpose of analyzing and describing students' thinking. Stage One, define a problem, is where a concept is identified for which students are struggling based on data. During this meeting, teachers used the UST for their source of data to gain insights into students' thinking. After identifying and defining the problem, they focused on this broad mathematical idea throughout the rest of the observed PLC meetings. The focus was on students' abilities to solve multi-step word problems.

Since the purpose of this PLC meeting was to analyze and describe students' mathematical thinking as part of defining the problem, the teachers focused their attention to a few of the big ideas emphasized in the screening tool, and then selected a few items as the focal points for interpreting the data and looking at student growth for these concepts across the year. Although a hired consultant led most of this specific PLC meeting, teachers should engage in this type of discussion as part of Stage One without the consultant to unpack the overall strengths and weaknesses of their students.

Stage One includes teachers analyzing the data to see the progress students make over time and digging deeper into the data to determine an area of focus for intervention. Teachers approached the data analysis in two ways. First, they reviewed holistic data that included averages (item-by-item) from the first two administrations of the UST comparing the Winter data to the Fall data and also comparing their grade level averages to the district average for those assessments. They also gathered class averages for particular concepts and compared the Spring data to the Fall and Winter data to get a sense of their overall growth. This helped them to narrow their focus to a few essential concepts that could serve as the basis for further in-depth analysis in Stage Two.

The second way the teachers approached the data analysis occurred after they had gained an overall sense of the students' strengths and weaknesses, and narrowed their focus. They were supposed to analyze some of their students' work for the narrowed set of concepts to further investigate and support their initial findings.

Although they focused on a mathematical idea for further investigation, the teachers in this PLC struggled to engage in a deeper analysis based on their students' work. The teachers honed in on a broad mathematical idea that focused students' abilities to solve multi-step word problems. Their discussions about students' work included mostly less descriptive talk during this stage of defining a problem. Below is one example of a less descriptive conversation thread as the teachers in PLC2 struggled to gain deeper insights about their students' thinking, even after being prompted by the consultant.

> Kris: Ok, so the average looks about the same as it was before. Um, so how'd they do on that one? Did they not know division? Did they not know to divide?
>
> Amy: They knew to divide, they just… the strategy was…
>
> Lisa: And I chalk it up as the same thing as it's been a while since we've revisited it. And that was in my head as something I really wanted to hit in morning work and stuff for the next…
>
> Amy: But thank the Lord Jesus above, that they at least got the equation. They knew that they were dividing.
>
> Kris: Ok (Line 214-227)

In this conversation thread, the talk was generalized and avoided the purpose of looking at the data. It was generalized when Amy simply stated that the students "knew to divide." She did not articulate which students could divide, whether students could divide efficiently, or if there was a specific aspect of division that was troubling for students. She did not refer to the students' work as she made those statements. Lisa avoided the data conversation as she claimed that students' struggles with division were due to the timeframe in which it had been revisited. The teachers in PLC2 continued to struggle as they attempted to analyze the data at a deeper level for other multi-step problems. They used mostly answer-oriented talk to describe students that "got it" and non-descriptive talk that detracted from the purpose of the conversation.

This PLC meeting aligned with Stage One of the RTI problem-solving process because this was their first analysis of the Spring UST data. Teachers analyzed the data to determine students' overall strengths and weaknesses so that they could define a problem for further analysis. The teachers focused on students' abilities to solve multi-step word problems, but did so in a less descriptive and less productive manner. Instead of unpacking the conceptual underpinnings when students did not "get it", the teachers often used non-descriptive talk avoiding a deeper analysis of their student work or hindering the progress of the discussion. They talked about students' reading ability, categorized them as "low" kids, mentioned how students rushed to solve the problem, or referenced whether the students liked math. These reasons appeared to contribute to the teachers' engagement in Stage One less productively.

PLC2b: Stage one & stage two – define the problem & analyze the problem. The second PLC meeting (PLC2b) appeared to be less productive as the teachers analyzed the screener data and described students' thinking. The purpose of this PLC meeting was to analyze and describe students' mathematical thinking, which aligned with Stage One and Stage Two of the RTI problem-solving process. This PLC meeting included two major components that helped to determine that they were engaging in Stages One and Two of the process and that they were doing so less productively: 1) the teachers defined a problem as they selected an area of focus that included a broad mathematical idea; 2) they analyzed the problem by describing students' thinking using less descriptive talk.

Selecting a focus to 'define a problem'. The beginning of this PLC meeting aligned with Stage One of the RTI problem-solving process because teachers defined a problem to be analyzed further. The team decided to focus on three questions from the Spring UST, which included solving multi-step story problems. This decision was based the teachers' analysis of overall trends in the data to see where the most students "didn't get it," where there was the "highest area of need," and which questions had the "lowest scores." In this excerpt below from the transcript of PLC2b is just one example of a conversation thread in which the teachers were selecting an area of focus using less descriptive talk.

> Amy: So my lowest would be… (pause) fractions… operates efficiently while problem solving… That one's question 5. That was, oh, division, hmm.
>
> Amy (continues): 1 is the multi-step problem with the cans.
>
> Melissa: For Amy, it's fractions, division and multi-step. (Line 61-69)
>
> Jeanine: Wait. You're writing down your lowest…
>
> Melissa: She gave me her lowest three and I just wrote 'em down. (Line 75-77)

This conversation threads included less descriptive talk because the teachers focused on questions with lowest scores rather than analyzing the students' work. They decided to just look at their own printed data sheets and find the questions that had the lowest scores. Many of the questions they referred to as their "lowest" in terms of scores fell under the mathematical idea of solving "multi-step" word problems. There were several more conversation threads in which teachers focused on students' scores for analyzing and describing students' thinking rather than looking at the students' work. The above thread is just one piece of this evidence. The team defined a problem by deciding to focus on students' abilities to solve multi-step word problems. This encompassed three questions from the UST, Questions 5, 7, and 9.

Analyzing and describing the students' thinking. This part of the discussion aligned with Stage Two of the RTI problem-solving process as teachers further analyzed the problem. Teachers in PLC2 decided to target "multi-step" word problems for intervention instruction. They discussed the selected questions from the UST for further analysis. The teachers used a blend of more, less and non-descriptive talk, but most of the conversation included less descriptive talk. The conversation thread below includes one example of the less descriptive, generalized (LD-G) talk teachers used to further analyze this problem.

Matt: Question 7 was- that's an addition problem.

Jeanine: But it was multi-stepped.

Matt: But that's like, that's a fairly easy problem.

Jeanine: It should be.

Nordie: Which, actually, one was that?

Jeanine: But they really had to keep track of like that was Miss Smith's class has 245 cans John's class has- (Line 184-195)

Their further analysis of the first multi-step word problem in this conversation thread was broad and generalized. The teachers used phrases such as "that's a fairly easy problem" and "it was multi-stepped." However, they did not discuss details about the mathematics in this problem or how the students were thinking about the mathematics. One could imagine a more descriptive discussion that would include a deeper look at students' work to determine the part of the problem that provided a challenge for the students.

When teachers did use students' work as part of their analysis of the problem, they tended to do using mostly less descriptive talk. For example, one teacher used the generalized phrase, "my kids did it that way" to describe students' thinking. She did not verbalize what the students did, if their strategy was efficient, or the specific part of the mathematics that students did or did not understand. Below is another example of a teacher engaging in Stage Two less productively.

Matt: Which, he's doing that. It shows he has a pretty good comprehension of how it works. (Line 279)

He described a student's thinking using general or broad terms as he confirmed the student had a "good comprehension of how it works." However, he did not articulate what it was that the student comprehended and there was no reference to the mathematics within this multi-step problem. As teachers in PLC2 continued to engage in Stage Two, their conversations also included non-descriptive, avoidance (ND-A) talk. They discussed whether students attended this school previously, students' reading abilities, and students' love of math rather than looking at students' work. As teachers attempted to analyze and describe students' thinking, their conversations appeared to detract from the purpose of the meeting and hindered the conversation moving forward.

Summary for PLC2b – teachers' engagement in stages one and two of the RTI problem-solving process. Teachers in PLC2 appeared to be less productive as they engaged in Stage One and Stage Two of the RTI problem-solving process. They defined a problem by confirming their intent to target multi-step word problems. However, this part of the discussion did not include talk about what it was the students struggled with mathematically or what might be targeted for intervention beyond the broad category of solving multi-step problems. Most of their analysis included less descriptive talk because the teachers used broad and generalized terms to make their decisions such as looking at questions with the lowest scores. The teachers attempted to further analyze the problem by discussing students' work, but did so using less descriptive talk. Specific details of students' thinking were not articulated and their conceptions or misconceptions were not fully described. These factors appeared to contribute to the ways in which PLC2 engaged less productively in Stage One and Stage Two of the RTI problem-solving process.

PLC2c: Stage two – analyze the problem. The third PLC meeting for PLC2 was a continued analysis of the problem aligned with Stage Two of the process. The teachers' purpose was to place students into groups for intervention instruction based on students' ability to solve multi-step problems. This PLC meeting seemed to be overall less productive because teachers used only less and non-descriptive talk, and they used students' scores to create four intervention groups rather than the students' work. Although, their stated intent was to "form groups" based on how students responded to the three selected questions, the teachers' discussion that followed did not include any analysis of students' work. The evidence from this PLC meeting will be presented to illustrate how the teachers created four intervention groups based on students' scores.

Creating intervention groups. Each of the four intervention groups was named based on the teachers' discussion about the students' scores for the three selected focus questions. The four intervention groups were: *Three competent, Two competent, One competent, and No competent*. This was a less productive way of grouping students because it generalizes students into categories based on scores rather than their thinking. Grouping students based on scores could present a challenge when teachers try to plan interventions targeted to students' thinking. A brief description of each intervention group is provided below to support the finding that this PLC was overall less productive as they engaged in the RTI problem-solving process. Their creation of intervention groups based on students' scores using less descriptive talk appears to have contributed to their productiveness in Stage Two.

Intervention Group 1: Three competent. Teachers used printouts of their class data to create the intervention groups based on students' scores. Their talk included different synonyms for the UST data such as the codes (C, T, I), the scores (2, 1, 0), and the colors (Green, Yellow, Red). I will use the term 'score' to refer to any of the three synonyms for the UST data.

As the teachers analyzed the UST data, they looked only at their printed data sheets rather than students' work to make grouping decisions. While some of the talk included attempts to dig deeper into the data, most of the conversation threads included generalized talk as teachers discussed ways to group students for intervention based on the scores rather than students' work. Below is an example for how teachers created an intervention group for the students who were scored as competent for all three selected focus questions.

> Jeanine: Alright, let's do… Now, the way I did it was all three were competent. That's my high, high.
>
> Lisa: Right, that's my high, high. (Line 511-514)

Jeanine launched the conversation as she suggested that they list students who were "competent in all three." Her colleagues agreed without articulating the mathematics that students struggled with and without looking at the student work during this discussion. They continued to use broad terms to describe students such as "high, high" rather than analyzing the students' conceptions or misconceptions when solving multi-step problems. Teachers used terms such as "high, high" as they described students' mathematics abilities holistically rather than articulating students' specific understanding of the selected focus skill.

Intervention Group 2: Two competent. Teachers continued to create intervention groups based on the students' scores rather than analyzing the students' work. One teacher suggested that the group be created based on which students scored a competent in two of the three selected focus questions. She simply asked, "do you wanna do two?" without specifying what "two" meant. She implied that they should group students together that were competent for two of the questions. The teachers again agreed with this suggestion without articulating the specific mathematics concepts that were challenging for students.

Sometimes teachers grappled with whether they should analyze the data further as they created the groups. For example, one teacher interjected a suggestion to look at the error students made on the questions they were analyzing. This suggestion was not acknowledged by the other teachers, which demonstrated a lack of interest in a deeper analysis of the data. Later in the discussion, the same teacher made another attempt to move beyond the scores for their analysis in the excerpt below.

> Lisa: No, I meant like, would it matter if they missed one, but some of them 5 and some missed 9. Do we want those in the same group? I mean, not that we need…
>
> Jeanine: No. I think a story problem's a story problem.
>
> Lisa: Ok. I agree.
>
> Jeanine: Yeah. I don't think… I mean, we could look at the problems, but I don't know if that…
>
> Lisa: Ok, no, I agree. (Line 192-207)

Although Lisa is attempting to engage her colleagues in a deeper analysis of the data, she used less descriptive talk to do so. Her suggestion focused on which students "missed" Question 5 and "missed" Question 9. She was still focused on correctness and whether students got it right. She did not explicitly suggest that they look at students' work to determine their conceptions and misconceptions about the mathematics. Again, her colleagues did not want to engage in a deeper analysis as they commented about it not really being necessary to look at the student work.

Intervention Group 3: One competent. The next intervention group included students who received a competent score for only one of the three selected focus questions. Again, a suggestion was made to create a third intervention group based on students' scores rather than engaging in a deeper analysis of the problem. In her comment below, Jeanine shared the process she used to create lists of students based the number of "competent" scores they received on the three questions.

> Jeanine: So this is two competent. This is three competent. And then do you wanna do one competent? (making list headers on her paper) (Line 174-175)

The other members of the PLC agreed with this suggestion and there was no further analysis of the data for Intervention Group 3. They did not look at the students' work that were placed in this group to determine if they had similar mathematical thinking. The teachers simply made lists of students based on these criteria to create the intervention groups.

Intervention Group 4: No competent. The last intervention group the teachers formed included the students who were not competent in solving any of the three selected focus questions. Jeanine again suggested they use the scores to group the students using the phrase "no competent" to name the last group. The teachers continued the discussion using less descriptive talk as they decided whether or not they needed to look more carefully at these students' thinking or simply place them all in the same group.

> Jeanine: And then, how do you wanna do the last group? Like, the ones that didn't get competent in any of the three. They just all get lumped in…
>
> Amy: I lumped 'em in… (points at her paper.) I lumped 'em in if they had inefficient or transitional… So like, if they have one transitional and two inefficient, I put them in here. (points to her paper) That's what I did. But I can go back, and… (Line 222-227)

Although the students could have had different combinations of transitional or inefficient scores demonstrating different mathematical thinking, the teachers decided to "lump them" together. They did not complete any further analysis of the students' work to determine if students were thinking similarly about the mathematics.

After the teachers created the intervention groups using the students' scores, they discussed dividing up the students in the first and last groups. Below is one conversation thread in which the teachers proposed "breaking up" some of their already formed intervention groups.

Lisa: Yeah, we're definitely gonna have to break up those low, lows. Maybe even the…

(Line 446)

Amy: Alright, I have my low, low. Is that how you wanna do it? You wanna do your high, highs first? And put 'em in a group?

Jeanine: Yeah. (Line 454-458)

The teachers did not explicitly state why they wanted to split up their already formed groups as they discussed the need to "break up those low, lows" and "high, highs." They did not actually look at students' work to determine the students' conceptions or misconceptions about solving multi-step word problems. Their suggestions for further analysis were still based on generalities and students' scores rather than students' mathematical thinking. They sorted their "all red" students from Intervention Group 4 into two new groups. This decision was based on which students "had number sense" and those that did not have number sense. Teachers completed this sorting without looking at the students' work. They made these determinations based upon what they knew about the students without referring students' abilities to solve multi-step problems.

Summary of PLC2c: Teachers' continued engagement in stage two of the RTI problem-solving process. Teachers' engagement in Stage Two appeared to be less productive during this PLC meeting for two reasons. First, as teachers in PLC2 formed each of these intervention groups, their conversation was entirely made up of less descriptive talk. Second, analysis of students' work was not a part of their decision-making process and students were placed in intervention groups based on their scores for the three selected questions. Although the focus was students' abilities to solve multi-step word problems, there was little discussion about understanding of these types of problems. This PLC discussion seems to have contributed to ways in which teachers engaged less productively in the overall RTI problem-solving process.

Summary of PLC2: The less productive PLC. Teachers in PLC2 seem to have engaged less productively in the stages RTI problem-solving process for three reasons. First, their discussions included mostly less descriptive talk as the teachers defined and analyzed a problem based on the UST data. Second, they selected a broad mathematical idea as their area of focus rather than an essential number concept. Finally, although the teachers analyzed and described students' thinking in order to create intervention groups, they did so using the students' scores rather than the students' work. Therefore, they did not gain deeper insights into students' thinking about solving multi-step word problems in order to plan targeted interventions.

In PLC2a, teachers engaged in Stage One of the RTI process as they completed an overall analysis of the data to define a problem area. The teachers analyzed the data using mostly less and non-descriptive talk. Even when prompted by the consultant to further analyze the students' work, the teachers often discussed other concerns such as the students' reading ability or how much the students enjoyed math.

In PLC2b, the teachers engaged in Stages One and Two of the RTI problem-solving process. They defined a problem deciding to focus on multi-step problems based on the "lowest" scores rather than analyzing students' thinking based on their work. The teachers did not articulate the mathematics that students struggled with or name the strategies their students were using to solve multi-step word problems. Their discussion included generalizations and non-descriptive talk that didn't advance the conversation and avoided the deeper analysis of the data. The non-descriptive talk detracted from the purpose of the PLC meeting and at times hindered their progress moving forward with their data analysis. Because the teachers struggled to explicitly articulate the conceptions or misconceptions the students had, there were very few intervention suggestions that tied to specifically to students' thinking.

In PLC2c, the teachers verbalized their intentions to look at the students' work so that they could create intervention groups based on students' thinking. However, most of their discussion centered on the scores students received and there was little to no references to student work while they created the intervention groups. One teacher made a few attempts to encourage her colleagues to take a deeper look at the data to analyze how students solved it, but this did not spark any interest in the other teachers to do so. Almost all of the discussion in PLC2c included less descriptive talk with zero instances of more descriptive talk. The teachers did not articulate students' struggles with solving multi-step problems as they formed the intervention groups during this meeting.

Overall, the teachers in PLC2 appeared to engage less productively in the stages of the RTI problem-solving process. They used mostly less descriptive talk throughout each of the observed PLC meetings, they selected a broad mathematical idea as their area of focus, and they created intervention groups based on students' scores rather than students' work. My conjecture is that the teachers in PLC2 would also engage in the other stages of the process less productively. Using less descriptive talk during these observed meetings seemed to make it difficult for teachers to suggest intervention ideas because they hadn't articulated students' thinking. This would also make it difficult for teachers to design interventions targeted to students' thinking as part of Stage Three and reflect on the interventions as part of Stage Five.

Chapter 6

TEACHERS' PERCEPTIONS

Research Question Two: To what degree do the teachers' self-reported perceptions of their uses of the UST and engagement in the RTI problem-solving process align with the researcher's PLC observations?

Introduction

In this chapter I will present the findings for Research Question Two. Based on my interviews with the eight teachers and the math coach and my analysis of the interview data, I have four significant findings that I will briefly describe as an overview; later in the chapter, I will present them in more detail with supporting data. I have selected four interview questions from the teacher interview protocol (Questions 2, 3, 10, 11) that directly related to and supported my findings from the PLC observations regarding teachers' engagement with the RTI problem-solving process. Questions 2 and 3 uncovered ways in which the teachers used the Universal Screening tool (UST) to gain insights into their students' thinking. Question 10 related to teachers' effectiveness at analyzing students' thinking, and Question 11 related to teachers' effectiveness at planning instruction targeted to students' thinking. These four interview questions provided insights into the teachers' perceptions with regards to their analysis of students' thinking and process of planning for instruction.

First, teachers who are members of each PLC stated in the interviews that they used the UST data in two ways: 1) to understand students' thinking and 2) to group students for intervention. Teachers who are members of PLC1 talked more descriptively during interviews about the ways in which they used the UST data, while teachers who are members of PLC2 talked less descriptively during interviews about the ways in which they used the UST data. This aligned with my observations of each PLC and the types of talk they used during their meetings. Second, teachers in PLC1 articulated their RTI problem-solving process to align targeted interventions to students' thinking in interviews in ways that were similar to what was observed in PLC meetings, and teachers in PLC2 generally described their RTI problem-solving process interviews in ways that were not similar to what was observed in PLC meetings. Third, teachers who are members of PLC1 described perceptions of their effectiveness at analyzing and describing students' thinking that aligned with my observations of their PLC meetings. Teachers in PLC2 held perceptions of their effectiveness at analyzing and describing students' thinking that differed from my observations of their PLC meetings.

Fourth, teachers from PLC1 and PLC2 reported different perceptions about their effectiveness at planning for instruction, and all teachers in PLC1 and PLC2 verbalized that my observations of their PLC meetings in terms of planning were accurate. Teachers from PLC1 confirmed my observations of their PLC meetings during the interviews, reporting that their process of planning was effective overall. Teachers from PLC2 confirmed my observations of their PLC meetings during interviews, reporting that their process of planning was weak overall. Teachers' awareness or lack of awareness about their interactions with the UST data and their engagement in the RTI problem-solving process may have implications for their own professional growth and for students' learning. The evidence for each of these findings will be presented using teachers' responses to the selected interview questions from the teacher interview protocol.

Teachers' Perceived Uses of the Universal Screening Tool (UST)

All eight teachers that were interviewed, four teachers in each PLC, stated during the interviews that they used the UST data in two ways: 1) to understand students' thinking and 2) to group students for intervention. Teachers who are members of PLC1 talked more descriptively during interviews about the ways in which they used the UST data. This aligned with my observations of their PLC meetings in which they used mostly more descriptive talk to analyze and describe students' thinking and to create intervention groups. In contrast, teachers who are members of PLC2 talked less descriptively during interviews about the ways in which they used the UST data. This aligned with my observations of their PLC meetings in which they used mostly less descriptive talk to analyze and describe students' thinking and to create intervention groups. Table 17 below provides an overview of the alignment between my observations and the teachers' perceptions in each PLC. To determine alignment, I interpreted teachers' responses during the interviews and compared them to what I had observed during PLC meetings.

Table 17 *Alignment of Researcher's and Teachers' Perceptions Regarding their Use of the UST*

	Researcher's Perceptions	**Teachers' Perceptions**	**Alignment**
PLC1	During the observed PLC meetings, they used the UST data to understand students' thinking in more descriptive ways.	They talked more descriptively during the interviews about how they used the UST data to understand students' thinking and group students for intervention.	Alignment
	During the observed PLC meetings, they used the UST data to create intervention groups based on students' thinking.	They stated that they used the UST data to create intervention groups with one teacher explicitly connecting to students' understandings.	Alignment
PLC2	During the observed PLC meetings, they used the UST data to understand students' thinking in less descriptive ways.	They talked less descriptively during interviews about how they used the UST data to understand students' thinking and group students for intervention.	Alignment
	During the observed PLC meetings, they used the UST data to create intervention groups based on students' scores.	They stated that they used the UST data to create intervention groups with three teachers explicitly connecting the groups to students' understandings.	Alignment

Teachers' use of the UST to understand students' thinking. All teachers in both PLCs shared in interviews that they used the UST to understand students' thinking. However, the type of talk used by teachers who belonged to each PLC differed in the interviews. Teachers who were members of PLC1 used more descriptive talk in the interviews as they described how they used the UST data, and teachers who are members of PLC2 used less descriptive talk in the interviews as they described how they used the UST data. More descriptive talk in interviews included instances when teachers stated that they used the screening tool to see which students understood a particular concept, to see growth in students' understandings about particular concepts, to determine which strategies students were using, and to decide upon concepts to target for intervention. During the interview, all four teachers in PLC1 talked more descriptively in at least one of these ways. One example of more descriptive talk as teachers in PLC1 described their use of the screening tool data to better understand students' thinking is below:

> Jessica: But I give it in small group, so I give it to 6 kids at a time. (Clearing throat) that way I can take notes as they go. …Like if they're counting on their fingers or like what they're doing, I like to make note of that.

Jessica's comment was considered more descriptive because she stated in the interview that she used the screening tool to determine which strategies students were using such as "counting on their fingers." Teachers who were members of PLC1 used more descriptive comments similar to Jessica's in which they were specific about how they used the UST data to understand students' thinking. Their talk during the interviews about understanding students' thinking aligned with my observations of their PLC meetings because they used mostly more descriptive talk to analyze and describe students' thinking.

Teachers from PLC2 used mostly less descriptive talk during interviews as they described the ways in which they used the UST data. Less descriptive talk during interviews included instances when teachers stated that they used the screening to see which students were competent, transitional, or inefficient, to determine which students were “getting it” or “not getting it”, or to determine what level a student was on with regard to a concept. All four teachers in PLC2 talked less descriptively in at least one of these ways. One example of less descriptive talk as teachers in PLC2 described their use of the screening tool data to better understand students’ thinking is below.

> Jeanine: Um, I guess every, probably every month we kind of regroup and relook at who’s getting it who’s not. Also obviously right after we give the screener we look at the data and we all come together and bring our, um, print out you know, who’s competent and who’s transitional and who’s incompetent and then kind of organize according to the skills.

Jeanine’s comment here from the interview was less descriptive because she referred to her understanding of students’ thinking as looking at “who’s getting it who’s not.” She also referred to the scores students received on the screening tool as a basis for understanding their thinking. Both of Jeanine’s references in this comment include broad, generalized ways of describing students’ thinking; therefore, her response was less descriptive. Their talk about during the interviews about understanding students’ thinking aligned with my observations of their PLC meetings because they used mostly less descriptive talk to analyze and describe students' thinking.

Teachers' use of the UST to group students for intervention. All four teachers from each PLC explicitly stated in the interviews that the UST helped them to create groups for intervention. Four of the eight teachers, one from PLC1, and three from PLC2, also connected the students' understanding to forming intervention groups during the interview. Below is an example of an instance when a teacher made connections between the groups that were formed and students' mathematical understandings.

> Cathy: …We use it at various different times especially if were starting new Smart groups if were looking to see which students already have an understanding about something… to see who had an understanding of multiplication.

During her interview Cathy stated that her PLC used the data when they were starting new intervention groups. Her response also included connections between the groups they created and students' understanding, specifically with multiplication in this example.

There were also instances when teachers simply stated during the interview that they used the UST data to create groups without connecting it to students' thinking. Below is an example of a teacher's interview response about grouping that did not connect the students' understandings to the creation of groups.

> Kerri: Yeah. I liked it. It definitely helped us form our Math Smart groups.

Kerri stated in the interview that her PLC used the UST data to help form Smart groups, which are their intervention groups. Her comment did not connect their creation of groups to the students' understanding about a particular concept. Although one might be able to imply in her comment that they formed the intervention groups based on students' thinking, it was not explicitly stated.

Only one teacher from PLC1 made explicit connections during the interview between the students' thinking and the intervention groups they created. This perception aligns with my observations of their PLC meetings during which I observed these teachers using students' thinking to create intervention groups. In contrast, three teachers from PLC2 made explicit connections during the interview between the students' thinking and the intervention groups they created. This perception does not align with my observations of their PLC meetings during which these teachers did not use students' thinking to create intervention groups. Instead they used students' scores.

In summary, teachers who are members of both PLCs stated that they used the Universal Screening Tool (UST) data in two ways: 1) to understand students' thinking and 2) to group students for intervention. With regard to their use of the UST data, teachers from PLC1 talked more descriptively during interviews, while teachers from PLC2 talked less descriptively during interviews about the ways in which they used the UST data. This finding is similar to that for Research Question 1b in which teachers from PLC1 talked more descriptively as they engaged in the RTI problem-solving process during their PLC meetings than did teachers from PLC2.

Teachers' Articulation of the RTI Problem-solving Process

Teachers from PLC1 articulated their RTI problem-solving process to align targeted interventions to students' thinking in interviews in ways that were similar to what was observed in PLC meetings, and teachers from PLC2 generally described their RTI problem-solving process interviews in ways that were not similar to what was observed in PLC meetings. Specifically, some of the teachers in each PLC described the RTI problem-solving process as they perceived it had occurred in their meetings. They differed in how their perceptions of the process they described aligned with my observations of their PLC meetings. For example, one member of PLC2 stated they looked at students' work as part of their process, which is not what I observed during their PLC meetings. Table 18 below provides an overview of the alignment between the teachers' perceptions of their RTI process and the process that I observed. To determine alignment, I interpreted the teachers responses during the interview questions and compared to my observations of their PLC meetings.

Table 18 *Alignment of Researcher's and Teachers' Perceptions about the RTI Problem-solving Process*

	Researcher's Perceptions	**Teachers' Perceptions**	**Alignment**
PLC1	During the observed PLC meetings, they engaged in the 5 stages of the RTI problem-solving process more productively.	They articulated the RTI problem-solving process they perceived (analyzed one concept, looked at students' work for misconceptions, grouped students based on similar thinking, planned targeted interventions), which aligned with my observations.	Alignment
PLC2	During the observed PLC meetings, they engaged in 2 stages of the RTI problem-solving process less productively.	They articulated the RTI problem-solving process they perceived (they looked at scores and students' work to place students into intervention groups), which differed from my observations.	Lack of Alignment

PLC1. Among the members of PLC1, three of the four teachers articulated the RTI problem-solving process they used to analyze students' thinking, form intervention groups, and plan targeted instruction that aligned to students' thinking in each of the groups. Below is a comment from one teacher who described a specific instance of when they moved through the RTI problem-solving process productively.

> Jessica: So just recently we looked at the one they had to solve the problem two different ways. And our big thing this year is efficiently solving it. So we looked at that and decided that okay that these are the students that can't do it at all or they're still drawing tallies or circles.

> Um and then we looked at our students who can do like a break apart strategy but maybe they can't use a number line efficiently. Because they viewed the number line as a one-way strategy, like just subtraction. Um, so then we looked at that and we grouped up our students and then we actually plan together for our Smart time. Like we sat and said okay this is what we want these students to be able to do, this is where we want to push them to.

Jessica briefly described the way teachers in PLC1 engaged in the RTI problem-solving process. She articulated that they looked at students' work to determine the needs of their students based on one particular concept, they grouped the students, and then planned interventions together as a PLC. Her brief overview aligned with my observations of their PLC meetings because I observed teachers in PLC1 analyze one concept by looking at students' work to determine the conceptions and misconceptions. They grouped students together who had similar thinking and then they planned interventions targeted to students' thinking.

During the interview, Rachel also provided a brief overview of the process teachers in PLC1 used when analyzing the screening tool data. It is less detailed, but still provides a snapshot of the process the teachers in PLC1 used.

> Rachel: Um, well we use it to group students. We usually focus on one skill or one strand and then we'll group students for their flex time. And we look at not just if they got it right, but what strategies they used and where they made mistakes and what their misconceptions are, and

then we try to target those misconceptions in small group.

In her response, Rachel shared that members of her PLC focus on one skill to place students into groups for intervention. She also described how they look beyond whether students get the questions right or wrong by looking the strategies students used and the misconceptions they held in order to plan targeted interventions. Again, Rachel's description of their RTI problem-solving process aligns with my observations of their PLC meetings because I observed teachers in PLC1 looking at students' work, rather than their scores, to understand the strategies their students used and then place students with similar thinking into intervention groups.

These descriptions align with my observations of their PLC meetings because I observed the teachers in PLC1 move through the stages of the RTI process of defining a problem, analyzing the problem, designing and implementing a plan, and reflecting on the implemented plan. Among members of PLC1, teachers' perceptions support my earlier finding for Research Question 1b that this PLC was more productive as they engaged in the RTI problem-solving process.

PLC2. Among members of PLC2, two of the four teachers were able to describe their process of grouping students for intervention when asked how they used the UST data to analyze their students' thinking. One teacher shared how they looked to see if the students were competent or not, which was less descriptive, and that they also looked at the students' work to see how they solved the problem.

> Jeanine: We look at not only if they're transitional or if they're incompetent or if they're competent but we also look at the work itself.

> What do they know? You know, how did they attack the problem? Where are they starting from? It's kind of their jumping off point. So it enable us to say well he made a minor error but he gets it or you know the kid knew to add first and then divide, or subtract first and then what if it was a multi step word problem. We can look at actually what they're doing and decide where they need to be placed according to what they've given us.

Jeanine briefly described the process she perceived that teachers from PLC2 engaged in as they analyzed the UST data. She shared that they looked beyond students' scores and analyzed their work to place students into intervention groups. The process she reported does not align with my observations of their PLC meetings. My observation revealed that teachers from PLC2 did not use students' work as apart of their data analysis, and they did not look at student work at all as they created intervention groups.

Only a subset of the teachers from PLC2 (two of the four teachers) described the RTI problem-solving process. Having only two teachers attempting to describe the process supports my earlier finding for Research Question 1b that teachers in PLC2 were less productive. If they did not enact multiple stages of the RTI problem-solving process in their PLC meetings, it seems likely that they would not describe the process during the interview. Additionally, the two teachers from PLC2 who described a process did so in a way that did not align with my observations of their PLC meetings because I observed teachers in PLC2 using only students' scores to place students into intervention groups rather than looking at students' work.

Teachers' Perceptions of Their effectiveness at Analyzing Students' Thinking

Teachers who are members of PLC1 reported perceptions of their effectiveness at analyzing and describing students' thinking that aligned with my observations of their PLC meetings, while teachers in PLC2 reported perceptions of their effectiveness at analyzing and describing students' thinking that differed from my observations of their PLC meetings. The evidence for this finding will be presented from three lenses for each PLC for their responses to three different parts of the interview questions: their effectiveness at analyzing students' thinking, ways to improve their analysis of students' thinking, and their agreement with my observations of their PLC meetings. Table 19 below provides an overview of the alignment between teachers' perceptions and my perceptions about their effectiveness at analyzing and describing students' thinking. To determine alignment, I report a brief overview of what I observed during their PLC meetings, and asked if they agreed with what I had observed. Then I compared their responses during the interview to what I observed during their PLC meetings.

Table 19 *Alignment of Researcher's and Teachers' Perceptions about Analyzing & Describing Students' Thinking*

	Researcher's Perceptions	**Teachers' Perceptions**	**Alignment**
PLC1	During the observed PLC meetings, they were effective at analyzing and describing students' thinking.	They stated that they were effective at analyzing and describing students' thinking, and they articulated ways to improve.	Alignment
PLC2	During the observed PLC meetings, they were not effective at analyzing and describing students' thinking.	They stated that they were effective at analyzing and describing students' thinking and had few suggestions for improvement. Although they confirmed my perceptions of their observed PLC meetings, they reported being more effective at analyzing and describing students' thinking earlier in the school year.	Lack of Alignment

PLC1. All four teachers who are members of PLC1 stated in the interview that they were effective as a PLC at analyzing students' thinking. Three of these teachers referenced the stages of the RTI problem-solving process they utilized in their PLC meetings as they analyzed the students' thinking. Below is Kerri's description of the ways in which her PLC was effective at analyzing students' thinking.

> Kerri: And, I mean, our PLCs, we really did look at the problems, and it took us a long time sometimes because we would separate the tests and be like, wait but this kid did it this way and this kid did it this way.

> Should we put them in the same group? Let's see. And Molli would be like, "well how did they get there?" and you're like, "just tell us" (laughs). But she refused to just tell us. She's like, "no, you know what they did." Like, "Oh, well, you know – " so that was just really helpful and it – I feel like this year I understand things better the way I teach them than I did last year.

In her interview, Kerri described the types of discussions that teachers in her PLC had as they analyzed students' work. She implied that they looked at the strategies students used to place students into intervention groups. She also described the type of support that the math coach provided to the teachers during the PLC meeting. The coach asked questions of the teachers to help them think deeply about the students' thinking. Kerri's depiction of the ways in which her team was effective at planning aligned with my observations of their PLC meetings, including the coach's support.

All four teachers from PLC1 responded in their interview that their PLC could improve some aspect of their data analysis to better understand students' thinking. Each teacher provided a different way to improve their data analysis, but all referred to it as something that could be enhanced. One teacher wanted to go back to the screener data more often in their PLC, one teacher wanted more time to analyze data in their PLC meetings, and two teachers hoped to find additional and consistent data sources to better analyze students' thinking. One example from the interview of a teacher's suggestion for improvement is below:

> Rachel: So, even though we were good at it most of the times,

> sometimes we did struggle to find common ground with what we wanted to use to look at students work. Um, and how important it is to look at the same problem or at least the same type of problem so that you can compare student work.

In Rachel's response, she acknowledged that her team was good at analyzing students' thinking most of the time. However, she also stated that they struggled to find opportunities in between screener administrations to look at students' work for a common assessment item in order to compare students' work. It is interesting that the teachers would want to engage in the RTI problem-solving process on a more regular basis, as this process can be very time-consuming. I interpret this to mean that the teachers in PLC found this process valuable in helping them to better understand their students' thinking in order to help students improve.

Finally, all four teachers who are members of PLC1 agreed with my perception of how they analyzed students' thinking as I observed it in their PLC meetings. In the interviews, I described a brief overview of what I observed in their PLC meetings. I observed frequent use of more descriptive talk while analyzing students' thinking, but they would also sometimes use less descriptive talk. They would then redirect themselves or get prompting from the math coach to continue to look at students' work and talk about students' specific conceptions and misconceptions. This redirection helped them to again use more descriptive talk. Each teacher stated in the interview that they were aware of these actions as I described them and agreed with the ways they interacted when analyzing students' thinking.

> Kerri: Um, I think so, yeah. And I think that part of that, not like making excuses, is that we only have 4 Math Smart groups, so if we could break it down into ten different groups, that would be awesome. Where we could really say, "OK." And I definitely agree 'cause we start getting all these piles and we're like wait, we can't, we just can't possibly do all these different groups. So then we end up going back to, "doesn't understand, kinda understands, understands, really understands." Because it's like, I mean… I think, I agree. And I know exactly what you're talking about.

In Kerri's comment from the interview above, she described how they sometimes became overwhelmed with the amount of data and the different ways students were thinking that they often became more general in their analysis. Kerri's response was just one piece of evidence that supported my observations being aligned with the teachers' perceptions. Another supporting piece of evidence was the math coach's perceptions from the interview presented below.

> Molli: I feel like third grade's come a long way this year. They started off talking more about the answers and who was getting the correct answer and about how many correct answers they were getting on some of the assessments we were looking at. And I feel their thinking has begun to change, although it sometimes needs to be redirected to more of the process that the students are using and the levels of the processes that they're using such the double digit addition that we've looked at

students who are still drawing picture representations of the numbers up to decomposing the numbers, using efficient strategies, and the number line, and place value methods. Um, I feel that they are able to really – some are able to really look at this work and talk about what the different students need whereas, in the beginning they were like, "these are all getting it right and these are all getting it wrong."

Molli, the math coach, also confirmed my observations stating that third grade teachers (PLC1) had made some great gains in their data analysis. She shared that teachers in PLC1 had moved away from focusing on whether students were right or wrong to focusing on the strategies students were using to solve the problems. Molli's comment is aligned with my observations of the PLC meetings.

Teachers who are members of PLC1 held perceptions of their effectiveness at analyzing and describing students' thinking that aligned with my observations of their PLC meetings. The interview data from Question 10 confirmed my observations of their PLC meetings and the teachers described ways to improve that suggests they would like to engage in the RTI problem-solving process more frequently with other data sources. This evidence supports my findings for Research Question 1b that states PLC1 was overall more productive as the engaged on the RTI problem-solving process. It connects to that finding because these teachers were aware of the process they went through as they analyzed students' thinking, they described ways to improve their process, and wanted to use the process more frequently to better understand students' thinking.

PLC2. Among the members of PLC2, three out of the four teachers perceived their team to be effective at analyzing students' thinking, which did not align with my observations. Two of the teachers who stated in the interview that their PLC was effective specifically referred to their efforts in looking at student work as what made them effective. These teachers' perception that they were effective at analyzing students' thinking based on their use of students work during their analysis does not align with my observations of their PLC meetings. Below is one example of a teacher's perception of their effectiveness at analyzing students' thinking.

> Amy: We look at the student data, I mean student work specifically, uh you know, group them into this student is breaking apart the numbers or this student is repeating the numbers. Or, you know, for um, multiplication, … (said something inaudible). Um, so looking at the student work. This student is, you know, has a good strategy to start, but doesn't know where to finish. So you kinda put them into a group, so we definitely look at student work and start there.

In Amy's response above, she explicitly states that teachers in her PLC used students' work to analyze their thinking and used what they learned to place students into groups for intervention. Her perception and that of the two others from PLC2 differed from my observations of their PLC meetings. I did not observe teachers from PLC2 use students' work to analyze students' thinking. Rather, I observed teachers from PLC2 use students' scores as the basis for analyzing students' thinking.

When asked how they could improve at the process of planning, two teachers who are members of PLC2 stated in the interview that their PLC could improve by having more time to analyze the data and looking at student work. The other two teachers did not articulate ways to improve their PLC's effectiveness at analyzing students' thinking. Below is Matt's perspective for how teachers from his PLC could improve their analysis of students' thinking including more time to analyze students' work.

> Matt: I think that (sighs), I think that if we had a little more time to do – to dive into students' work. I think that a lot of time, our PLC time is chewed up with so many other things that it's hard to dive, actually dive into a student's work.

Matt's response during the interview states that he would have liked to spend more time analyzing students' work to better understand their thinking. He also stated that their PLC time would often be used to do "other things" and that they found it hard to take the time to "dive into a student's work." Below is a comment from Lisa, one of the two teachers who could not articulate any ways to improve their analysis of students' thinking.

> Lisa: I don't know, 'cause I felt like we were trying (laughs). In good faith, we were trying in good faith. You know? And in good faith, we were trying to go by the program and it's a question I have about reading and math. That, wait, how did we drop the ball if we were doing everything we were asked to do?

Lisa stated in her interview that she is unsure how teachers in her PLC could improve at analyzing students' thinking because she thinks they have done everything asked of them. She did not refer to their use of students' work or their scores as ways to improve. Her response is generalized as she stated that teachers in her PLC "were doing everything we were asked to do." She did not explicitly state what they did or how they could improve upon it. Her argument is that their efforts trying to meet the needs of their students through the problem-solving process should justify that they do not need to improve.

Finally, all four teachers who are members of PLC2 agreed with my perception of how they analyzed students' thinking as I observed it in their PLC meetings. In my observations, they used less descriptive talk that included mostly scores or codes to analyze students' thinking. Student work was not a major part of their analysis. While all four teachers who were members of this PLC agreed with my observations, three of them argued that they had done a more in-depth analysis of student work as a part of their process in PLC meetings earlier in the year.

> Matt: Mmhmm. Yeah. So when we originally started doing – uh doing the screener or using the screener to break our groups apart, we um, we actually went back and we created like a rubric and like the kids- they were like alright these kids are you know, doing this method and these kids are doing this method. So that's actually how we broke our groups apart, which was, I think, pretty beneficial.

Matt's comment implied that teachers in his PLC had used students' work as a part of their data analysis in prior PLC meetings during the year. He stated that they looked at the strategies students used to group students for intervention. The three teachers from PLC2 who held perceptions that included the use of students' work as part of their data analysis does not align with my observations of their PLC meetings.

Teachers who are members of PLC2 reported perceptions of their effectiveness at analyzing and describing students' thinking that did not align with my observations of their PLC meetings. The interview data confirmed my observations of their PLC meetings. Some teachers in PLC2 described ways to improve that suggests they would like to engage in the RTI problem-solving process more frequently, while some did not have ways to improve their data analysis process. This evidence supports my findings for Research Question 1b that states PLC2 was overall less productive as they engaged on the RTI problem-solving process.

Teachers' Perceptions of Their Effectiveness at Planning

Although teachers from PLC1 and PLC2 reported different perceptions about their effectiveness at planning for instruction, all teachers from both PLC1 and PLC2 verbalized that my observations of their PLC meetings in terms of planning were accurate. The evidence for this finding will be presented from three lenses for each PLC for their responses to three different parts of Question 11: their effectiveness at planning for instruction, ways to improve at planning, and their agreement with my observations of their PLC meetings. Table 20 below provides an overview of the alignment between teachers' perceptions and my perceptions about their effectiveness at planning intervention targeted to students' thinking. To determine alignment, I provided a brief overview of what I observed during their PLC meetings and asked if they agreed with my observations. Then I compared their responses during the interview to what I observed during their PLC meetings.

Table 20 *Alignment of Researcher's and Teachers' Perceptions about Planning*

	Researcher's Perceptions	**Teachers' Perceptions**	**Alignment**
PLC1	During the observed PLC meetings, they were effective at planning interventions targeted to students' thinking.	Although there were mixed perceptions about their effectiveness in planning, most teachers reported that they were effective at planning, which aligned with my observations.	Alignment
PLC2	During the observed PLC meetings, they did not plan interventions targeted to students' thinking. Most references to intervention ideas were done so less descriptively.	They stated that they were weak at planning, which aligned with my observations.	Alignment

PLC1. Although, teachers from PLC1 reported mixed perspectives about their effectiveness at planning for instruction, most stated that they were effective which aligned with my observations. Three teachers stated in their interviews that they planned well as a PLC, while the fourth teacher reported a contradictory perspective. One of the teachers who reported that their team planned well said that their team was

"most effective at planning," while the teacher with the contradictory perspective stated that their planning was weak. The three teachers who stated in interviews that their process of planning was effective provided different reasons for their effectiveness. Two teachers stated that it was effective when they planned interventions together, helped each other, and treated all of their students as important while they planned. Another teacher shared that their team's ability to delegate and bring back plans to share was how they were effective at the process of planning instruction. Below is Rachel's comment where she summed up her reasons why she perceived her team to be effective at planning.

> Rachel: I think we're most effective at planning. That's where we delegate well and we would take like, um, once we made our groups, and made a general plan together, like we could always rely on each other to plan, um, effective, you know, intervention time. And then we would come back together and kind of share what we did. Um, and then we would often share our plans so that they could be re-used. You know, if I was planning a lesson with adding by place, then in four weeks, when the low group is finally at adding by place, there's no reason for that teacher to reinvent that.

Rachel stated in her interview that teachers from PLC1 "make a general plan together" and then they relied on each other to further plan on their own. Then they would come back to the PLC and share what they had done. Her comment aligns with my observations of their PLC meetings because I did observe the teachers as they created an overall plan together for each group, and then at the follow-up meeting they reflected on what they had implemented based on their continued individual planning.

When asked how they could improve at their planning process, three of the four teachers from PLC1 reported that they would benefit from spending more time on planning together. These teachers said that there was too much time in between their PLC meetings for which the purpose was planning. Below is Cathy's comment in which she reported her need for more time for planning together as a PLC.

> Cathy: I would like (in a low voice) - people are going to hate me but, I know me personally I would like a PLC planning session, like right now our PLC's are more geared towards analyzing and everything. But we don't sit and plan together. But when we went to the LFS[3] trainings and that was our sole purpose was to plan a unit. It went so much faster and easier because our group we are cohesive together. So we just all sit and we say okay, this is what were going to do and how about this dah dah dah dah. But we don't actually have like the time to just sit and plan.

Cathy reported that she wanted more time to plan together as a team. She stated that they did a lot of analyzing of students' thinking, but they did not get enough time to sit and plan together. She also shared a time when her team had a set time when the specific purpose was to plan and she reported that it was "faster and easier" during that

[3] LFS is an acronym for Learning-Focused Solutions. This is a structure used for planning.

time. If three out of the four teachers from PLC1 stated that they could improve by having more time to plan together, I interpret this to mean that they found their PLC meetings beneficial when their purpose was planning. This aligns to what I observed as I found that teachers from PLC1 were more productive in the RTI problem-solving process which included planning.

All four teachers in PLC1 agreed with my observations of their planning process. In the interviews, I described a brief overview of what I observed in their PLC meetings.

They would create a general plan together by discussing specific resources or ideas for a particular group of students' thinking, unpack the intervention and talk about how to implement it, and then plan the specific details on their own. After the intervention was implemented, the teachers would come back together to share and reflect on the intervention's effectiveness. Although they all agreed with my perception of how they plan in their PLC meetings, one teacher stated that she would like to do this planning process more frequently.

Teachers who are members of PLC1 described perceptions of their effectiveness at planning instruction that aligned with my observations of their PLC meetings. The interview data confirmed my observations of their PLC meetings and the teachers described ways to improve that suggests they would like to engage in the RTI problem-solving process more frequently to plan together. This evidence supports my findings for Research Question 1b that states PLC1 was overall more productive as they engaged on the RTI problem-solving process. It connects to that finding because these teachers were aware of the process they went through as they planned instruction, they described ways to improve their planning, and wanted to plan together more frequently.

PLC2. When asked about their effectiveness at planning, teachers who are members of PLC2 reported an overall perception that they were weak in planning collaboratively together as a team. Two teachers explicitly stated that either planning was not their strength or that it could be better. These two teachers shared that most of their planning was done independently after they analyzed the data as a PLC. One of these two teachers also reported that the team could benefit from planning together more frequently.

> Matt: I think that that is a place where we could use some strength. I think that we could use a little bit of work on the planning instruction just because – not as individuals, but as a group. Because um, I think a lot of times we look at the issue, and then we say ok um, these students need to do – this is what they need to be able to do and the sometimes we kind of just leave it there in PLC. Like, I think that it would be better if – it would be nice if we were able to say, this is the issue, here are some resources we have to address that issue.

Matt's comment indicated that the teachers from PLC2 could use more strength in terms of planning. He reported in the interview that they look at what the "students need to do" during PLC meetings and stop there. He implied that teachers from PLC2 plan individually and would benefit from planning together as a group. A third teacher shared in the interview that she didn't feel they planned as a PLC at all. And finally, a fourth teacher stated in her interview that members of her team would bring resources, such as websites or handouts, to pass out to the other teachers, which indicates sharing rather than planning.

When asked how they could improve their process of planning, teachers who are members of PLC2 reported that they could improve their planning process by having a master list of resources to pull from, by having more time to plan out lessons together, and by having less "busy work" tasks to complete during their PLC meetings. Below is one example of a teacher's suggested improvement for planning.

> Lisa: I wish that we could work on writing the ALPs[4] together. And working on the maps together and um I wish that it had been more inclusive.

Lisa's comment aligns with Matt's previous statement about needing to plan better together as a group. She reported that she wished the planning had been more inclusive rather than done individually. Her response aligns with my observations of their PLC meetings, as I did not observe teachers from PLC2 do any planning together.

All four teachers in PLC2 agreed with my observations of their PLC meetings with regard to planning. In the interviews, I described a brief overview of what I observed in their PLC meetings. I observed the teachers sorting students based on their

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[4] ALP is the acronym for an acquisition lesson plan. It is a planning template used in this district.

scores and placing them into groups, but I did not observe any planning. One teacher stated in the interview that they basically planned independently once they divided students into groups. Another teacher shared in the interview that there wasn't enough time for planning. Her comment from the interview is below.

> Jeanine: Yeah, exactly because there's not enough time for all of us to sit and say I'm gonna use problem of the week for Math Forum or...

In her interview, Jeanine simply stated that there was not enough time for her team to plan together. There was not much discussion that followed after the teachers agreed with my observations of their planning, or lack of planning.

Overall, teachers who are members of PLC2 reported that planning was weak for them, which aligned with my observations and findings from their PLC meetings. Many of the teachers from PLC2 stated that they could improve by spending more time planning together as a team. This evidence supports my finding for Research Question 1b that PLC2 was less productive as they engaged in the RTI problem-solving process as they did not advance to the planning stage.

Summary of Teachers' Perceptions

The evidence presented from the interview data confirms my earlier findings for Research Question 1b that teachers in PLC1 were more productive as they engaged in the RTI problem-solving process and teachers in PLC2 were less productive as they engaged in the RTI problem-solving process. There were four findings based on the interview data presented here in support of my observations of PLC meetings for

PLC1 and PLC2. First, teachers who are members of both PLCs perceived that they used the Universal Screening Tool (UST) data in two ways: 1) to understand students' thinking and 2) to group students for intervention. With regard to their use of the UST data, teachers from PLC1 talked more descriptively during interviews, while teachers from PLC2 talked less descriptively during interviews about the ways in which they used the UST data. These differences in their talk during the interviews aligned with my observations of their more and less descriptive talk during their PLC meetings.

Second, teachers from PLC1 articulated their RTI problem-solving process to align targeted interventions to students' thinking in interviews in ways that were similar to what was observed in PLC meetings. These descriptions align with my observations of their PLC meetings because I observed the teachers in PLC1 move through the stages of the RTI process of defining a problem, analyzing the problem, designing and implementing a plan, and reflecting on the implemented plan. These teachers' perceptions support my earlier finding for Research Question 1b that this PLC was more productive as they engaged in the RTI problem-solving process.

Teachers from PLC2 generally described their RTI problem-solving process interviews in ways that were not similar to what was observed in PLC meetings. Only a subset of the teachers from PLC2 (two of the four teachers) was able to describe the RTI problem-solving process as they perceived it. Having only two teachers attempting to describe the process supports my earlier finding for Research Question 1b that teachers in PLC2 were less productive.

Third, teachers who are members of PLC1 reported perceptions of their effectiveness at analyzing and describing students' thinking that aligned with my observations of their PLC meetings. The interview data confirmed my observations of their PLC meetings and the teachers described ways to improve their data analysis that suggests they would like to engage in the RTI problem-solving process more frequently with other data sources. This evidence supports my findings for Research Question 1b that states PLC1 appeared to be more productive overall as they engaged in the RTI problem-solving process. These teachers were aware of the process they went through as they analyzed students' thinking, they described ways to improve their process, and they wanted to use the process more frequently to better understand students' thinking.

Teachers in PLC2 reported perceptions of their effectiveness at analyzing and describing students' thinking that differed from my observations of their PLC meetings. Some teachers reported in the interviews that they used student's work as a part of their data analysis, which did not align with what I observed. Although two teachers provided ways that PLC2 could improve their process of analyzing students thinking during the interview, two teachers could not identify any suggestions for improvements. Several teachers from PLC2 agreed with my PLC meeting observations, but also reported in the interview that they had previously used the UST data along with students' work as part of their analysis, which was contrary to my observations.

Finally, teachers who are members of PLC1 and PLC2 reported different perceptions about their effectiveness at planning for instruction, and all teachers in both PLC1 and PLC2 verbalized in the interviews that my observations of their PLC meetings in terms of planning were accurate. Teachers who are members of PLC1 reported that their planning was effective, which aligned with my observations of their PLC meetings. The interview data confirmed my observations of their PLC meetings and the teachers described ways to improve their planning that suggests they would like to engage in the RTI problem-solving process more frequently to plan together. Many of the teachers from PLC2 stated that their planning was weak, and that they could improve by spending more time planning together as a team. This evidence supports my finding for Research Question 1b that PLC2 appeared to be less productive as they engaged in the RTI problem-solving process.

Teachers' awareness or lack of awareness about their interactions with the UST data and engagement in the RTI problem-solving process can be important. If teachers recognize when they are engaging productively in the process and are using more descriptive talk, they experience enough benefits so that they do so even more frequently. It might also inspire them to help their colleagues engage more descriptively and productively in the process during PLC meetings. It is more worrisome if teachers do not recognize when they exhibit less productive engagement or less descriptive talk. They may think they are engaging in the process in productive ways and may not see any need for improvement. Having another person sharing his/her perspective may provide some insights to teachers that they may not have seen for themselves. If teachers are not aware of a need for improvement they may continue engaging and interacting in similar ways with little or no growth over time. This would ultimately impact students' learning when teachers are not engaging in a process productively to design instruction that targets students' thinking.

Chapter 7

TEACHERS' USE OF RESOURCES

Research Question Three: How do teachers use resources to plan for targeted instruction aligned with students' mathematical thinking?

a. What resources do teachers seek out and use to plan for intervention instruction targeted to students' thinking in more and less descriptive ways?

Introduction

In this chapter I will present the findings for Research Question Three; for this research question I used the term "resources" to describe what teachers consult when planning intervention instruction. This included curriculum materials, instructional strategies or tools, websites, or even people. As part of this research question, I did not include the Universal Screening Tool as a resource because that was a resource for understanding and describing students' thinking. The resources I am referring to in Research Question Three are instructional resources for planning. I wanted to learn more about the resources that teachers consulted while planning because I wanted to know what they value as a PLC. If they consult some resources more regularly than others, it might mean that they value these resources and will use them more. I want to ensure that teachers have the resources they need to plan effective instruction. If there are important resources that teachers do not find useful, or that they do not use regularly, I need to determine if and how they should be used in the future. Additionally, teachers' use of more and less descriptive talk while consulting or referencing resources might provide insights into how well the teachers understand the resources and the connection to students' thinking in order to implement the intervention effectively. Learning more about what resources teachers are currently consulting will help me use that information to make decisions about resources in my district.

Based on my PLC observations and interviews with the eight teachers, I have three significant findings that I will briefly describe as an overview; later in the chapter, I will present them in more detail with supporting data. For Research Question Three, I analyzed the transcripts of three PLC meetings from each team. I did not analyze the last PLC meeting transcript from PLC1, as their purpose was to reflect on what they had planned and implemented. The evidence for these findings will be presented with supporting evidence from the transcripts of these PLC meetings and from the transcripts of the interviews.

First, teachers in each PLC utilized a variety of instructional resources for planning targeted instruction. These resources were part of three categories: district-provided curricular resources, curricular resources not district-provided, and human resources. This finding was not surprising because teachers were familiar with the purposes and uses of these resources. What was more surprising about this finding was the explicit reference to the math coach without prompting during the interviews when teachers were asked about the planning resources that would be beneficial to them in general. I interpret their spontaneous and explicit reference to the math coach to mean that they value having the coach as a resource or support while planning during their PLC meetings. In general, teachers used the resources I expected to see them using when planning targeted instruction.

Second, I compared each PLC in terms of how frequently they referenced particular resources while talking about planning; overall, teachers in PLC1 referenced resources while planning intervention instruction more frequently than teachers in PLC2, teachers in each PLC appeared to reference resources while planning more or less frequently based on their access to these resources and their engagement in the RTI problem-solving process. I use the term 'reference' to mean instances when teachers verbally name or consult a resource within a conversation thread or single comment. If a resource was mentioned multiple times to target a need within one conversation thread or comment, I considered this one reference. If a resource was mentioned multiple times, but for different targeted needs or in different conversation threads or comments, each time was a different reference. While planning intervention instruction, teachers referenced resources more frequently when they had regular access to them and when they engaged more productively in the RTI process. While planning intervention instruction, teachers referenced resources less frequently when they had less access to them and when they engaged in the RTI process less productively.

Finally, when I compared each PLC in terms of the nature of descriptive talk they used when talking about resources, teachers in PLC1 used more descriptive talk when talking about resources as compared to teachers in PLC2. As teachers in PLC1 referenced resources while planning, they talked more descriptively by making connections between the resource and the students' thinking being targeted. As teachers in PLC2 referenced planning resources, they talked less descriptively by briefly referencing resources using broad language and without making connections between the resource and students' thinking. This is important because teachers who could talk more descriptively about their resources suggests that they were more aware of how that resource could help them plan instruction targeted to their students' thinking.

Which Resources Did Teachers Use While Planning?

Teachers in PLC1 and PLC2 at Turner Elementary School used three types of resources as they planned instruction targeted to students' thinking: district-provided curricular resources, curricular resources not provided by the district, and human resources. Each type of resource will be elaborated upon with supporting evidence below along with an overview in Tables 21, 22, & 23.

District-provided curricular resources. As teachers planned instruction targeted to students' thinking, they turned to curricular resources that the district provided to them. There were five district-provided curricular resources explicitly referenced in the observed PLC meetings that teachers discussed as they were brainstorming or planning interventions: *Number Talks, Investigations*, *Common Core State Standards*, *The Math Forum*, and *Do the Math*. Table 21 below provides an overview of the district-provided curricular resources.

Table 21 *Curricular Resources Referenced in PLCs that are District Provided*

Type	**Name of Resource**	**Description**	**Example**
Curricular Resources – district provided	Number Talks	This is a book with a collection of Number Talks that are targeted to building fluency and mental math at each grade level.	"Matt: We might be able to, um are there any *Number Talks* with multi-step like that?"
	Investigations	This is the instructional resource for core instruction. It is a set of curriculum materials that includes teachers' manuals, student activity books, and assessments for teachers to teach mathematics to heterogeneous groups of students. These materials are leveled by grade.	"Molli: What's the game that you guys had in *Investigations*? Rachel: Close to 100? Molli: Where it's adding tens and ones? When you get to flip the cards? All say: Capture 5."
	Common Core State Standards	This is the set of standards that teachers must use to plan instruction. Each teacher has a booklet with the standards.	"And use the back of the Common Core book for the different types, too. 'Cause missing addends is huge."

Table 21 (Continued)

Type	**Name of Resource**	**Description**	**Example**
Curricular Resources – district provided	Math Forum	This is an online collection of contextualized problem-solving tasks.	"Matt: Ok, then let's do a group that's already skilled, required, or – Melissa: We can push with the Math Forum with the multi-step, multi-operations."
	Do the Math	This is an intervention program the math coach uses with Tier 3 students. It is a set of intervention modules that address four main number concepts, addition & subtraction, multiplication, division, and fractions. This is intended for use with small groups of students, but Molli also shares games or activities with the teachers to use with lots of students.	"Molli: I will also give you the, um, *Number Core* book from *Do the Math*. Jessica: Ok. Molli: Which will probably give you some ideas. You and I can sit down and talk about those needs. 'Cause that will, I love the way she puts the verbiage together and how you ask them and how you show them."

First, *Number Talks* is a book that is a supplemental resource that was provided by the district to all teachers to help students build the mental math and computational fluency goals as outlined in the standards. This book contains a series of mini-lessons for each grade level, K-5, for essential number concepts. It also includes informational reading about how to perform a *Number Talk*, the purpose of *Number Talks*, and conceptual understanding that supports the number concepts. Additionally, there is a DVD that contains sample *Number Talks* that were implemented in other classrooms so teachers can see them in action. Teachers referenced this resource frequently as they planned instruction targeted to students' thinking. The example below represents an instance of when teachers were analyzing and describing students' thinking based on the UST data, which sparked an idea for an intervention resource.

> Matt: We might be able to, um, are there any *Number Talks* with multi-step like that? Most of 'em are pretty much…
>
> Melissa: More mental math
>
> Matt: Yeah.
>
> Amy: And they break apart numbers.
>
> Matt: Yeah. (Line 244-253)

Teachers in PLC2 were discussing intervention ideas for students who were struggling to solve multi-step problems and wondered if *Number Talks* would be a source for those types of problems. They were just brainstorming ideas at this point and were talking through whether this resource would be something worthwhile to look into for targeting multi-step problems. They did not fully unpack this resource to make a final decision, as that was not the purpose of the meeting. Since Number Talks targets number concepts to build fluency and mental math, the team moved on to the next resource idea.

Second, teachers mainly referenced their core curriculum resource, *Investigations*, to use games from within their grade level or previous grade levels to adapt for a particular need they had targeted based on students' thinking. *Investigations* is a set of curriculum materials that includes teachers' manuals, student activity books, and assessments for teachers to teach mathematics to heterogeneous groups of students. These materials are leveled by grade and provide opportunities for differentiation of instruction. Sometimes teachers use a game or activity from *Investigations* and adapt it for intervention to target students' thinking. Below is one example of the ways in which teachers referenced a game or activity from their core resource in order to find ways to adapt it to align to a targeted need.

> Molli: What's the game that you guys had in *Investigations*?
>
> Rachel: Close to 100?
>
> Molli: Where it's adding tens and ones? When you get to flip the cards?
>
> All say: Capture 5.
>
> Kerri: Are you talking about with the dimes and pennies?
>
> Rachel: Capture 5 is they either have like plus/minus 10, 20, 20, or 1, 2, 3. And they have to know that if I'm-
>
> Jessica (talks over): What their jump is. (motions hands on the hundred chart)
>
> Rachel (continues): If I'm doing minus or plus 10, 20, 30, I'm moving vertically on the hundreds chart. If I'm doing 1s, 2s, 3s, it's Capture 5 (motions horizontally). (Line 71)

This conversation thread above represented an initial brainstorm for a group of students who were struggling to use the number line for adding and connecting it to place value. The teachers identified a game the students have played before using the hundreds chart. In the next PLC meeting, the teachers decided to use this game and adapted it to have the students spin a spinner and use a number line to show how they added the numbers rather than the hundreds chart.

> Molli: So we'll wanna do these (spinners) and your Capture 5 game. And have those conversations about what happens to the number when you're adding ten and multiples of ten. And then, like what you just said. Show them the number line and how this can work. (Line 468)

They considered this game because it could be easily adapted from using the hundreds chart to having the students use a number line to record their solutions. Molli also suggested the use of spinners for this intervention to differentiate the game for different levels of learners. The spinners each had different sized numbers to add allowing for students to find sums with numbers of different sizes and place values.

Third, the *Common Core State Standards* (CCSS) are the new standards recently adopted by the State of Delaware, and each teacher was provided with a hard copy in a booklet form to use for planning instruction. The CCSS are organized by grade level for the elementary grades and includes supplemental information in the appendix. The consultant and the math coach, rather than the teachers, were the ones who referenced this curricular resource during the observed PLC meetings as shown below.

> Molli: And use the back of the Common Core book for the different types, too. 'Cause missing addends is huge. (Line 1137)

The CCSS were mainly referred as a source of information for thinking about and planning core or intervention instruction. References to the CCSS were based on teachers' need to understand the critical areas of focus for a grade level or the types of problems students should encounter at a grade level. Molli referenced the CCSS book to alert the teachers' attention to the supplemental information provided in the appendix of the standards document so that they were aware of this information to meet the needs of all of their students.

Fourth, *The Math Forum* is an online resource for which the district has provided a membership to all math teachers in grades 4 – 12, while teachers in grades K – 3 can also gain access upon request. This resource includes contextual, problem-solving tasks and problem-solving strategies for teaching mathematics. Teachers mainly view this as a resource they can use for students who are stronger in mathematics and is often referenced it for use with their "higher" students.

> Matt: Ok, then let's do a group that's already skilled, required, or –
>
> Melissa: We can push with the Math Forum with the multi-step, multi-operations.
>
> Matt: And with that group I think we should push perseverance. That we should use some of those perseverance problems, multi-step.
>
> Lisa: I agree. (Line 404)

In the transcript above, teachers referenced the Math Forum as a resource for their students that were "already skilled" at solving multi-step problems. They wanted to use the Math Forum problems to target perseverance for the students they identified as being competent for their area of focus. This resource was only referenced by teachers in PLC2, as they had the most access to the materials for a longer period of time.

Finally, *Do the Math* is a resource that can be used for many purposes, but our primary use is for intervention support. Each school has only one set of the materials and the intervention modules address four main number concepts, addition & subtraction, multiplication, division, and fractions. *Do the Math* includes teachers' manuals with scripted lessons, student workbooks, and manipulatives for each module. This resource is intended for use with small groups of students and is often delivered by the math coach, but Molli also shares games or activities that can support the teachers as they plan for targeted instruction.

> Molli: I will also give you the, um, *Number Core* book from *Do the Math*.
>
> Jessica: Ok.
>
> Molli: Which will probably give you some ideas. You and I can sit down and talk about those needs. 'Cause that will, I love the way she puts the verbiage together and how you ask them and how you show them.
>
> Jessica: And that's all in the book?
>
> Molli: It's all in the book. (Line 48 – 58)

This piece of the transcript above was an instance of when Molli shared one of these modules with a teacher who was planning for intervention. Jessica was planning intervention ideas for the group of students who struggled with understanding tens, and the *Number Core* module focuses on composing numbers up to ten. This module precedes addition and subtraction, which was a fit for the group that Jessica was targeting.

The district provided all of the five curricular resources above, and all teachers have access to them either directly or through their math coach. It was not surprising that these five resources were explicitly referenced during PLC meetings as each of these resources are well-known by teachers and are utilized frequently for instruction. One resource that was not mentioned in any PLC meetings was *Center Stage*. *Center Stage* is an intervention resource that includes games and activities that target concepts by grade level. It was surprising that teachers did not refer to this resource while planning because teachers have each had their own set for several years and the games and activities had been aligned to each core instructional unit and concept. Although it was not referenced while planning during PLC meetings, several teachers did reference the *Center Stage* kits as a resource for planning during interviews.

Curricular resources not district-provided. As teachers planned instruction targeted to students' thinking, they also turned to resources that were not provided by the district. These resources mainly stemmed from three different sources: teacher-created activities, websites, and activities suggested by the consultant. Table 22 below provides an overview of the sources for resources that teachers referenced while planning instruction that was not provided by the district.

Table 22 *Curricular Resources Referenced in PLCs that are Not District-provided*

Type	Source of resource	Description	Example
Curricular Resources – not district provided	Teacher created activities	Activities such as a discussion were often suggested as the resources for an intervention with purposeful questioning.	"Build those numbers, talk about those numbers, what happens when we have a number over ten? Or over 9? And what do those two digits stand for?" "They need to see it and have that conversation. What happens when we multiply 3 by 10? What happens to that number? What happens when we times 5 by 10? "
	Activities suggested by outside consultant	Teachers referred to activities or strategies that were suggested by the consultant during her PLC visits.	"Jessica: Is it the one where you're saying use the index card like Kris did? Where they expanded them out? Molli: That would work, too."
	Websites	Teachers might refer to a website as a resource for planning instruction.	"There's a Common Core Math, a Common Core site."

The first source for resources that were not district-provided that teachers refer to while planning instruction is any activity that is teacher-created such as a discussion or other instructional strategy or tool. A discussion was viewed as a resource because the coach or other colleagues shared possible questions that can be asked during a discussion that might target a student's thinking. Below, Molli describe an intervention idea that would be a teacher-created discussion.

Molli: So they need a conversation about what happens when you add a ten. Not when you add a ten, this is the answer. I'm not gonna count by ones, they need to add tens and then look at it. I added ten to each one of these numbers. What happened? How did those number change? (Line 68)

The teachers in PLC1 were planning interventions for each group of students they had created based on students' understanding of place value for addition. The group that Molli discussed here struggled to understand place value including understanding that ten ones make a group of ten and how groups of ten affect the value of a number when added to it. She described a discussion as an intervention suggestion that the teachers would implement with students. She provided explicit suggestions for questions that could be asked of students during that discussion. This was just one example of an intervention idea that was teacher-created rather than coming out of a book, the internet, or other already created source.

The second source for resources that were not district-provided was any activity that was suggested by an outside consultant. The consultant attended PLC meetings at Turner Elementary three times this school year. During each visit she provided suggestions for core and intervention that would help teachers as they planned instruction that was targeted to students' thinking. Below is one conversation thread during which the teachers used the consultant as the source for an intervention idea.

Jessica: Is this the one where you're saying use the index card like Kris did? Where they expanded them out?

Molli: That would work, too.

Rachel: No, these are the kids that think about the digits individually and wanna do the algorithm…

Molli: And they need to do expanded form. They need to know what those numbers stand for.

Jessica: So that was that activity that she did where she took 62 and she brought it out. (motions expanding the index cards with her hands).

Molli: But they can probably start with 2 digit numbers to see something that they're- and low 2 digit numbers. Something that they're familiar with. (Line 148)

In this conversation thread, Jessica remembered an intervention activity that the consultant had shared with them in a previous PLC meeting. This was a place value activity where students used index cards of different sizes to compose and decompose numbers using the expanded form of the numbers. Jessica referenced the consultant by name and described the activity that Kris had suggested.

The third source for resources that were not district-provided included websites. Websites were not referenced frequently and did not include any specific connection to the students' thinking. One example was the conversation thread below from PLC2.

Nordie: There's a Common Core Math, a Common Core site.

Matt: With problems.

Lisa: You know, to use the same kinds of problems and then just adjust the numbers.

In this instance, teachers in PLC2 were brainstorming intervention ideas to help students with solving multi-step problems. A special education teacher, Nordie, referenced a math website related to the common Core State Standards. This site was referenced without including the exact name of the website and without a reason why this site would be a source for interventions.

Human resources. Finally, teachers utilized human resources as they planned instruction targeted to students' thinking. Human resources included the math coach, the consultant, or colleagues. Table 23 below provides an overview of the human resources that were referenced by teachers during PLC meetings.

Table 23 *Human Resources Referenced During PLC Meetings*

Type	**Resource**	**Description**	**Example**
Human Resources	Math Coach, Consultant, or Colleagues	The people that teachers turn to as they plan instruction targeted to students thinking.	"Cathy: Would it be a good idea to play like a Capture 5 and Capture 3 but instead of doing 300-600, do it with (inaudible)? Molli: Absolutely. "

One instance for when a teacher used a human resource is in the piece of the transcript below:

Cathy: Would it be a good idea to play like a Capture 5 and Capture 3 but instead of doing 300-600, do it with (inaudible)?

Molli: Absolutely.

Rachel: Yeah, I was just thinking I would give them the cards but I'm not gonna give them the chart.

Cathy: 'Cause I remember for one of 'em I did, I used sentence strips because they had that long line on the backside and that's the number line they used to show…

Molli: Well, it can't hurt to have the hundreds chart, but let's match it with something on the number line. Absolutely. Like, what did you just do? How could you show that on the number line? 'Cause that links it directly. (Line 641)

Cathy sought advice from the math coach, Molli, and her colleagues for ways to adapt a game for an intervention idea. Cathy asked a question during the PLC meeting about how to adapt the Capture 5 game, and Rachel and Molli provided feedback to her. During the interviews, three teachers, two from PLC1 and one from PLC2, also explicitly referenced the math coach as a resource that they would benefit from having at all of their PLC meetings. Below is one example from Cathy:

Cathy: Um, I would like our math coach to be present at all of them if she could, if she could. Because like she has the best ideas, because she has gone, she's been in grades above, she's been in grades below, she's been in and out of other grades and she can kind of help guide us in our thinking of which direction or what planning or other interventions that

> we maybe haven't even seen because that's something they do in first grade or something they do in fifth grade.

This was a surprising piece of data because the question that was asked referred to the term "resources" and not specifically human resources. These teachers referred to the math coach as a resource spontaneously and unprompted by the researcher. So these teachers perceived the math coach as resource during the interview without prompting. Here, Cathy reported that Molli had a wide range of knowledge spanning multiple grade levels and that she had ideas to help them as they planned interventions.

Review of the types of resources teachers referenced. There were three types of resources that teachers referenced during PLC meetings district-provided curricular resources, curricular resources not provided by the district, and human resources. The five district-provided resources that were referenced during PLC meetings were not a surprising finding as teachers have access to these materials and are fairly familiar with their purpose and uses. It was surprising that teachers did not turn to the *Center Stage* kits as they planned for intervention during PLC meetings, but several teachers referenced them during the interviews. The three sources of resources that were not provided by the district were also expected findings as they included teacher-created intervention ideas, the consultant, and websites. All three sources were familiar to teachers and were easily accessible.

Finally, human resources were either implicitly or explicitly referenced. During PLC, the references to human resources were more implicit as teachers sought the advice of the math coach, colleagues, or the consultant. During the interviews, the references to the math coach were explicit as teachers reported that Molli would be a beneficial resource to have in all of their PLC meetings. This was a surprising finding as the teachers were not asked about her specifically in the question, but were asked about the types of resources that would beneficial to their PLC in planning instruction.

How Frequently Did Teachers Talk About Resources While Planning?

Teachers in each PLC referenced resources for planning instruction at different frequencies. Teachers in PLC1 referred to *Number Talks* and their own teacher-created resources more than other resources for planning instruction while teachers in PLC2 referred to *Number Talks* and *The Math Forum* more than other resources. This was not surprising as all teachers have their own *Number Talks* book and are strongly encouraged to use these on a regular basis. Additionally, teachers in PLC2 have had access to the *Math Forum* for longer than the teachers in PLC1 so it was also not surprising that this resource was the most frequently referenced by teachers in PLC2. What was surprising was that teachers in PLC1 referred to *Number Talks* three times as much as teachers in PLC2.

Table 24 shows the number of times a resource was referenced as part of a different conversation thread about that particular resource. As shown in the table below, teachers in PLC1 referred to *Number Talks* 12 times and their own teacher-created resources 17 times, which were both much more frequent than any other resource. Additionally, teachers in PLC1 referenced resources at a much higher frequency than teachers in PLC2. This appeared to be the result of the productiveness of each PLC as they engaged in the RTI problem-solving process. PLC1 was more productive as they engaged in this process and moved to the planning stage and beyond. Therefore, they referenced several resources while planning in Stage Three. PLC2 was less productive in the process and did not move to the planning stage or beyond. Therefore, they referenced resources less frequently.

Table 24 *Frequency of References per Resource for each PLC*

Resource	PLC1	PLC2
District-Provided		
Number Talks	12	4
Investigations	4	1
Standards	6	1
Math Forum	0	5
Do the Math	1	1
Not District Provided		
Teacher Created	17	1
Consultant	4	0
Websites	0	2
Human		
Coach, Consultant, Colleagues	6	2

Teachers in PLC1 explicitly referenced the math coach as a resource during PLC meeting discussions. During the observed PLC meetings, teachers in PLC1 asked questions of their math coach and mentioned resources she had shared with them. Of the six times human resources were referenced in PLC1, four of them included the math coach, Molli. Below is one of the four instances:

> Kerri (talking to Molli): Well, you did give us stuff and you told us to make sure we're putting our number lines in more than one. (Kris: ok) She did tell us that when we were planning our fraction unit. And I did see question today on the DCAS where it was like one, zero to three and it was between 2 and 3. And the one student was like moved right a long and I was like, yes! (Line 434)

For PLC2, the math coach was only present for PLC2a, the first meeting. Molli was not one of the two references to human resources made by the teachers in PLC2. It appears that PLC2 did not draw upon the expertise of the math coach as frequently as they did not have as much access to her within their PLC meetings.

Teachers in each PLC referenced resources more or less frequently based on their access to these resources and their engagement in the RTI problem-solving process. Teachers referenced resources more frequently when they had access to them such as Number Talks for PLC1 and PLC2 and the Math Forum for PLC2. When teachers had less access to a resource, it tended to be referenced less frequently such as the math coach for teachers in PLC2. Overall, teachers in PLC1 referenced resources more frequently as they moved more productively through the stages of the

RTI process, ultimately getting to the planning stage and beyond. In total, teachers in PLC2 referenced resources less frequently as they moved less productively though the stages of the RTI process, and not getting to the planning stage.

How Descriptively Did Teachers Talk About Resources While Planning?

Teachers in PLC1 talked more descriptively about the resources they referenced, while teachers in PLC2 talked less descriptively about the resources they referenced. Teachers in PLC1 made connections between the resources referenced and how they targeted students' thinking. As teachers in PLC1 referenced and discussed possible resources for planning instruction, they often made connections to the specific mathematical need being targeted. It is important for teachers to understand how a resource may or may not target students' thinking. If they talk more descriptively about the resource, it may help them to uncover how the resource does or does not target the students' thinking. If teachers talk less descriptively about the resources, they may not determine how it does or does not target the students' thinking. Then they may be providing an intervention to a student that is not helpful in advancing their thinking forward in the learning progression. Below is an excerpt from the transcript of PLC1c in which teachers referenced the *Number Talks* resource.

> Molli: So how could we get them from here to numbers? Like what would the goal of your *Number Talk* be?
>
> Cathy: Well the goal is to get them to… to understand that strips represent 10 whatever we're discussing. You know what I mean? If

they have 3 strips it means they have 3 tens, 3 sets of ten.

(Molli writes on the smart board)

Jessica: So writing the numbers underneath of it.

Rachel: And then hopefully they'll go, 'Oh, I put all the tens together. That makes 30.' (Line 319)

The teachers were planning an intervention to move students from a less efficient addition strategy, strips and singles, to a more efficient strategy, using place value. They have decided to use a *Number Talk* and planned the discussion that would help the students become more efficient when adding. As the teachers referred to the resource, they tried to connect the use of the resource to the specific mathematical thinking of the targeted students by discussing the goal of the intervention.

In contrast, teachers in PLC2 often referred to resources on a broader level looking for ideas to help students with solving multi-step problems. The references to resources did not include discussion about what specifically the students struggled with when solving multi-step problems. Below is one conversation thread from PLC2b where teachers were brainstorming ideas for resources for helping students with multi-step problems.

Melissa: So then what would we use…

Lisa: I haven't looked, but that iXL… (iXL is a website for students to practice skills)

Matt: I bet you there's some good stuff on – I'm sure there's some good stuff on Math Forum. I bet you there's a section of stuff on multi-step, multi-problem…

Melissa: So even for the lower ones?

Matt: Probably. We can look and see. I mean, there might be some third grade stuff.

Melissa: That’s true. So Math Forum. What else could we use?

Lisa: Or we could take the problems and make the numbers smaller.

Nordie: There’s a Common Core Math, a Common Core site.

Matt: With problems.

Lisa: You know, to use the same kinds of problems and then just adjust the numbers.

Matt: We might be able to, um are there any Number Talks with multi-step like that? Most of ‘em are pretty much…

Melissa: More mental math

Matt: Yeah.

Amy: And they break apart numbers.

Matt: Yeah. (Line 223)

Although several resources are referenced, none are connected to the mathematical thinking for the target group of students. There were four resources referenced in this conversation thread, but there was very little unpacking of the resources. The teachers did not discuss any of the resources in detail and they did not describe how the resource would or would not help address the students’ thinking. It appears that teachers in PLC2 discussed resources less descriptively than teachers in PLC1. When teachers do not connect the resource to students' thinking, they may not be sure it is the right intervention that targets the students' specific need. The students might then receive an intervention that does not help to advance their thinking forward in the learning progression.

Summary of Teachers' Use of Resources While Planning

This research question revealed three key findings. First, teachers in PLC1 and PLC2 referenced three types of resources as they engaged in the RTI problem-solving process during PLC meetings, district-provided curricular resources, curricular resources not provided by the district, and human resources. The five district-provided resources mentioned during PLC meetings were not surprising as they are familiar to teachers and are utilized frequently for instruction. Although teachers mentioned a sixth district-provided resource during the interviews, it was surprising that *Center Stage* kits were not referenced during PLC meetings because each teacher has had one of the kits for several years, and these kits provide games and activities for students that address important concepts at each grade level.

There were three sources for resources that were not district-provided, teacher created activities, websites, and activities suggested by the consultant. Teachers sought out resources that were not provided by the district during their planning discussions in PLC meetings when they described ideas such as an adaptation of a game, a discussion that could be led with students, or some other type of resource that was not on the district curriculum list. Additionally, teachers utilized human resources as they planned for instruction during PLC meetings such as their math coach, their colleagues, or the consultant. These references to human resources were explicit when teachers directly mentioned the person as the resource and implicit when teachers sought the advice of the math coach, colleague, or consultant during the discussion. The math coach was also explicitly referenced during interviews as a resource that would be beneficial to teachers during PLC meetings.

Second, the frequency for which teachers referenced resources for planning differed for each PLC based on their access to these resources and their engagement in the RTI problem-solving process. Teachers referenced resources more frequently when they had regular access to them such as Number Talks for teachers in both PLC1 and PLC2 and the Math Forum for teachers in PLC2. When teachers had less access to a resource, it tended to be referenced less frequently such as the math coach for teachers in PLC2. Overall, teachers in PLC1 referenced resources more frequently as they moved more productively through the stages of the RTI process, ultimately getting to the planning stage and beyond. Teachers in PLC2 referenced resources less frequently as they moved less productively though the stages of the RTI process, and not getting to the planning stage.

Finally, teachers in PLC1 talked more descriptively about the resources they referenced, while teachers in PLC2 talked less descriptively about the resources they referenced. Teachers in PLC1 made connections between the resources referenced and how they targeted students' thinking. In contrast, teachers in PLC2 made general or broad references to resources without unpacking them or making connections between the resources and the targeted needs of the students. Talking more descriptively about the resource and how it targets the students thinking might better ensure that students will receive an intervention that advances their thinking forward in the learning progression. Talking less descriptively about a resource and not connecting it to students' thinking may lead to the students receiving an intervention that is not aligned to their thinking. If the intervention is not targeted to address the students' needs, then it may not help advance the students' thinking forward in the learning progression.

Gaining a better understanding about the types of resources teachers consult, the frequency at which they reference them, and the descriptiveness in teachers' talk about resources will help me to make informed decisions within my district. For example, we have spent a lot of time and money to invest in the *Number Talks* book as a resource for teachers to provide targeted instruction for their student. Each teacher has his or her own book, the math coaches have been well trained to support their teachers, and there have been several professional development sessions offered to support teachers in their use of this resource. It is important for me to have a better understanding of whether teachers find this resource valuable, which teachers are using it, and how well they are using it. For example, when teachers in PLC1 frequently referenced with MD talk and used a resource while planning, they may be more aware of the benefits that resource can provide. This type of information is essential for me to determine if this resource is effective for us as a district, if it was a valuable investment, and if some teachers need additional support in understanding or using the resource. As a district leader, I need to ensure that teachers have the resources they need to plan effective instruction, that they understand how to implement them well, and that they have the additional support needed to be successful.

Chapter 8

DISCUSSION & IMPLICATIONS FOR PRACTICE

The goal of this study was to examine the ways in which teachers in professional learning communities (PLCs) engaged in the Response to Intervention (RTI) problem-solving process for mathematics using student data from the Universal Screening Tool (UST). Through three research questions, my study suggests that being more detailed or descriptive when analyzing and describing students' thinking enables teachers to engage more productively in the other stages of RTI process. It also suggests that using less descriptive talk to analyze and describe students' thinking limits teachers' abilities to engage in the stages of the RTI process productively. The best way to summarize the findings is that teachers must learn to use more descriptive talk as they engage in the first two stages of the RTI problem-solving process to analyze and describe students' thinking, as this can support their abilities to be more productive in the other stages of the process.

Although descriptive talked appeared to correlate with teachers' productive engagement in the RTI problem-solving process in this study, I also argue that descriptive talk can occur independent of this process. Teachers can talk descriptively about students' thinking in a variety of settings. There are many opportunities for teachers to assess students' understandings of a particular mathematics concept in order to inform their instruction. This study focused on intervention instruction through the RTI problem-solving process using the UST data as a basis for analysis, but teachers can and should talk descriptively about their students' thinking using other assessments, as well. Some of these assessments might include district common assessments, formative assessments, homework assignments, and other in-class tasks. Teachers are encouraged to use multiple formats for assessing students' mathematical understandings, diagnosing students' conceptions and misconception, and planning targeted instruction. All of these opportunities are independent of teachers' productive engagement in the RTI problem-solving process. Below is brief description for what I have learned when descriptive talk is embedded in the RTI problem-solving process and correlates with teachers' productiveness in the process.

Productive engagement during PLCs varies according to different stages of the problem-solving process differently. First, prior to participating in the RTI problem-solving process, teachers must come to the first PLC meeting (Stage One) having already completed an individual analysis of their students' data and have determined an initial set of conclusions about which concepts their students do or do not understand. This prior analysis should provide a foundation for teachers as they attempt to define a common problem to address about a particular mathematical concept for students across their classes.

Next, for teachers to engage productively in Stages One and Two of the problem-solving process, they should use more descriptive talk to analyze and describe the nature of students' thinking based on students' work rather than the scores from the assessment data. Based on the students' work, the teacher would define one specific concept as a focus for further analysis. Using the students' work as part of the discussion provides the opportunity for teachers to use more descriptive talk and can help to facilitate a deeper conversation about students' conceptions and misconceptions. More descriptive talk in these two stages would include articulating students' thinking, naming specific strategies that students used, and focusing on the efficiency of the strategies rather than the correctness of the students' solutions. A sign that these discussions were productive would be the creation of several intervention groups based on the similarities in students' thinking about the focus concept.

Productive engagement in Stage Three includes teachers discussing specific details about intervention resources and how these resources might address students' thinking as teachers design a plan for intervention. Teachers would use more descriptive talk in this stage to name a specific intervention resource, to link the resources to students' thinking, and to unpack the intervention resource to understand it and how it can be implemented with students. It would be difficult for teachers to engage in this stage productively if they have not been descriptive as they analyzed and described students' thinking in Stages One and Two of the process.

After implementing the planned interventions, teachers engaging in a productive PLC would bring student work to the next PLC meeting to reflect on the effectiveness of the interventions as part of Stage Five of the process. During this discussion teachers would use descriptive talk to share how the intervention was implemented, reflect on specific students' thinking, and describe next steps for these students within the learning progression. They might also engage in the problem-solving process by repeating some of these stages several times before starting again with a new concept.

This brief reflection describes about what I have learned about productive engagement during PLC meetings for the RTI problem-solving process. Although the ideas presented above are directly related to the findings in this study correlating productive engagement with teachers' use of descriptive talk, I believe there are also other factors may affect teachers' ability to engage productively in the RTI problem-solving process that are independent of their type of talk. First, teachers' preparedness and use of time may also impact their productiveness in the RTI problem-solving process. For example, some teachers might come to the PLC meeting prepared having already done an analysis of their data, come with student work to analyze, and have intervention ideas for targeting students' thinking. In contrast, some teachers might not come to PLC meetings prepared. They might not have analyzed the data or looked beyond students' scores, they might not bring the students' work to the meeting, or they might not have any ideas for intervention.

Another factor could be maximizing PLC meetings to get the most from their time together. For example, some teachers working in PLCs might maximize their meeting time by getting started right away, bringing the necessary materials and data, taking notes, keeping the conversation focused on the goal or purpose, and setting goals/next steps for future meetings. In contrast, some teachers might not maximize their time during PLC meetings by not get started immediately, not having the necessary materials or data, not staying focused on the goal or purpose getting easily distracted by other topics of conversation, or not setting goals/next steps for future meetings.

Lastly, the presence of the math coach may be a factor that influences the teachers' productiveness in the RTI Problem-solving process. For example, to help a PLC be more productive the math coach may be able to help facilitate the conversation, provide insights into the learning progression across grade levels, or share resources that might target students' thinking for intervention. If the math coach is not present, the teachers may not be able to facilitate the conversation themselves or they may not have the breadth and depth of knowledge of the learning progressions or the available resources. It might also impact the productiveness of the PLC if the math coach is able to participate in their discussions on a regular basis or if the participation is sporadic. Each of these other factors could impact the productiveness of the teachers' engagement in the RTI problem-solving process that are independent of their descriptive talk. Although these factors were not the focus of this study, they may be just as important to study in future research to determine the impact they each might have on teacher's productive engagement.

It is important for teachers in PLCs to be aware of what it means to engage productively in an RTI problem-solving process so that they can challenge themselves and their colleagues to strive for productive engagement in their own PLC meetings for math RTI. Additionally, being aware of their own productiveness as they engage in the problem-solving process can enable teachers to self-reflect and self-correct if they find that they are becoming less productive. If teachers lack awareness about their own productiveness in the problem-solving process, they may not see a need for improvement or professional growth, which could ultimately mean less student growth.

Viewing Findings in Light of Prior Research

Using this problem-solving process for RTI in mathematics is relatively new to teachers, so I wanted to study the ways in which they were attempting to engage in the process. Studying how teachers engaged in this process provided new insights to better understand how to help them fully implement the RTI framework and the problem-solving process in the future. Here, I present my finding in light of prior research that has been completed.

RTI problem-solving process. Using a problem-solving approach to determine students' needs for intervention is described and often recommended in research relating to the implementation of an RTI framework (Tilly, 2008; Hall, 2008; NASDSE, 2005; Brown-Chidsey & Steege, 2005). The teachers in this study engaged in a 5-step RTI problem-solving process that included the following stages: 1) Define the problem, 2) Analyze the problem, 3) Design a plan, 4) Implement the plan, and 5) Evaluate the effectiveness of the plan. These five stages parallel many other problem-solving models found in research. For example, in the problem-solving model recommended by Brown-Chidsey & Steege (2005), there are five steps that are very similar to the five stages enacted by the teachers in this study. There are only minor differences in the wording. Other researchers such as Tilly (2008) provide a problem-solving model for RTI but combine or eliminate steps leaving only four stages of the process. Tilly's model uses language similar to that in the process I have defined for Edgewood School District, but combines Stages 3 and 4 together leaving only four steps in his model. Table 25 below provides an overview of the stages in these different, but similar problem-solving models.

Table 25 *Side-by-side Comparison of Problem-solving Models*

	Edgewood School District	Brown-Chidsey & Steege	Tilly
Stage 1	Define the problem	Problem identification	Is there a problem and what is it?
Stage 2	Analyze the problem	Problem definition	Why is the problem happening?
Stage 3	Design a plan	Designing intervention plans	What can be done about the problem?
Stage 4	Implement the plan	Implementing the intervention	
Stage 5	Evaluate the effectiveness of the plan	Problem solution	Did the intervention work?

Given my reading of prior research, I was aware that a problem-solving model existed as an option for teachers to utilize as they implement response to intervention. However, there was little guidance provided in research about how such a model could be implemented for mathematics, as most research and published books focused on reading RTI. In addition, I had not observed a problem-solving model being implemented in practice officially anywhere, so I had only the experience of reading about it. Even though this problem-solving approach served as a lens for my research, I did not fully realize the potential for this process until I saw it enacted by the teachers in this study and analyzed the PLC meeting observations more thoroughly. Conveniently, my data analysis occurred simultaneously with my district's development of an RTI framework and problem-solving process for mathematics.

Although Hall (2008) did not define stages of a problem-solving model, she did recommend its use within an RTI framework because it focuses on identifying the needs of specific students and therefore produces better results (p. 70). Hall (2008) also described two other big ideas with regard to the problem-solving model that align with some of my findings in this study. First, she states that teachers need to learn to analyze data by going deeper than looking at scores or levels to inform instruction. This idea aligns with my finding that teachers who talked more descriptively when analyzing and describing students' thinking were more productive in the RTI process and those that those that analyzed and described students' thinking using less descriptive talk moved less productively through the RTI process. It also aligns with my finding that teachers who were more productive used students' work as a major part of their data analysis and those who were less productive did not use students' work as a major part of their data analysis. Specifically, less productive teachers used scores to analyze students' thinking.

Second, Hall (2008) states that it is essential for the coach to be involved in helping teachers through the problem-solving process (p. 78) as an expert at data analysis and grouping of students. This idea correlates to my PLC meeting observations for this study. The PLC that used more descriptive talk and moved more productively through the stages of the RTI problem-solving process had the math coach as an active participant in each of their observed PLC meetings. The PLC that used mostly less descriptive talk and moved less productively through the stages of the process had the math coach present for only one of their observed PLC meetings.

Till (2008) provides questions for each stage of the problem-solving model. Although these questions were not asked explicitly as teachers in this study engaged in the RTI problem-solving process, I utilized these questions and other descriptions of the problem-solving model as I developed the model for my district. Tilly (2008) and other researchers provide detailed descriptions and/or further questions to ask within each step or stage of their proposed models that were synthesized in order to create our model for Edgewood School District. A more thorough description will be provided later in this chapter under "Implications for Practice."

Descriptive talk. Teachers' use of more, less, and non-descriptive talk was a key factor in many of the findings in this study. Teacher's use of these types of descriptive talk included variances based on the purpose for the talk. When teachers were analyzing and describing students' thinking, more descriptive talk included nuanced and strategy-oriented talk. This is similar to research presented by Jansen and Spitzer (2009) who described nuanced talk as teachers using descriptions that are mathematically specific, naming details about students' thinking (p. 135), and this nuanced talk aligned with teachers' capabilities to link instruction to students' thinking. In my study, I found that teachers were also strategy-oriented in the ways that they described students' efficiency with strategies and when they described the number of strategies their students could use successfully. Nelson, Slavit, & Deuel (2012) characterize similar teacher interactions as demonstrating an improving stance (Charalambous & Silver, 2008) towards data analysis in which teachers learn by exploring the student data but also use it to launch new questions, problematizing the practice (p. 16). Teachers in PLC2 were willing to explore reasons for the students' understandings.

My study also transcended prior research by presenting a varied nature of ways in which teachers used more descriptive talk differently depending on the purpose of their talk. As teachers moved to different stages of the RTI problem-solving process, their descriptive talk adapted to the purpose of that stage. For instance, when teachers in PLC1 moved to the planning stage of the RTI process, their descriptive talk morphed in ways that focused on planning. Their descriptive talk included targeting interventions, understanding the interventions, and revisiting students' thinking. Although, the premise of being specific and naming details is still the same, the teachers focused the descriptive talk on planning interventions rather than analyzing the data.

When teachers analyzed and described students' thinking, less descriptive talk included generalized and answer-oriented talk. This type of talk is implied in research presented by Jansen and Spitzer (2009) but not explicitly named as was done in my study. Generalized talk stems from prior research and includes teachers making broad or general statements about an individual student's or groups of students' mathematical understandings, often making broad claims about student learning (Nelson, Slavit, & Deuel, 2012). For my study, being less descriptive also included answer-oriented talk in which teachers' talk about their students' thinking tends to focus on correctness and used words like "get it" and "doesn't get it" (Otero, 2006) to describe their students' understandings, make blanket statements, or categorize students. Otero (2006) doesn't specifically name this type of talk as I have done in my study.

Again, my study also transcended prior research by defining varied ways in which teachers used less descriptive talk differently depending on the purpose of their talk. As teachers moved to different stages of the RTI problem-solving process, their less descriptive talk adapted to the purpose of that stage. For instance, when teachers in PLC2 engaged in Stage Two of the RTI process, their less descriptive talk morphed in ways that focused on grouping students based on scores rather than looking at their work. Teachers' less descriptive talk included generalized grouping decisions, generalized attempts, and grouping students using scores. Although, the premise of using more generalized and broad statements is still the same, the teachers focused the less descriptive talk on generalized ways of grouping students based on their scores rather than analyzing the students' work.

Another type of talk that was found in this study (and was not found in research) was teachers' use of non-descriptive talk. This type of talk was different than less descriptive talk as it included ways in which teachers talked during PLC meetings that did not describe the mathematics students did or did not understand, it did not focus on students' strategies, and it often detracted from the purpose of the meeting. One example of non-descriptive talk is avoidance talk that included parts of teachers' conversations that steered the discussion away from students' thinking about the mathematics. It often hindered the discussion by adding extraneous information that was unrelated to the mathematical data or purpose of the conversation.

Assessments that facilitate more descriptive talk. In order for teachers to be able to talk more descriptively about students' thinking, they must first have an assessment that facilitates this type of discussion. The teachers in this study used the *Universal Screening Tool for Number Sense* (UST), which has this exact purpose. It was designed to engage teachers in a deeper analysis of students' thinking to uncover the layers and nuances students' understandings and the efficiencies of their strategies. Although Shinn (2002) does not fully articulate the benefits of using this type of assessment, he does describe the limitations of using more global assessments. He states that global assessments measure general abilities, which is not useful for goal setting or planning interventions for students (p. 672).

He also described the global assessments as including too broad a span of concepts with few questions per concept making it difficult to draw conclusions about what students do or do not understand mathematically. In contrast, the UST assesses only essential number concepts providing a focus for teachers. It also includes a rubric that is different from many other assessments in that it layers students' thinking not based on correctness of their solution, but on the efficiency and accuracy of the strategies that students use. This type of assessment and rubric is new for teachers. They have had to shift from thinking about the rubric as "penalizing" students when they received a score of transitional to thinking of it as providing valuable information what students do or do not understand about the mathematics. Shinn (2002) references some research that distinguishes between the types of assessments that will provide adequate information to teachers about what students know or the strategies used and the types of assessments that provide a more global picture of students' abilities. However, little research has been conducted specifically for mathematics.

Implications for Practice

This study has significant implications for practice in Edgewood School District. First, teachers are just beginning to experiment with implementing Response to Intervention (RTI), and they need support and guidance for implementing it effectively. Second, professional development is needed to ensure that teachers are knowledgeable about RTI, including the problem-solving process, have the content knowledge to assess students' understandings and provide targeted interventions, and understand how the resources available for intervention target students' thinking. Although each of these implications is important, the bulk of this section will focus on the support and guidance for teachers, as this has been a major part of my study and professional practice over the past several months.

Support and guidance for teachers for RTI implementation. In this section I will share how this study relates to my professional career and the work being done in my district. I will share the process by which I developed an artifact for use with elementary mathematics teachers as a result of my work for this study and the ongoing work of mathematics leadership in my district. Finally, I will describe the RTI Resource Guide that was developed based on the work done in my study and highlight how it differs from what we previously had in place.

Prior to this study, teachers had not implemented the RTI framework for mathematics to its full potential. At each elementary school in my district, teachers have experimented with various components of the framework to determine what was working well, what needed improvement, and were evolving towards a full implementation of RTI for mathematics in the near future. Teachers have had a lack of structure or guidance provided for implementing RTI for mathematics besides the State regulations. Although explicit guides were created for reading RTI, very little has been done to support similar efforts for mathematics in my district. My goal for this school year was to provide the necessary support and guidance for math RTI as had been done for reading.

In order to do this effectively, I sought the assistance of a leadership team that included building-level math coaches and/or teacher leaders from each school, as well as, math coaches from the district level. This leadership group meets once per month, and to support these efforts, we dedicated four meetings over the past several months to accomplish this task. The first step was to have the leadership team read the RTI regulations multiple times to unpack and understand their purpose and implications for our district. Building a shared understanding of the regulations document among the members of the leadership team was essential to moving forward in generating guidance for our teachers. Although members of this leadership team had seen the regulations before having discussed them in prior coaches' meetings, we had not fully unpacked them for our own understanding and interpretation.

During our first two meetings we began our journey by following an informal investigative process that helped us with a 'status check' with our RTI implementation. First we reflected on what each school was doing in attempts to implement RTI, next we read the regulations, and then we compared what we were doing to what was actually required in the regulations. We were investigating three big overarching questions with regard to RTI implementation:

- What are we doing?
- What should we be doing?
- How can we get there?

The first question, 'What are we doing?' referred to the experimentation that schools were doing with various aspects of the RTI framework in order to begin implementing RTI. The second question, 'What should we be doing?' was the opportunity to read the regulations and build a shared understanding of them. The third question, 'How can we get there?' was our opportunity to determine how we could push ourselves closer to a full implementation of the RTI framework for mathematics. The leadership team was able to build a shared understanding about some aspects of the RTI framework, but there were still several questions and clarifications that were needed.

The next two sessions included the leadership team working in small groups to help clarify lingering questions and define all of the aspects of RTI framework. The team took a deeper look at each component of RTI to distinguish between the tiers and to ensure we developed a framework that was teacher-friendly. By teacher-friendly, I mean designing a framework that included less jargon and was easy to read and understand for teachers. If the document is not teacher-friendly, they won't use it. The development of the framework included defining the RTI problem-solving process. The RTI problem-solving process was a major focus of investigation in this study, and the team wanted to ensure that we designed a framework that included a clearly defined problem-solving model for identifying and meeting the needs of our students.

The RTI resource guide. The draft for this document (artifact) that is entitled, "Response to Intervention Framework: Guide for Teachers" (located in Appendix D) is the first step in reaching our goal of providing support and guidance for teachers to implement RTI for mathematics. This guide will provide information for teachers for how to implement the RTI framework for mathematics, and more specifically, the RTI problem-solving process for identifying and meeting the needs of their students. Although we could have easily adopted and revised someone else's framework and process, to truly “own” an RTI framework we had to go through this development process ourselves.

This resource guide is vastly different form the original draft that was previously in place. The previous guide included a list of resources that teachers could utilize for intervention instruction for each of the tiers of the RTI framework. Although that type of resource is valuable and will likely be embedded in the final version of the new Resource Guide, it did not help teachers engage in the process. My study highlighted the need for teachers to understand the RTI framework, specifically the problem-solving process, and how to engage in it productively. Based on my research, I decided that developing guidance and support for engaging productively in RTI was a more important first step because it would help to provide foundational knowledge for the process. The previous document was a one-page resource guide aligned with Stage Three of the problem-solving process because it listed the types of resources available for teachers as they planned for intervention instruction. The new Resource Guide provides guidance and support for engaging in RTI framework and RTI problem-solving process because it provides insight about what teachers should do and what they should consider.

This Resource Guide was not only informed by my analyses, I also developed it with the help of my mathematics leadership team, and it was also influenced by work done by the Delaware Department of Education (DEDOE) and the work done by the reading staff in Edgewood School District. Although each section of the document is described briefly below, the RTI problem-solving process was the section of the Resource Guide that was most influenced by my research.

Section 1: Introduction to RTI. The introduction section includes an overview of RTI including a definition that is further elaborated. We utilized the DEDOE adopted definition of RTI to launch our guide along with a pictorial representation of a defined RTI triangle similar to that for reading RTI. This introduction to the guide provides a snapshot of the overall RTI framework.

Section 2: Universal screening. Section 2 outlines the universal screening process. This was placed first, after the introduction, because all of the information shared beyond this point relies on the data collected from the initial screening process. You will notice that on each page of this document, I've tried to incorporate a visual representation along with written descriptions to create balance between what the user must read and what can be discerned from a graphic. For example, on page 2 of the document, the screening process is defined in a flowchart on the left with the regulations on the right. While the regulations include the minimum requirements of the law, it is enhanced by what is expected in our district with adaptations and the visual flowchart representation. This flow chart has one component that was informed by my research, the last step, which refers to the problem-solving process. This step in the RTI framework was not explicit and was one option for how teachers might identify and meet the needs of their teachers. Because my research suggests that the problem-solving model might be productive for teachers when they talk more descriptively about their students' thinking, our math leadership team wanted to be sure this was an explicit part of our RTI Resource Guide.

Section 3: Tier 1. Page 3 begins the distinctions between the tiered levels of the RTI framework starting with Tier 1. Again, this page is balanced with the information teachers must read and a visual representation that captures the essence of written content. Tier 1 has three areas for which further clarification and definition is required before it can be finalized. These areas in need of further clarification are denoted by an asterisk. First, the team needs to clarify and define the meaning of "at risk" or "students who are below the 25^{th} percentile on a norm-referenced test or the designated cut score on a curriculum-based measure." This needs additional clarification because we do not give students a norm-referenced screening tool, and our new Universal Screening Tool (UST) was not designed to include "cut scores." Cut scores on the UST have little to no value in understanding students' thinking in order to identify their needs for targeted intervention. The leadership team must define what "at risk" means for mathematics in Edgewood School District based on the UST data. This is the component of Tier 1 that was most influenced by my data analysis even though it is still a work in progress. In my study, when teachers focused on students' scores rather than students' work as part of the data analysis, the PLC seemed to move less productively through the stages of the problem-solving process. The math leadership team does not want to define the "at risk" students by looking at screening scores holistically; rather they want to define it using the concepts. Because the math leadership is still determining what this should look like, this component of Tier 1 is not yet defined.

Second, the team must clarify which school-based team (SBT) is to review students who did not fall below the cut score, but still not meet the benchmark on the UST (the "watch list"). There are several different types of SBTs within the school, and we need to ensure we have right team making the decisions for RTI in mathematics. Third, the team must clarify how teachers will monitor the progress of students in Tier 1 who are on the "watch list." There are no guidelines in place for this part of Tier 1, yet. The clarification for these three areas will occur in future meeting to ensure that information can be provided in the guidelines document.

Section 4: RTI problem-solving process. Section 4 of the document defines the RTI problem-solving process for teachers. This is the section of the research guide that was most informed by my research because the stages were defined based on how the teacher in PLC1 engaged productively in the problem-solving process. It also includes a visual representation of the process along with the guiding questions for each stage of the process in written form. This process designed for our district is an adaption of the problem-solving models presented in the research and is based on the information gathered in this study. There are guiding questions for teachers to think about as they engage in each stage of the process. Specifically, in Stage Two, a guiding question asks teachers to describe the concerns using specific details about what the student does or does not understand about the concept. This is because my research found that if teachers are more descriptive in their talk about students' thinking, they are more productive as they engage in the other stages of the process.

One other significant part of the RTI problem-solving process is the analysis that is to be done before teachers engage in this process as a PLC. This prior work is noted at the top of the page. Research recommends that each teacher come to the PLC meeting ready for the problem-solving process having already analyzed their data to determine overall strengths and weaknesses for their class (Hall p. 72). This will allow the PLC to have a starting point for discussion and prevents the teachers from spending too much PLC meeting time doing an initial analysis. The initial analysis can be done individually before the meeting so that teachers already have a sense for what their students do and do not understand.

Sections 5 and 6: Tier 2 and Tier 3. Sections 5 and 6 are anticipated to have similar information for Tiers 2 and 3 as was included in other sections. Although the leadership team has begun the discussion for these tiers, the details have not been fully developed for the document. These discussions are continuing at our future meetings to ensure we have support and guidance ready for our teachers in the next school year.

Next steps. The next steps for this work include short-term and long-term goals. First, upon completion, this document will be presented to the Superintendent's Council that includes the curriculum director, the schools directors, the assistant superintendent, and the superintendent. This council will review our guidelines, provide feedback for improving the document, and provide final approval once they are satisfied with our framework. This is a short-term goal as it could happen in just a few short months.

Second, the document must be shared with teachers through professional development. This is a long-term goal as it will take several months to a year to develop, design, and implement professional development that helps teachers to understand the RTI framework for mathematics, especially the RTI problem-solving process. Teachers must learn how to engage in the RTI problem-solving process productively which includes using more descriptive talk. In order to use more descriptive talk, teachers will need to understand the difference between more, less, and non-descriptive talk and have opportunities to practice analyzing the data using descriptive talk. They must also participate in continued professional development that helps them understand the purpose of the assessment items, including the mathematics concepts within the various learning progressions being assessed. Having this content knowledge will help them to talk more descriptively about their students' thinking, which will facilitate more productive engagement in the overall RTI problem-solving process.

Finally, an even larger long-term goal is to develop a resource guide that helps teachers to unpack the learning progressions of important number concepts in the elementary grades. This guide would provide access to information about which resources would address particular understandings or misconceptions within a given learning progression. This would help teachers find the right intervention resource once they have identified the students' needs. I hope to create this as a digital repository for teachers, which is another reason for this being a long-term goal. It will take some time to create such an even more thorough resource guide for teachers.

Future Research

My study launches several ideas for new research to be explored with regard to implementing RTI for mathematics. First, more research should be conducted to explore teachers' use of more, less, and non-descriptive talk as they engage in the stages of the RTI problem-solving process. It would be beneficial to mathematics education community to determine if these types of talk impact the ways in which other teams teachers engage in the RTI process, especially at different grade levels. It would also benefit the mathematics education community to further study whether these ways of talking were similar or different to the ways in which teachers talk when analyzing other types of assessment data. Better understanding how teachers engage with and discuss data as a part of the RTI problem-solving process can inform our future work with teachers. If we gain deeper insights into the types of descriptive talk that are most beneficial to teachers moving more productively through the RTI process, we can use that knowledge to inform professional development for teachers.

Second, further research regarding assessments that will facilitate deeper conversations about students' thinking would greatly benefit the mathematics education community. If we have focused assessments that provide meaningful information to teachers about their students' mathematical understandings, teachers can engage in conversations that include more descriptive talk. We can use these assessments in professional development to help teachers learn to diagnose and understand students' thinking. Studying assessments that help teachers to better understand students' conceptions/misconceptions and the conceptual underpinnings within the mathematics may provide insights to them provide more targeted interventions aligned to students' thinking.

Finally, the mathematics educational community could benefits from additional research on the impact or role of the math coach within the PLC. Some schools have a person designated as a math coach and some do not. In my research, the math coach was an active participant in one of the PLC teams and seemed to impact the types of discussions they had during their meetings. It would be interesting if future research could explore this impact in greater detail, especially for schools that do not have someone designated in this type of position. One might wonder if having a math coach might improve the quality of the PLC meeting discussions.

Limitations

I believe the findings from my study are extremely important and will enhance the knowledge base of RTI within the mathematics education community. However, there were some limitations. First, this study consisted of only two teams of teachers working in PLCs, which is a very small sample size to make broader research claims across other teams or other schools. Although, the sample was small for my study, it was important to research small groups of teachers in detail over a long period of time to gain insights into the nature of engagement in RTI in mathematics. If there were more teams of teachers involved in this study, I would not have been able to follow them as closely during their PLC meetings, and I would not have been able to interview every teacher within those teams.

Second, this study could have also been improved by observing teachers' engagement in more than one cycle of the RTI problem-solving process. My study consisted of two PLCs engaging in one cycle of the process because it occurred later in the school year. If I had begun the study earlier in the year, I might have been able to observe and analyze more than one cycle of the process. Even though my study was limited to observing only one cycle of the RTI problem-solving process, my findings are still significant because it provides insights into the ways in which teachers engage in this process at an early experimentation phase of implementation. If teachers can be productive at such an early phase of implementation of RTI, perhaps their growth in using descriptive talk will increase as they gain more experience in engaging in the process.

Conclusions

It is important to understand the ways in which teachers engage in the RTI problem-solving process because such an analysis can provide insights into how to help teachers become more productive during PLC meetings focused on RTI. The findings from this study suggest that talking more descriptively about students' thinking early in the RTI problem-solving process can help teachers to design and implement interventions that are targeted to students' thinking. If students receive intervention that is targeted to their specific thinking, the interventions are more likely to help them move further along in their trajectory of understanding about a particular concept, ultimately improving their learning and overall mathematics achievement. In order to design instruction that is targeted to students' thinking, this study suggests that teachers must engage productively in the RTI problem-solving process using assessment data that goes beyond simply using scores or generalizations about students' understandings. More descriptive talk during each stage of the process might enable teachers to engage productively through an entire cycle of the process. Better understanding of descriptive talk and productive engagement will help professional developers design learning experiences for teachers that help improve descriptive talk and encourage productive engagement in the RTI problem-solving process, ultimately improving intervention instruction for students.

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Appendix A

OBSERVATION PROTOCOL

Observation Protocol

Guiding Questions for PLC observations:

- How are teachers using the screening tool to analyze students' thinking?
  Rationale: This guiding question will focus my attention to ways in which teachers analyze the data for understanding student thinking, and whether their analyses are more nuanced or generalized in how they characterize the students' understanding of concepts.

- What resources do teachers utilize to plan for targeted instruction aligned with students' mathematical thinking? How are they using them? What rationales do they give in the PLCs for why they have chosen them? Are they talking about using these resources in ways that are targeted to students' thinking or do they give other rationales for using them?
  Rationale: This guiding question will focus my attention to the resources teachers utilize while planning, how/why they select the resources, and how they perceive the resources to be useful in aligning instruction to the students' thinking.

Description of the Observation	My Initial Interpretation
This section will include pieces of the teachers' discussion or teachers' actions during the PLCs.	This section will be my initial interpretation the descriptions in terms of the guiding questions and my anticipated codes or themes.

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Appendix B

INTERVIEW PROTOCOLS

Interview Protocol – Teacher
I want to thank you for taking the time to meet with me today.
My name is Crystal Lancour and I would like to talk to you about your experiences with implementing the RTI process for math. Specifically, I am interested in how you are using the screening tool data to gain insights into your students' thinking and the resources you use to design instruction that targets your students' needs.

The interview should take 45-60 minutes. I will be taping the session because I don't want to miss any of your comments. Although I will be taking some notes during the session, I can't possibly write fast enough to get it all down. Because we're on tape, please be sure to speak up so that I don't miss your comments. All responses will be kept confidential, and only I have access to your interview. Remember, you don't have to talk about anything you don't want to and you may end the interview at any time.

Are there any questions about what I have just explained?
Are you willing to participate in this interview?

1. How long have you been teaching in this school? Has it always been in third/fourth grade?

QUESTIONS ABOUT RESOURCES TO USE FOR ANALYZING STUDENTS' THINKING

2. Have you used the Universal Screening Tool? How often do you use it? When do you decide to use it? Are you happy with how you've been using it?
3. How have you used the data from the screening tool to gain insights into your students' thinking?
    - Can you give me an example of a situation when you analyzed students' thinking using the screening tool? What, specifically, did you learn about students' thinking?
    - What data or information from the screener was the most informative?
    - What new strategy or intervention have you tried in RTI because of the conversations around the screening tool?
4. What other information or tools do you use to make sense of your students' thinking? Why do you use this approach or these tools? Do you prefer this approach or these tools to the screener? Why or why not? Does your math coach help you to better understand your students' thinking? In what ways?
5. Are there other forms of tools or supports that you would like to help you understand your students' thinking? If so, what, ideally, would you hope for?

QUESTIONS ABOUT RESOURCES FOR PLANNING TARGETED INSTRUCTION ALIGNED WITH STUDENTS' THINKING

6. What instructional resources have proved to be valuable in planning and implementing instruction? Why do you consider each of these to be helpful? In what ways are they helpful? Are any of the resources particularly helpful for

planning instruction that helps you address your students' mathematical thinking?

  - o Can you give me an example of one specific instance when you planned instruction after using the screening tool to assess students' thinking? What did you learn from the screening tool? How did you plan your instruction after learning this? What did you decide to do to teach this student or these students? Why did you decide this? What resource did you use, if anything? Why or in what ways was that resource helpful? Did you consult any other resources? Why or why not?
  - o How many times a week do you use Number Talks with your class or your RTI group?
  - o How do you decide which students receive instruction using the Do the Math modules?

7. Out of the instructional resources that you have available to use, how do you decide which ones to use? In what situations do you prefer one resource over another?
8. Does your math coach help you to select resources for instruction? How does your math coach help you with instructional resources, if at all? As your math coach helps you with resources, what reasons does the coach provide about why the instructional resources would helpful? IF NOT MENTIONED… How often is students' thinking used as the reason for why the instructional resource would be most useful?

TEACHERS' INSIGHTS ON RTI RESOURCE GUIDE

9. If there were a resource guide, like a document of some sort for teachers to use, with guidelines for implementing Math RTI, what kind of information would want to be included?
    - o How might an RTI Resource Guide be helpful to you and your team as you plan instruction to meet your students' needs?

ADDITIONAL FOLLOW UP QUESTIONS

10. In what ways would you say that your PLC is effective at the process of analyzing students' thinking? In what ways could your PLC improve at the process of analyzing students' thinking?
    - o What would help your PLC improve at analyzing students' thinking, if anything? What supports would you benefit from having? Any additional resources or supports? Why?
    - o In my observations of your PLC, I noticed…. <u>[give a description about how they described students' thinking to each other in the PLCs – more or less nuance, which tools they used most regularly and how they used them.]</u> Would you agree with my observation?

11. In what ways would you say that your PLC is effective in the process of planning for instruction? In what ways could your PLC improve in the process of planning instruction?
    - What would help your PLC improve at planning for instruction, if anything? What supports would you benefit from having? Any additional resources or supports? Why?
    - In my observations of your PLC, I noticed…. [give a description about how they planned for instruction – aligned with students' thinking or not and which tools they used most regularly and how they used them] Would you agree with my observation?
12. Is there anything else you would like to share about the Math RTI process?

Interview Protocol – Math Coach

I want to thank you for taking the time to meet with me today.
My name is Crystal Lancour and I would like to talk to you about your experiences with implementing the RTI process for math. Specifically, I am interested in how you are using the screening tool data to gain insights into your students' thinking and the resources you use to design instruction that targets your students' needs.

The interview should take 45-60 minutes. I will be taping the session because I don't want to miss any of your comments. Although I will be taking some notes during the session, I can't possibly write fast enough to get it all down. Because we're on tape, please be sure to speak up so that I don't miss your comments. All responses will be kept confidential, and only I have access to your interview. Remember, you don't have to talk about anything you don't want to and you may end the interview at any time.

Are there any questions about what I have just explained?
Are you willing to participate in this interview?

1. How long have you been the math coach at this school? Which grade levels PLCs have you been able to participate in regularly?

QUESTIONS ABOUT RESOURCES TO USE FOR ANALYZING STUDENTS' THINKING

2. What would you like to share about your third grade team's abilities to gain insights into their students' mathematical thinking?
    - What are their strengths?
    - How could they improve?
    - Do they use they use the data from the Universal Screening Tool to gain insights into their students' mathematical thinking?
        - If so, how do they use it? How often? In what ways? What data or information from the screener was the most informative?
    - What new strategy or intervention have these teachers tried in RTI because of the conversations around the screening tool?
    - What other data sources do the third grade teachers use? Why have they found these sources to be valuable, do you think?
3. What would you like to share about your fourth grade team's abilities to gain insights into their students' mathematical thinking?
    - What are their strengths?
    - How could they improve?
    - Do they use they use the data from the Universal Screening Tool to gain insights into their students' mathematical thinking?
        - If so, how do they use it? How often? In what ways? What data or information from the screener was the most informative?
    - What new strategy or intervention have these teachers tried in RTI

because of the conversations around the screening tool?
  - What other data sources do the fourth grade teachers use? Why have they found these sources to be valuable, do you think?
4. What do you do to helping your teachers to better understand their students' mathematical thinking?
  - Have those approaches been effective, do you think? Why or why not?
  - Is there anything you would like to do differently to help your teachers better understand their students' mathematical thinking?

QUESTIONS ABOUT RESOURCES FOR PLANNING TARGETED INSTRUCTION ALIGNED WITH STUDENTS' THINKING

5. In your observations of your third and fourth grade PLC, what instructional resources have been valuable to use when planning instruction? Why are these resources valuable?
  - Are there any resources that are more or less valuable for planning instruction that directly addresses specific aspects of students' mathematical thinking? Why or why not?
  - How many times a week do you use Number Talks with your RTI group?
  - How do you decide which students receive instruction using the Do the Math modules?
6. Why do you think a teacher would use one instructional resource over another, out of the different options that are available to them?
7. How do you help your teachers make decisions about which instructional resources to use? In what ways do you try to help your teachers select resources that are aligned to your student's' mathematical thinking?

COACH'S INSIGHTS ON RTI RESOURCE GUIDE

8. If there were a resource guide, such as a document with guidelines for implementing Math RTI, what kind of information would you want to be included in this guide?
  - How might an RTI Resource Guide be helpful to you and your teachers as you plan instruction to meet students' needs?

ADDITIONAL FOLLOW UP QUESTIONS

9. In my observations of each PLC, I noticed how the teachers talked about students' mathematical thinking. <u>[Share what you noticed about each team – how specific or nuanced they were, which tools they used, how they used them.]</u> Do you agree with my observations? What else do you think I should know about how these teachers analyze students' mathematical thinking? Is there any other resource or support that would help them? Why or why not?
10. In my observations of each PLC, I noticed how the teachers planned for instruction. <u>[Share what you noticed about each team – how targeted their</u>

instruction was or was not to students' mathematical thinking, what resources they used, how they used them.] Do you agree with my observations? What else do you think I should know about how these teachers analyze students' mathematical thinking? Is there any other resource or support that would help them? Why or why not?

11. Is there anything else you would like to share with me about the Math RTI process in this school district? What is going well? What could be improved?

Appendix C

PREVIOUS RESOURCE GUIDE

DRAFT

Response to Intervention (RTI) - Mathematics (Elementary)

Universal Screening – Fall, Winter, Spring		
Tier 1	**Tier 2**	**Tier 3**
• Formative assessment – ○ notice/wonder well (what can be measured/ counted) ○ Formative assessment binder ○ Assessment prompts ○ Exit tickets or distributed summary strategies ○ • Classroom routines/10 minute math ○ Time ○ Calendar ○ Today's number ○ Quick images ○ Money ○ Start with/Get to • Math workshop – differentiated activities/centers to match students' needs ○ 24 game (various levels – single digit, double digit, variable) ○ Center stage ○ Off grade level games ○ Small group instruction – targeted to needs ○ Differentiating the tools/manipulatives offered or available based on needs • Marian Small – ○ Parallel tasks ○ Open questions	• Number Talks – targeted to students' needs • Math workshop/centers ○ Small group instruction – targeted to needs ○ 24 game (various levels – single digit, double digit, variable) ○ Center stage ○ Off grade level games ○ Differentiating the tools/manipulatives offered or available based on needs • Do the Math program • Targeted instruction on how to use tools/manipulatives well • Preview/Pre-teach • Drexel/Math Forum tasks – ○ to launch a unit in an interesting way ○ to notice/wonder well ○ to differentiate or use in centers ○ for extended thinking strategies • Change intensity of a Tier 1 intervention	• Do the Math (DTM) • Number Talks – targeted to students' needs • Math workshop/centers ○ Small group instruction – targeted to needs ○ 24 game (various levels – single digit, double digit, variable) ○ Center stage ○ Off grade level games ○ Differentiating the tools/manipulatives offered or available based on needs • Targeted instruction on how to use tools/manipulatives well • Preview/Pre-teach • Change intensity of a Tier 2 intervention

• Drexel/Math Forum tasks – ○ to launch a unit in an interesting way ○ to notice/wonder well ○ to differentiate or use in centers ○ for extended thinking strategies ○ • Using Extended Thinking strategies/lessons (error analysis, debate/compare strategies, etc) • Differentiated HW General Strategies • Number Talks • Standards for Math Practice • Error analysis • Debate strategies/compare strategies for similarities/differences • Marian Small – open tasks/parallel tasks • Fast Math • Fraction Nation	General Strategies • Number Talks • Standards for Math Practice • Error analysis • Debate strategies/compare strategies for similarities/differences • Marian Small – open tasks/parallel tasks • Fast Math • Fraction Nation -Compass Learning?	
Data: -screener data -MRI (Math Reasoning Inventory) -Formative assessments -District common assessments	Data: -DTM assessments -Formative assessments	Data: -DTM assessments -Formative assessments

Appendix D

NEW RESOURCE GUIDE

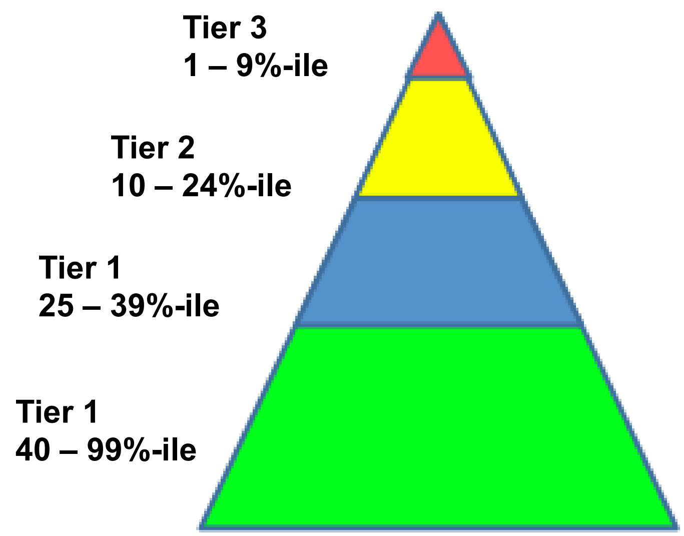
Response to Intervention Framework
Guide For Teachers (Mathematics)

Introduction

<table>
<tr><th>What is Response to Intervention?</th><th>RTI Framework</th></tr>
<tr><td>
Delaware has adopted the definition of Response to Intervention as published by the National Association of State Directors of Special Education (2005):
“RTI is the practice of providing high-quality instruction and intervention matched to student need, monitoring progress frequently to make decisions about change in instruction or goals and applying child response data to important educational decisions. RTI should be applied to decisions in general, remedial and special education, creating a well-integrated system of instruction/ intervention guided by child outcome data.”

Response to Intervention (RTI) is thought of as response to instruction, since it refers to the process of providing high-quality instruction to all students while differentiating instruction so each student can access the information being taught.
Response to Intervention is application of the scientific method or problem solving process to classroom instruction. RTI is not a curriculum; it is not a new program; but rather, it is an ongoing process of providing high-quality instruction, assessing for understanding, differentiating instruction, adjusting instruction based on data, and assessing to see if the changes create the learning desired. Response to Intervention is language in the federal law and regulated in state code.
Decisions for providing more intensive or different instruction are based on data from assessments that range from universal screening of all students to curriculum-based measurements for all students, each of which provide information to the teacher on what students know and whether students are learning what we believe we are teaching.

</td><td>
Edgewood has adopted a three-tiered model, with an embedded fourth tier, for implementation of RTI to provide high-quality instruction while meeting the needs of each student based on the data collected during formative, diagnostic, and summative assessments.



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Universal Screening

Screening Process

Administer Universal Screening Tool

- Preview the Screening Tool and the Rubric
- Anticipate students' responses
- Administer the Screener - observing students as they work

Analyze Screener Data & Students' Work Indivually to Determine Strengths/Needs for your Students

(See page ___ for guidelines & support for this.)

Meet with PLC to Discuss Data Across Classrooms

- Triangulate With Other Data: Common Assessments, DCAS, Formative Assessments, other?

Using the **Problem-Solving Process** to make Decisions for Interventions Based on the Data (page 4)

Guidelines for Screening

Elementary School:

- Must be given to all students at least 3 times a year (specific times frames; fall, winter, spring); within 2 weeks of the beginning of school
- When a student first enters school, the screener must be given within 2 weeks of entering school.

Middle School 6-8:

- Must be given to all students 3 times a year (specific times frames; fall, winter, spring); within 2 weeks of the beginning of school
- Must be given within 2 weeks of the beginning of the school or when the student enters school.

High School 9-12: ...maybe different according to course…(IM1, IM2, and IM3 only???)

- Must give all students the screener 3 times a year (specific times frames; fall, winter, spring); within 2 weeks of the beginning of school
- Must be given within 2 weeks of the beginning of the school or when the student enters

Response to Intervention Framework
Guide For Teachers (Mathematics)

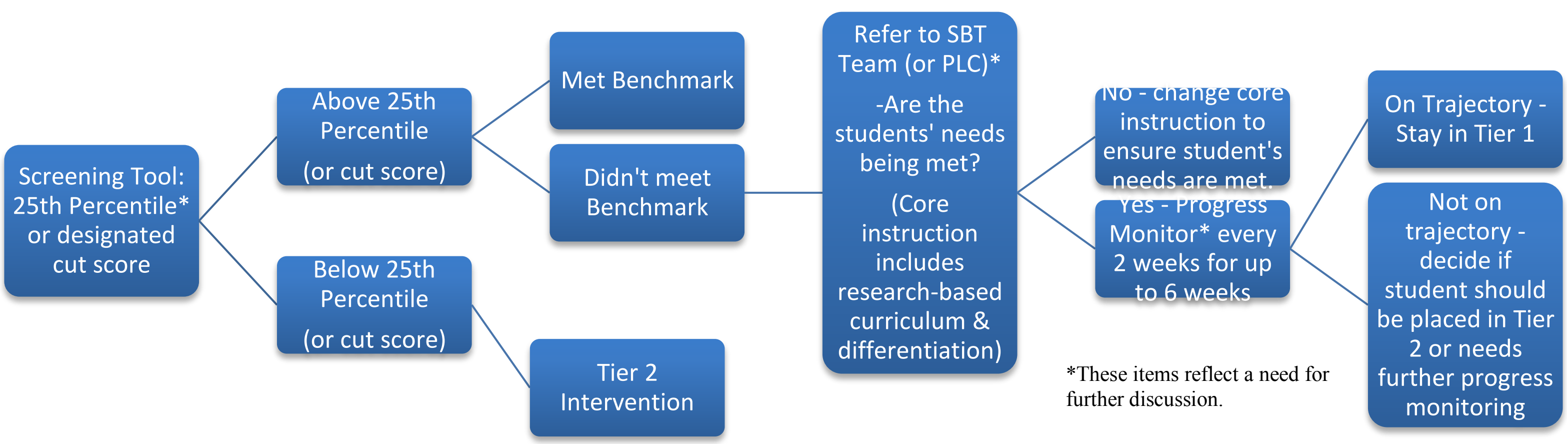
Tier 1

Tier 1	
Focus of Tier 1: To provide high quality instruction through a research-based core curriculum aligned to CCSS and matched to student need. The core curriculum shall be taught with integrity and will include differentiation.	

Screening:
• Students will be screened 3 times per year, in the Fall, Winter, and Spring (See page 2, "Universal Screening Tool" for additional information).
 	
"At Risk" Students:
• Students who score below the 25th percentile* on a norm referenced test or the designated cut point on a curriculum based measure (Screening Tool) for any instructional screening, shall be provided Tier 2 interventions.
	"Watch list" students:
	• A student who scores above the 25th percentile (or designated cut score), but does not meet benchmark on a screening tool, will be reviewed by an SBT* team (ex: PLC) to assure the student is receiving differentiated, needs-based instruction.
	  ○ Monitor students' progress* every two weeks for up to 6 weeks to determine if students are on trajectory to meet end of year benchmarks.
	  ○ If not on trajectory after 6 weeks, the SBT team may decide if these students need Tier 2 interventions for further progress monitoring.

A Problem-solving Model will used to determine students' needs based on the screening tool data. (See page 4 for RTI Problem-Solving Process)	

Tier 1 Flow Chart



Response to Intervention Framework
Guide For Teachers (Mathematics)

RTI Problem-solving Process

Prior to beginning the problem-solving process, teachers must administer the Universal Screening Tool and analyze the data individually to identify strengths, weaknesses, and overall trends. Teachers will bring this information, along with the students' work, to a PLC meeting during which the teachers will engage in the RTI problem-solving process as a team. Below are some guiding questions for each stage.

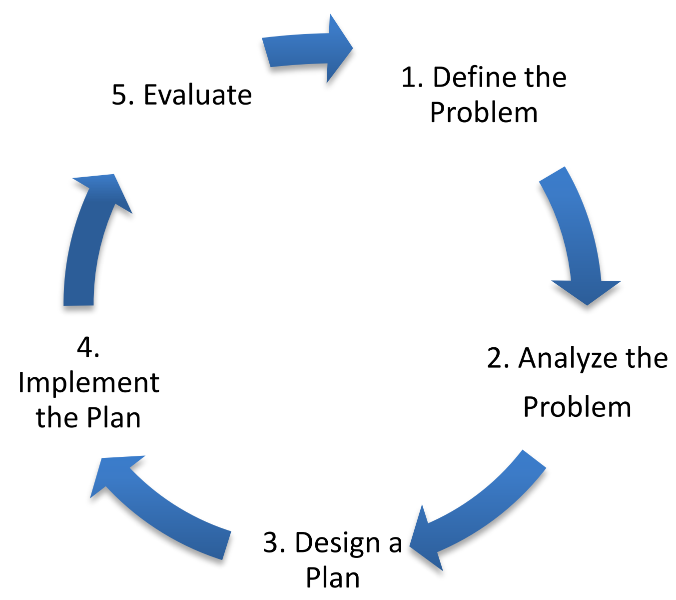
Stage 1: Define the problem (target area of concern)
- Is there a problem and what is it?
  - What is the student expected to do?
  - What is the student actually doing?
- Is the problem within one cluster on the screener or multiple clusters?
- Which concept is the most essential to address first?

Stage 2: Analyze the problem
- Why is the problem happening?
- How can you describe the problem using specific details about what the student does or does not understand about the concept?
  - What strategies did the student use?
  - How efficient are the strategies?
- What is evidence of understanding or misconceptions?

Stage 3: Design a plan
- What can be done about the problem?
- What interventions will target the specific need of the student?
  - Is there a game that can be adapted from *Investigations* or *Center Stage*?
  - Is there a *Number Talk* that aligns to this need? *Do the Math*?
  - Other district approved resources? (See page ___)
- How can you ensure the selected interventions target the appropriate need?
- How will students be grouped for intervention? How will you decide which teacher teaches which group?

Stage 4: Implement the plan
- Will the intervention be delivered in whole group, small group? Other?
- If small group, what will the other students be doing?

Stage 5: Evaluate the effectiveness of the interventions
- Did the intervention work?
- How will you know if it worked?
- What will be your next steps if it worked? If it didn't work?



Tier 2

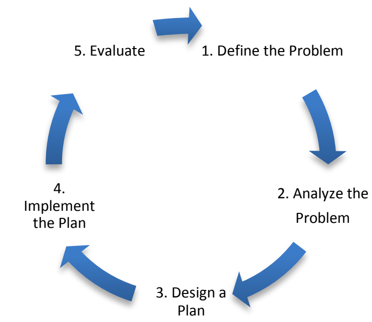
Tier 3

Appendix E

FACILITATOR GUIDE

Introduction

This document serves as a guide to those who facilitate PLC discussions focused on the RTI Problem-solving Process. It is a companion document to the ***Response to Intervention Framework Guide for Teachers*** and supports page 7 most specifically, the RTI Problem-solving Process.



Stage 1

What the ***Response to Intervention Framework Guide for Teachers*** says for Stage 1:

Stage 1: Define the problem (target area of concern)

- Is there a problem and what is it?
    - What is the student expected to do?
    - What is the student actually doing?
- Is the problem within one cluster on the screener or multiple clusters?
- Which concept is the most essential to address first?

Stage 1		
Productive Features	**"Look Fors" (Productive)**	**"Look Fors" (Cautions)**
Teachers have administered and scored the Screener.	• The recording sheet is completed with notes/comments from their observations	• Teachers may not have their recording sheets • Teachers may not have observed the specified questions and taken notes. • Teachers may not have analyzed the data ahead of time individually. • Teachers may have only looked at students' scores and not their work. • Teachers use less descriptive talk.
Teachers have reviewed the data independently to determine overall strengths and weaknesses.	• Evidence that teacher has reviewed the data: highlights, color, coding, notes	
Facilitator has reviewed data to anticipate the conversation.	• Evidence that the facilitator has reviewed the data: He/she has notes about data prepared to discuss highlighting overall strengths/weaknesses • Evidence that the facilitator has prepared for the conversation: He/she has anticipated and planned questions to generate discussion about the data.	
Teachers engage in discussion as a PLC to discuss their findings and determine an area of focus (target a concept for further analysis).	• As teachers discuss the data, listen for how they talk about the students' thinking. Are they using more descriptive talk, less descriptive talk, or non-descriptive talk? (see the next page for additional guidance on the types of talk) • Determine if teachers are using the scores, students' work, or both to determine a focus concept.	

Types of Descriptive Talk for Stages 1 & 2:

As teachers engage in Stages 1 & 2 of the problem-solving process, listen for these types of descriptive talk. Consider the questions provided to strengthen the conversation.

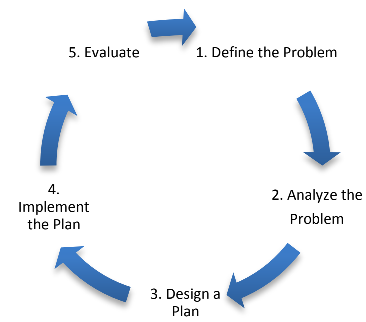
Type of Talk	Description	Example	Questions to Ask
More Descriptive Talk			
Nuanced	Name the specific strategy a student (or group of students) might be using or can articulate the mathematics the student is struggling with using descriptive language	"They are still not able to look at 65 as 60 and 5 and be able to put the tens together and the ones together… they don't understand that it's 60, 5. Six tens…"	• Is this an essential Number concept for this grade level?
Strategy-oriented	Teachers focus on the efficiency of the strategies the students are using or how many strategies the students are able to use successfully rather than focusing on correctness or getting the answer.	"… but what if it's a kid who only does the break apart, like my other- like the kids are doing, that the kids who are drawing strips and singles, like they're doing it one efficient way and then they're resorting back to strips and singles. The kids who are doing it one efficient way and have no strategy…"	• Is this an efficient strategy? • Are there other strategies you'd like to see the students using? • What are the two strategies that are most important for this grade level?
Less Descriptive Talk			
General	Teachers might discuss students having strategies, but never actually name the specific strategy a student might be using or do not fully articulate the mathematics the student is struggling with using descriptive language.	"Most of my kids did it that way. " OR "Which, he's doing that. It shows he has a pretty good comprehension of how it works."	• Can you say more about the strategies your students used? • What does the students demonstrate understanding of?
Answer-oriented	Teachers focus on whether or not the students get it right (correctness), they use the "get it/don't get it" language, and use scores as a basis for their discussions rather than strategies or efficiency of strategies.	"When they were multiplying fractions and it was like 90 fifths or whatever it was. You got 90/5, but you didn't get the correct answer. You didn't answer the question." Or "I think that with a lot of those students, they get it."	• How did the student get the answer? • What their strategy effective? • What does the student "get"? • What part of the concept is the student struggling with?
Non-descriptive Talk			
Avoidance	Some comments in the PLC discussion appeared to avoid meaningfully digging to the student work and data analysis. This type of talk hinders the conversation and does not help to move the PLC forward.	"I chalk it up as the same thing as it's been a while since we've revisited it. " OR T1: She loves math. T2: She wasn't here last year? T1: No. They're kind of in and out. I think they were gone for a couple of years, but they were here back in the day.	• What does the students' work show about what they understand about this concept? • How can we focus on what the student is showing us?

Less descriptive talk when grouping students for intervention:

Type of Talk	Description	Example	Questions to Ask
Less Descriptive Talk			
Generalized Grouping Decisions	Talk includes ideas about using the score codes from the UST (Competent, Transitional, or Inefficient) to group students rather than looking at specific student misconceptions. It also includes broad terms to describe students such as “high” or “low” rather then using the score codes from the UST.	“Alright, I have my low, low. Is that how you wanna do it? You wanna do your high, highs first? And put ‘em in a group?”	• Can you say more about the strategies your students used? • What does the students demonstrate understanding of?
Generalized Attempts	Teachers attempt to make grouping decisions by suggesting a deeper look at student data, but do not specify what should be analyzed. They use general terms such as “who missed number 5” instead of articulating what misconceptions students might have had for the mathematics in number 5.	T1: No, I meant like, would it matter if they missed one, but some of them 5 and some missed 9. Do we want those in the same group? I mean, not that we need… T2: No. I think a story problem’s a story problem. T1: Ok. I agree.	• How did the student get the answer? • What their strategy effective? • What does the student “get”? • What part of the concept is the student struggling with?
Grouping Students using Scores	Teachers use the codes from the UST, or synonyms such as numbers (2, 1, 0) or colors (green, yellow, red), to break the students into groups for intervention.	Amy: Joe is yellow, yellow, green. He has one competent.	• Can we group the students by what they understand about the concept? •
Non-descriptive Talk			
Avoidance	Teachers steer the conversation away from the mathematics and use of the UST data while teachers described how they would group students for intervention. This included talk that detracted from analyzing the UST data and avoided digging into the students’ work.	Jeanine: …And she’s very high in math, but it’s reading. It’s a reading issue.	• What does the students’ work show about what they understand about this concept?

Stage 2

<u>What the ***Response to Intervention Framework Guide for Teachers*** says for Stage 2</u>:

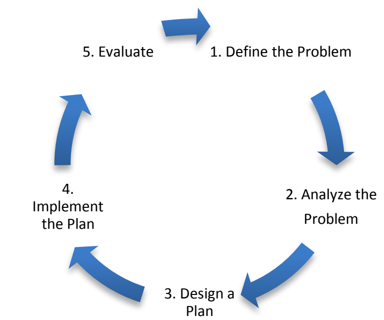


Stage 2: Analyze the problem

- Why is the problem happening?
- How can you describe the problem using specific details about what the student does or does not understand about the concept?
  - What strategies did the student use?
  - How efficient are the strategies?
- What is evidence of understanding or misconceptions?

<table>
<tr><th colspan="3">Stage 2</th></tr>
<tr><th>Productive Features</th><th>“Look Fors” (Productive)</th><th>“Look Fors” (Cautions)</th></tr>
<tr><td>Teachers have identified a focus concept to guide their discussion.</td><td>• Evidence that teacher has reviewed the data: highlights, color, coding, notes
• Teachers have an area of focus identified based on the importance of the concept for the grade level and learning progression.</td><td rowspan="4">• Teachers have identified an area of focus based on scores.
• Teachers do not use students’ work as part of their analysis.
• Teachers have identified a focus that is not essential to the grade level or learning progression.
• Teachers use less or non-descriptive talk (see page 2 for questions).
• Teachers create intervention groups based on scores. (see page 2 for questions)</td></tr>
<tr><td>Teachers have students’ work with them to refer to during the discussion.</td><td>• They revisit students’ work to further analyze students’ thinking using more, less, and non-descriptive talk (See previous page).
• Student work is a major part of the data analysis.</td></tr>
<tr><td>Facilitator has previewed the focus concept and had prepared questions and resources to guide the discussion.</td><td>• Evidence that the facilitator has reviewed the concept: He/she has notes about concept and the learning progression prepared to help teachers understand it.
• Evidence that the facilitator has prepared for the conversation: He/she has anticipated and planned questions and/or resources to generate discussion about the concept.</td></tr>
<tr><td>Teachers engage in discussion as a PLC to discuss their findings and further analyze students’ understanding in order to place students into intervention groups based on similar thinking.</td><td>• As teachers discuss the data and student work, listen for how they talk about the students’ thinking. Are they using more descriptive talk, less descriptive talk, or non-descriptive talk? (see the previous page for additional guidance on the types of talk)
• Determine if teachers are using the scores, students’ work, or both to further analyze the data.
• Groups are formed based on similar thinking (conceptions/misconceptions)</td></tr>
</table>

Stage 3
<u>What the ***Response to Intervention Framework Guide for Teachers*** says for Stage 3</u>:



Stage 3: Design a plan

- What can be done about the problem?
- What interventions will target the specific need of the student?
  - Is there a game that can be adapted from *Investigations* or *Center Stage*?
  - Is there a *Number Talk* that aligns to this need? *Do the Math*?
  - Other district approved resources?
- How can you ensure the selected interventions target the appropriate need?
- How will students be grouped for intervention? How will you decide which teacher teaches which group?

Stage 3		
Productive Features	**"Look Fors" (Productive)**	**"Look Fors" (Cautions)**
Teachers have identified students' conceptions/misconceptions and have these ideas written down. They have grouped students with similar thinking into intervention groups.	• Teachers come prepared with their notes about students' conceptions/ misconception for each intervention group. • The notes are specific to the each intervention group and not based on scores.	• Teachers are unprepared and do not know students' conceptions/ misconceptions. • Teachers have grouped students based on scores so they struggle to plan targeted interventions. • Teachers do not have instructional resources available for planning. • Teachers are using less descriptive talk as they plan interventions. • Teachers simply name intervention ideas without connecting the intervention or resources to the students' thinking. • Teachers do not discuss the intervention to understand it.
Teachers have instructional resources out for planning.	• Resources are out that align to students' thinking (Ex: Number Talks, Math Forum problems, Investigations games, Center Stage activities, etc.)	
Teachers have students' work with them to assist with planning and revisiting students' thinking.	• Students' work is sorted/groups by the intervention groups. • Teachers revisit the students' work frequently as they plan/design interventions for students to ensure the interventions target the students' thinking.	
Teachers engage in discussion as a PLC to collaboratively plan targeted interventions for each intervention group.	• Teachers ask questions of each other to understand the intervention and how it can be implemented with students. They share/exchange ideas. • As teachers discuss the data, listen for how they talk about the students' thinking. Are they using more descriptive talk or less descriptive talk? (see the next page for additional guidance on the types of talk) • Determine if teachers are using the scores, students' work, or both to design & plan interventions. • Use the questions provided below to facilitate the conversation, if needed.	

Types of Descriptive Talk for Stages 3:

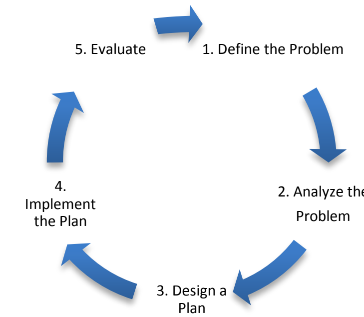
As teachers engage in Stages 3 of the problem-solving process, listen for these types of descriptive talk. Consider the questions provided to strengthen the conversation.

Type of Talk	Description	Example	Questions to Ask
More Descriptive Talk			
Targeting Interventions	The teachers articulate how the suggested intervention would or would not target the specific need of the students. It might include discussion about the learning progression for the targeted concept and the specific understandings that precedes or stems from that concept.	"And you can go more into second grade, too, if you want. 134 in second grade. And second grade will start with 10 + 10, 10 + 11, and really having those conversations. What happens to the number in the tens place? What happens to the number in the ones place? 12 + 13, 14 + 15. So that they can make those connections."	• What resource, activity, or game might target the students' thinking? • How does it target the student's thinking?
Understanding Interventions	Teachers try to understand the purpose of an intervention for how it could target the students' misconceptions. They would also talk through how an intervention might be implemented to determine if it actually targeted the correct need or to determine what might be the next step for students.	T1: Ok. So you said start with these Number Talks here. T2: The ones in kindergarten start at page 90. And it's just how many dots do you see? And how do you see them? (pause) And maybe you don't need them spread out. Maybe you just need to show three as three. Maybe we start with just the five frame. T1: Ok. T2: And start with 3 and two missing. T1: And then from that you said go to the first grade ten frames? T2: First grade double ones. Um, you can make teen numbers, too. Like I see ten and two. 10 plus 2 is 12 and that helps to get the place value. And to get them to not count the ten takes a lot, too.	• What is the purpose of this intervention? • How can it be adapted for the needs of the students in this group? • What are some questions you can ask to push the students' thinking further?
Revisiting Students' Thinking	Teachers revisit students' thinking about a particular concept as they talk through an intervention and which aspect of a concept was an issue for students.	"So we talked about how they know what the number line looks like, but they don't know, like they'll find the difference when they're adding. They'll add on the number line when they're supposed to be finding the difference."	• What is it that the student does know about this concept? • What are they still struggling with?

Facilitator Guide

Less Descriptive Talk			
General Interventions	Teachers discuss intervention tools, programs, or strategies but with much less specificity. An intervention idea may be suggested, or even named, but it is not fully articulated to describe the purpose of the intervention or how it might target the specific needs of the students.	T1: I will also give you the um Number Core book from Do the Math. T2: Ok T1: Which will probably give you some ideas. You and I can sit down and talk about those needs. 'Cause that will, I love the way she puts the verbiage together and how you ask them and how you show them. T2: And that's all in the book? T1: It's all in the book.	• Can you say more about how this resource will target the student's thinking? • Does the intervention need to be adapted to meet the students' needs or should it be implemented as it is? • Should this be implemented with the whole group, small group, or one-on-one?
Revisiting Students' Thinking	Teachers may plan an intervention and revisit students' thinking about a concept, but do so in a way that does not fully articulate the thinking. It may include phrases like, "they can do it" and "most can do that." The word 'it' was used to describe a strategy the students struggled with and the strategy may not be fully elaborated to determine a targeted intervention.	T1: So if they're here right now. How do we get them to… How can we… Because they might come with this as an answer to start with. So how can we then jump them from here to here? (pointing on smart board) T2: Yeah, but most 'em can do that. T3: Well all the kids in this group- T1: Well your kid's in this group can. So… T2: They can do adding by place 3 digit.	• How did the student get the answer? • What is the next step to help move the student further along in the learning progression?

Stage 5



<u>What the ***Response to Intervention Framework Guide for Teachers*** says for Stage 5</u>:

Stage 5: Evaluate the effectiveness of the interventions

- Did the intervention work?
- How will you know if it worked?
- What will be your next steps if it worked? If it didn't work?

Stage 5		
Productive Features	**"Look Fors" (Productive)**	**"Look Fors" (Cautions)**
Teachers bring notes, comments, or feedback about the interventions they implemented	• Evidence that the teacher has reflected on the effectiveness of the intervention – notes, SMART Notebook documentation, selected pieces of student work.	• Teachers are not able to describe the intervention in detail. • The teacher did not bring evidence of the effectiveness (data/ student work) • Teacher did not bring notes or feedback. • Teacher did not review the students' work prior to the meeting. • Teacher does not have student work samples to share. • Teacher uses less descriptive talk. • Teacher is unable to describe next steps for students in the intervention group.
Teachers has students' work (if part of the intervention).	• Evidence that teacher has reviewed the students' work (it is sorted or grouped) • Teacher has selected important pieces of student work to share with the group. • Teacher refers to the student work as he/she reflects on the intervention noting specific details about students' understanding using descriptive talk. (See next page for notes about descriptive talk).	
Teachers engage in discussion as a PLC to reflect on the effectiveness of the implemented interventions.	• Teachers ask questions of each other to better understand how the intervention was implemented and/or how students responded. • As teachers reflect on the intervention, listen for how they talk about the students' thinking and the intervention's effectiveness. Are they using more descriptive talk or less descriptive talk? (see the next page for additional guidance on the types of talk) • Determine if teachers are using the students' work to reflect on their understanding of the concept. • Teachers determine next steps for the students in the intervention group.	

Types of Descriptive Talk for Stages 5:
As teachers engage in Stages 5 of the problem-solving process, listen for these types of descriptive talk. Consider the questions provided to strengthen the conversation.

Type of Talk	**Description**	**Example**	**Questions to Ask**
More Descriptive Talk			
Reflecting on the Interventions	Teachers reflect on how the intervention was implemented with students. They share details about the intervention so that the others understand how it was implemented.	"We talked about what, um, expanded form is since it's place value. Alright, so what we did was we started talking about expanded form. And I put up the number 29. And I told them, I said, "well how do you know that it's 29?' Like, what do you see? What can you tell me about it? So we talked about how 29 could be 2 tens and a 9. And a couple of them said it could be 4 fives and a nine. And we talked about how we could put those fives together and everything like that. Um, and then we kinda just went into, 'Well, what if I have 28?' 'What if I wanna combine them?' So one of my kids, um, one of 'em, actually it was your kid (pointing), came up. 'Well if we keep all of our- if we use the expanded form, and keep all of our tens in one area, and all of our ones in one area, it will be easier to add them all together.' Because they wanted to do like the number strings and it wasn't working out because they didn't know their tens and ones. So we did that one first."	• What was the purpose of your intervention? • How did it target the students' thinking? • Was it effective? How? • What would you change? • What questions did you ask of the students? • How did they demonstrate understanding?
Reflecting on Specific Students	Teachers discuss the progress of the interventions they implemented including how specific students in their groups learned the content and/or strategies specific students might have used.	"Then, Kayla was sort of on the right track. She said that she started out by thinking about 60 – 50. And it was ten. And she said that that was her estimate. And she knew that her answer would have to be close to that. But then she was one, she answered the other way. She answered 19. So she got to the ten, but then she moved one in the wrong direction instead of… so then she showed me that to check herself. She did it by, in parts. (60-50 = 10 estimate, 60-40 = 20, 20 – 9 = 11 on SMART Board)."	• How did your students respond to the intervention? • How do you know it was effective for each student? • Can you describe how students demonstrated understanding or lack of understanding?
Discussed Next Steps	Teachers describe what they plan to do next as a result of the learning from the intervention they implemented.	"So tomorrow, we're moving up and we're gonna try to do… instead of just what number do we see, 'Ok, so we see a 6. How many more would I need to make it a ten?' Well, I see there's 6. And there's 4 empty. And we're gonna try to… We'll see how that goes."	• What are the next steps for these students? • Does each student need the same next step? • How will you differentiate?

Less Descriptive Talk			
Generalized Reflecting	Teachers reflect on their implemented interventions using broad or general statements about how students were thinking or the strategies the students were using. The talk is not specific about what students might have understood or not understood after experiencing the intervention.	T1: I think they understand that negative number now a whole lot more. T2: Yes. T3: Because we actually focused on it a while lot more this year. T1: Right.	• Can you say more about what students understand? • Did they understand the concept better after the intervention? • How do you know? What does the student work show? • What made the intervention effective?

Appendix F

IRB LETTER

UNIVERSITY OF DELAWARE

RESEARCH OFFICE

210 Hullihen Hall
University of Delaware
Newark, Delaware 19716-1551
Ph: 302/831-2136
Fax: 302/831-2828

DATE:	March 21, 2013
TO:	Crystal Lancour, BSED, MI
FROM:	University of Delaware IRB
STUDY TITLE:	[442270-1] A Study of Teachers' Implementation of RTI for Mathematics: Teachers' Use of Resources to Gain Insights into Students' Thinking & Provide Targeted Instruction Aligned to Student Thinking.
SUBMISSION TYPE:	New Project
ACTION:	APPROVED
APPROVAL DATE:	March 21, 2013
EXPIRATION DATE:	March 20, 2014
REVIEW TYPE:	Expedited Review
REVIEW CATEGORY:	Expedited review category # 7

Thank you for your submission of New Project materials for this research study. The University of Delaware IRB has APPROVED your submission. This approval is based on an appropriate risk/benefit ratio and a study design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

This submission has received Expedited Review based on the applicable federal regulation.

Please remember that informed consent is a process beginning with a description of the study and insurance of participant understanding followed by a signed consent form. Informed consent must continue throughout the study via a dialogue between the researcher and research participant. Federal regulations require each participant receive a copy of the signed consent document.

Please note that any revision to previously approved materials must be approved by this office prior to initiation. Please use the appropriate revision forms for this procedure.

All SERIOUS and UNEXPECTED adverse events must be reported to this office. Please use the appropriate adverse event forms for this procedure. All sponsor reporting requirements should also be followed.

Please report all NON-COMPLIANCE issues or COMPLAINTS regarding this study to this office.

Please note that all research records must be retained for a minimum of three years.

Based on the risks, this project requires Continuing Review by this office on an annual basis. Please use the appropriate renewal forms for this procedure.

If you have any questions, please contact Jody-Lynn Berg at (302) 831-1119 or jlberg@udel.edu. Please include your study title and reference number in all correspondence with this office.