DISTRIBUTED INSTRUCTION AS A GROUNDED THEORY APPROACH TO DETECTING A RELATIONSHIP BETWEEN DISTRIBUTED LEADERSHIP AND INSTRUCTION

by

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DEDICATION

In honor of my mother, Woudnesh Ewnetu; two fathers, Harold Thames and Mulugeta Wodajo; daughter, Abyssinia Ewnetu Hoover; and the Seeds of Diaspora from which I grew in a land of unprecedented opportunity.

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Working with David K. Cohen has been the single greatest intellectual pursuit of my life. During my studies with David I was encouraged to ask deep questions about the dilemmas of teaching practice and the practice of managing those dilemmas through policies impacting leadership structures, funding, legal remedies requiring whole school reforms, and the alignment of research-based curriculum, teacher training, and student assessments. As we pushed hard on these questions at the recurring fore was the question of what constitutes the rational design of teachers' work given our desired outcomes for student learning. I read extensively across industry sectors on quality improvement, the design of feedback loops on technical practice, and the nature of apprenticeship in refining practice. What emerged from these studies was a desire to study teachers' work with an instructional leader in a school context that used research based curriculum, curriculum training, and classroom observations between an instructional leader identified based on her instructional expertise and more novice teachers.

I am deeply grateful for the support Kristi Holmstrom offered me early in this work. If it hadn't been for my experience teaching instructional leadership to Masters students at the University of Michigan with Kristi, I may never have met the instructional leader whose work with teachers and students became the site of my study. At the

earliest outset of my study, what I had set out to do was to investigate whether an instructional leader's work with teachers could influence shared instructional practices that were observably distributed across the teachers with whom she worked. What emerged from my study of practice were deeper insights regarding connections between mechanisms within distributed leadership, more specifically, and multiple dimensions of instructional practice. It was through this study that much of the reading and work I had done under David came to life, and without the depth and breadth of that reading the work involved in this study would have never come to fruition.

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Last, I would like to acknowledge my family and the seeds of Diaspora to whom this dissertation is dedicated. I come from a family of immigrants. My mother Woudnesh Ewnetu is the most sacrificial mother I have ever known. Her passion and compassion for her children is unsurpassed. She is the daughter of Balambaras Ewnetu

Hailu who was a merchant's son and a merchant himself from Gondar, Ethiopia. Ewnetu Hailu was an Ethiopian Jew who came to Addis Ababa with nothing but a donkey and became one of the wealthiest men in Ethiopia before the Ethiopian Revolution. If one might ever think to complain to my mother she might very well look you in the eye and say "Do you have more than a donkey? Then what's your excuse?" My father, Harold Thames, is a deeply religious evangelical American who has always unconditionally loved, supported and encouraged me. My second father, Mulugeta Wodajo, received his Masters in Education from Harvard University and his Ph.D. in Comparative Education from Columbia University on an Ethiopian government scholarship. He later became the Dean of the School of Education and Vice President for Academic Affairs at Haile Selassie University, now the University of Addis Ababa. His belief in the development of human capital as Africa's path forward, and as the Diaspora's means of making a lasting contribution to the continent, has inspired me to press on and forge ahead in my educational and career aspirations.

To understand the role of my family in my life is to first understand that I am the only American born child in my family. My other siblings were all born in Ethiopia and came to this country later in life. To Jima, Nini, and Hiwote words are inadequate to describe my appreciation and admiration of the lives you have forged for yourselves in America. Your courage and determination have always inspired me to never complain and to never take for granted the privilege of being born in the U.S., and the pride that comes with being born in Ethiopia. Jima is a medical doctor who has built a hospital in Ethiopia for those that would otherwise not be able to have access to medical care, while raising two children. Nini is an electrical engineer who has worked on space shuttles and

satellites for Boeing and Lockheed Martin, while raising two children. Hiwote is a nurse who works tirelessly around the clock to be the best, most compassionate nurse, while raising three children. To Felasfa, a renowned orthopedic surgeon, while raising two children; you are a constant reminder of excellence, grace and humility. I will never forget seeing you on television on Dateline, and thinking, why don't I know my brother is the kind of surgeon that would be on Dateline discussing specialized treatments for adults and children with rare bone tumors? Your accomplishments shine the brightest, and yet you always say the least. And the closest in age to me is Tizeta, my dearest sister, who has one of the sharpest and quickest minds I have ever engaged. She is a civil rights lawyer who has worked on behalf of women's rights on the African continent. She helped draft the Ethiopian Constitution and worked to protect women's rights in South Africa shortly after its Constitution had been drafted. With parents and siblings such as these, there has never been a reason for each of us to not continue, to not press forward, to not have compassion, to not dig deeper and dream bigger, and to not demand a contribution to the collective from ourselves. The belief in the development of human capital and the pursuit of education as a means of bettering our lives and our countries has been the thread that binds our work together. It is because of you that Mark and I named our daughter, Abyssinia Ewnetu Hoover, in honor of my mother's homeland, and without you I would never have begun the first step of the journey that has been this work. Thank you; you are my family and my life.

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ABSTRACT

This dissertation provides a conceptual model of distributed instruction in order to contribute to theory development regarding connections between distributed leadership and multiple dimensions of instructional practice. It also contributes a grounded theory approach to detecting a construct of distributed instruction across teachers' instructional practices. This construct and its detection across teachers' instruction introduces a new and emergent method of detecting a progression of instructional policy and practice alignment within the instructional dynamics of teachers working closely with an instructional leader.

CHAPTER 1

INTRODUCTION

American education researchers have put forth efforts to cultivate instructional policy and practice alignment through the study of logically consistent instructional policies intended to support the teaching and learning demands facing the nation's schools in the 21st century (Fuhrman, 1993; Honig, 2006; Porter, 2002, 2007; Spillane, 2001; Cohen, 2011). Theory and tool development to better understand when and under what conditions instructional practices align with coherent policies are especially salient to the work of instructional policy research in the United States given its vast decentralization (Cohen and Spillane, 1992; Porter, 2007). The study of mechanisms in support of instructional policy and practice alignment involves both policies and the activity of actors within and across various levels of instructional governance: State, district, school and classroom (Fuhrman, 1993; Cohen and Spillane, 1992; Cohen, 2011). Moreover, nested within and across each of these various levels are groups of leaders and followers, such that any person whom is a leader at one level of instructional governance may be a follower at another level of instructional governance (Spillane, 2006).

A prominent construct in education that developed to support the needed alignment between instructional policy and practice is distributed leadership (Spillane,

2001, 2006). Mutually cooperative leadership structures that can exist within distributed leadership are intended to improve an organization's ability to adapt to changing client needs compared to top-consolidated or traditional forms of leadership (Barnard, 1968). In the context of education the traditional model of leadership represents an individualistic, heroic model of principal as instructional leader (Spillane, 2006). In contrast to traditional leadership, when I use the term "distributed leadership" I am referring to a leadership structure that is distributed across teachers as instructional leaders. These instructional leaders serve as instructional mentors and coaches to the teachers whom have been their peers. The instructional leader as mentor and coach is someone whose role is to observe teachers teaching, and whose teaching is observed by those same teachers.

The distributed leadership structure in which teachers as instructional leaders serve as boundary spanners between district- and school-level leaders and the work of teaching, itself, can be described as a cooperative or mutually-constructed structure of power, knowledge and practice. For example, these instructional leaders may participate in district level trainings specifically focused on the knowledge needed for teaching, work and practice of teaching, and the development of observation protocols as a form of instructional improvement curriculum for the teachers with whom they work. As co-developers with district level instructional leaders these instructional leaders then use these tools together with the teachers they coach and mentor. It is in this way that instructional leaders within the context of distributed leadership may serve as boundary spanners that increase alignment between district- or school-level instructional policies and classroom-level instructional practices.

According to Jim Spillane (2001) elaborating a theoretical model of distributed leadership in schooling is necessary for those engaged in instructional leadership work to adequately support teachers to align their instructional practices with instructional policies designed to meet the changing teaching and learning demands of the 21st century. To this end, Spillane further developed the theoretical model of distributed leadership and its embedded forms of coordination in educational contexts. His elaboration of distributed leadership used vignettes of the work of administrators and instructional leaders operating within hierarchical, yet decentralized, layers of instructional governance in the United States. More specifically, in Spillane (2006) he provides evidence for the presence of distributed leadership in the leadership work of improving teaching and learning in schools. He uses vignettes of leadership activity to describe theoretically relevant interdependencies (Thompson, 1967) embedded in explicit forms of instructional leadership activity. It is precisely through these forms of leadership activity and the embedded interdependencies that a collective practice of enacted instructional policy coordination produces both vertical[1] and horizontal[2] alignment within the performance of leadership work.

In this dissertation I present a conceptual model of distributed instruction to contribute to theory development regarding connections between distributed leadership and teachers' shared instructional practice aligned to district-level policies. In particular, distributed instruction describes a hypothetical relationship between specific policy mechanisms and specific dimensions of shared instruction between teachers. I then use a

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[1] Vertical alignment refers to alignment *between* hierarchical levels of instructional policy governance.
[2] Horizontal alignment refers to alignment across multiple groups of leaders and followers *within* a given level of instructional policy governance

grounded theory approach (Suddaby, 2006) to inform my analysis of teachers' shared instructional practices that constitute the instructional leader's pedagogical routine as supporting evidence that policy mechanisms in support of *teaching as distributed activity* (Cobb, 2003) have actually influenced teachers' instruction. In order to elaborate on this hypothetical relationship between distributed leadership and instruction I use evidence for the presence of distributed instruction from vignettes of the instructional dynamics across the instructional leader and two teachers she mentors that are teaching the same 7th grade math lesson. It is through an analysis of shared instructional practice and the embedded theoretical interdependencies (Thompson, 1967) that I identify a construct of distributed instruction. Distributed instruction as an identifiable and observable construct within shared instructional practices across teachers provides a possible progression of instructional policy and practice alignment that begins with collective forms of shared instructional practice, and then moves to coordinated, and finally collaborative forms of shared or distributed instructional practice.

The problem I describe below is that current research on distributed leadership's influence on instruction stops at the lowest level of shared instructional practices, collective or pooled aspects of shared instruction, aligned to instructional policy. I describe why this is a problem and what a richer account of possible connections between policy mechanisms within distributed leadership and deeper dimensions of teachers' shared instructional practices with an instructional leader can contribute to our understanding of instructional policy and practice alignment.

The Problem

This dissertation provides a conceptual and analytic framework to address the lack of theory and empiricism that explicitly connects distributed leadership to shaping and changing deeper dimensions of instruction (Spillane and Burch, 2006). In particular, the lack of both theory and empiricism that explicitly connects distributed leadership to instructional dynamics within teacher-student interactions around the content has led some researchers to claim that distributed leadership is more a practice of re-labeling leadership roles than a construct that can be leveraged for improving teaching and learning in schools (Harris et al., 2007, 2009; Spillane and Burch, 2006). Consequently, education researchers have called for further theoretical and empirical contributions to detect how, in what ways, and in what contexts distributed leadership can be used to bring about instructional change (Harris et al., 2007, 2009; Camburn and Rowan, 2003). Given decades of research on instruction's resistance to influences from the administrative core by education researchers and organizational scientists alike (Weick, 1976; Meyer and Rowan, 1977), it is no surprise that the legitimacy of distributed leadership as a useful construct rests with its capacity to influence instruction. In fact, instruction's resistance to change has been a barrier to instructional policy's attainment of goals for teaching and learning, and thereby the field's own legitimacy, more broadly (Stigler and Hiebert, 2009, 1999; Bryk, 2009; Cohen, 1990; Firestone, 1989; Fullan, 1991; McLaughlin, 1987; Spillane et al., 2002; Cohen et al., 2003; Cohen, 2011).

Spillane and Burch (2006) critique criticisms that leadership does not influence matters of instruction in schools as outdated. They provide a more nuanced, rather than monolithic, view of how and whether leadership influences instruction in the era of

standards- and test-based accountability, in which policymakers legislate both what teachers should teach and acceptable levels of student achievement (Spillane and Kim, 2012). In particular, Spillane and Burch point to uneven dimensions of leadership's influence on instruction (Cohen and Ball, 1990). They describe six different aspects of instruction that may be influenced by leadership, though, unevenly: content, academic tasks, student groupings, classroom discourse norms, teaching strategies and instructional materials. *Content* refers to topic coverage, sequencing, and amount of time spent on particular topics. *Academic tasks* refer to the intellectual products students are expected to produce. *Student groupings* refer to how students are grouped for instruction including whole class, individual, and small-group arrangements. *Classroom discourse norms* refer to the ways teacher and students talk with one another around the content. *Teaching strategies* refer to strategies teachers use to engage students, including the types of questions they ask and the types of representations they use. *Instructional materials* include textbooks, curricular materials and manipulatives.

Spillane and Burch note that in the current standards-based environment of schooling distributed leadership is connected to some dimensions of instruction more clearly than others. Namely, matters of content, instructional materials, student groupings and academic tasks are more readily influenced by distributed leadership in mathematics and literacy, while less so in other content areas (e.g. science and social studies). However, they go on to highlight the conceptual and methodological challenges for future theoretical and empirical work that explicitly connect distributed leadership to shaping and changing instruction in a manner that encompasses all dimensions of instruction inclusive of deeper dimensions such as classroom discourse and teaching

strategies. As a result, in response to these calls for further research on distributed leadership's influence on instruction I suggest that an equally important question to raise is what do we expect to change in instruction because of distributed leadership, and what does that look like?

To date, Camburn and Han (2009) is the most developed work on connecting the influence of distributed leadership to specific dimensions of instructional practice. Camburn and Han developed measures of teachers' use of instructional leaders (as a measure of activated distributed instructional leadership), the extent of teacher clarity in expectations for instruction (a measure of activated distributed instructional leadership), and a survey of teachers' use of specific instructional activities (a measure of instruction). They found that teachers in America's Choice, a Comprehensive School Reform (CSR) known for a high level of distributed leadership, reported a higher use of desired instructional practices than similarly situated teachers in non-CSR schools.

However, while this study of distributed leadership's influence on instruction captures teachers' reported use of instructional activity or tool use espoused by America's Choice, it doesn't unpack how teachers adapted these tools to the client-facing environment of student thinking. I raise this point because the theoretical advantage of distributed leadership to traditional leadership is that it would provide greater adaptability to the client-facing environment, which among other things is inclusive of classroom discourse and teaching strategies teachers use with students. Moreover, the lack of teachers' instructional adaptation to student thinking around the content has been one of the primary obstacles to providing opportunities for students to learn highly ambitious

State content standards (Stigler and Hiebert, 1999, 2009; Cohen et al., 2003; Cohen, 2011).

In the context of mathematics teaching, for example, the dominant pedagogical routine is that the teacher initiates an instructional interaction with an academic task, the student responds, and the teacher evaluates whether the student's response is correct or incorrect. My use of the term "pedagogical routine" refers to a teacher's recurring set of instructional moves made in interactions with students around the content. In mathematics teaching the dominant pedagogical routine that I described above is referred to as IRE, Initiate-Respond-Evaluate pedagogy (Stigler and Hiebert, 1999; Schoenfeld, 2002). According to Schoenfeld (2002), the "[IRE sequence] can be implemented with a fair amount of latitude… however, the stereotype – grounded in reality – is that in traditional didactic mathematics lessons, short IRE sequences are ideal vehicles for fostering student mastery of procedural skill." Consistent with this view of IRE "grounded in reality" is a static, non-adaptive pedagogical routine that evaluates student thinking, and does not adapt to student thinking with further inquiry to support deeper understanding of mathematical concepts. It is for this reason that the IRE pedagogical routine is associated with students' shallow knowledge of math concepts that while perhaps sufficient in the 20th century has proven insufficient for the demands of the 21st century. As a result, if distributed leadership does nothing to interrupt the non-adaptive IRE pedagogical interaction with student thinking in mathematics teaching, there is no reason to believe that all students will have the opportunity to learn, let alone attain, the ambitious state standards or standards espoused by professional teaching organizations

such as the National Council of Teaching Mathematics (NCTM, 2001) and the Common Core Standards (Porter et al., 2011).

However, how exactly distributed leadership is suppose to disrupt the IRE pedagogical routine and how we would know it was the work of distributed leadership that disrupted the IRE pedagogical routine has yet to be specified. In theory, distributing leadership to teacher leaders with pedagogical expertise desired by the district should enable teachers to observe the instructional leader's instruction and enable teachers' instruction to be observed by the instructional leader. These reciprocal observations in theory would support teachers to learn the desired pedagogical routine performed by the instructional leader. Still to be answered though is, "How does one know if the instructional leader's pedagogical routine is being taken up by those teachers she mentors and to what extent?"

According to Lewis (2006) detecting an individual teacher's adjustment to, rather than evaluation of, student thinking is no small task; let alone detecting the distribution or spread of the instructional leader's adjustment to student thinking across multiple teachers' instruction. Lewis (2006) recounts from her experience watching videos of teachers' instruction with other teachers (both pre- and in-service teachers) that much of the physically visible work of teaching goes unseen by those observing instruction. The examples Lewis provides regard how the questions teachers pose in interaction with student thinking go unseen by observers. Lewis states that perception familiarity produces laxation (i.e. lack of detail) in what observers are able to see in instructional dynamics because of the mind's determination that it has seen this before. As a result,

pre-determined habits of mind create barriers to seeing previously unseen dimensions of practice, especially in the area of adjusting instructional moves to student thinking.

Perception bias then becomes a significant barrier to overcome in the analysis of a teacher's adjustments to student thinking in order to detect a pattern of shared adjustment to student thinking across teachers that converges with the instructional leader's pedagogical routine. Consequently, in order to detect an instructional leader's adjustment to student thinking I used an analytic framework by which to track such adjustments to student thinking by first distinguishing the separate instructional moves the instructional leader makes in a recurring fashion, constituting a pedagogical routine. I then used each of the instructional leader's instructional move as a unit of analysis through which to compare and contrast her instructional moves with that of the other teachers she works with closely. It is in this way that I address whether a given teacher's adjustment to student thinking converges with the instructional leader. Following these observations I conduct post-observation interviews to discuss instances of shared instructional practices between the teachers and the instructional leader to learn whether the factors the teachers say influenced shared instructional practices are connected to distributed leadership. It is in this way that I contribute to a grounded theory approach by which one may detect whether and to what extent teachers' shared instructional practices are plausibly connected to features of distributed leadership, and thereby alignment between instructional policy and practice. Consistent with (Glaser & Strauss, 1967) the grounded theory methods employed to develop a conceptual model of distributed instruction in this dissertation does not "make truth statements about reality, but, rather [elicits] fresh

understandings about patterned relationships between social actors and how these relationships and interactions actively construct reality." (Suddaby, 2006)

In so doing, I make efforts to build the conceptual and analytical tools Spillane and Burch (2006) state are needed for future theoretical and empirical work on the relationship between distributed leadership and instruction.

Dissertation Overview

This dissertation contributes a conceptual model of distributed instruction by elaborating a hypothetical relationship between policy mechanisms within distributed leadership and specific dimensions of a pedagogical routine inclusive of teachers' discourse norms and teaching strategies used with students around the content. By doing so, I define the hypothetical outcome of distributed leadership as a shared pedagogical routine that diverges from the dominant IRE pedagogical routine while converging to a pedagogical routine that is observable and consistent with that of the instructional leader. I provide a conceptual investigation of the organizational science origins of distributed leadership, and thereby distributed instruction, in order to provide the conceptual or theoretical basis for how policy mechanisms within distributed leadership could influence teachers' instruction inclusive of classroom discourse and teaching strategies below, and more fully in the conceptual framework in Chapter 2.

According to Thompson (1967), evidence of leadership's influence on technical performances occurs in three forms: *first* is through standard tool use, *second* is through coordinated plan of actions, and *last* is through shared adjustment to the environment. Top-consolidated or traditional forms of leadership may do well at attaining the first two forms of influence on technical performance (i.e. 1. standard curriculum or lesson plan

use and 2. shared pacing of lesson plans). However, the comparative advantage of distributed leadership to top-consolidated leadership is that its mutually constructed activities lend it to greater forms of teachers' shared adjustment to the environment of student thinking in ways desired by leadership (Barnard, 1968). Consequently, distributed leadership is hypothetically better positioned to disrupt the IRE pedagogical routine and bolster patterns of teachers' shared instructional adjustments to student thinking in a leadership-desired manner than traditional leadership. I put forth that a construct of distributed instruction as a hypothetical outcome of distributed leadership is the central task of instructional change in school reform efforts, and thereby removes ambiguity regarding the value-added role that distributed leadership can play in the process of instructional change.

The logic I follow in this dissertation has five parts. I *first* develop a conceptual model to explain the theoretical underpinnings of the basis for my hypothesis concerning which policy mechanisms within distributed leadership influence which dimensions of instructional practice. *Second*, I define the desired outcome of distributed leadership on instruction as the instructional leader's identifiable and recurring pattern of shared adjustments to student thinking. Again, this pattern of adjustment to student thinking among the teachers the instructional leader mentors must diverge from IRE pedagogy, and converge with the pedagogical routine of the instructional leader with whom the teachers work closely. *Third*, I devise an analytic lens for detecting the instructional leader's pedagogical routine in an attempt to identify what the district's desired pattern of adjustment to student thinking looks like in practice. *Fourth,* I determine whether the instructional leader's pattern of instructional adjustments to student thinking is shared by

teachers she mentors. By doing so, I identify whether teachers share patterns of adjusting to student thinking with the instructional leader in a manner that constitutes the classroom discourse norms and teaching strategies supported by distributed leadership within the school and district. *Last*, I conduct post-observation interviews with teachers to learn how a teacher came to perform similarly patterned instructional moves to the instructional leader. By asking where or how a teacher learned to make a specific instructional move I am seeking to learn whether and to what extent she shares instructional practices with the instructional leader due to policy mechanisms within distributed leadership. I then examine whether the factors said to influence similarity are in keeping with the hypothetical connections stated within my conceptual framework based on a review of organizational science literature.

Similar to Spillane and Burch (2006), the conceptual framework and analytic lens this dissertation provides to examine how, whether, and to what extent distributed leadership *can* influence instruction counters a dichotomized conception of whether distributed leadership influences instruction. Instead this dissertation develops a hypothetical spectrum of how policy mechanisms within distributed leadership might influence multiple dimensions of instruction in different ways, in order to predict what it would look like, in order to enable one to *see* it if it did occur. The ability to see connections between distributed leadership and instruction supports both research and practice on the iterative work of improving teaching and learning in schools through building district and school capacity to attribute small gains (Weick, 1984) in shifts in teachers' instruction. I use this hypothetical spectrum of instructional connections to

distributed leadership in order to introduce and elaborate three nested levels of distributed instruction.

The first of these constructed nested levels of distributed instruction is, *distributed instruction by shared content and tool use*. Distributed instruction by shared content and tool use requires that teachers use the collective resources of tools and curriculum provided by leadership within their district. This first level of distributed instruction includes shared dimensions of instruction Spillane and Burch refer to as instructional materials, student groupings and academic tasks (the level at which Camburn and Han's 2009 work on distributed leadership's influence on instruction stopped) and represents a *collective* form of shared instructional practice. The construct of *collectively* distributed instruction by shared content and tool use only concerns shared content and tool use and makes no distinction regarding how the content and tools are used in interaction with students, only that they are in fact used.

The second constructed level of shared instructional practice is *distributed instruction by plan*. Distributed instruction by plan requires teachers to adhere to the coordinated schedules put together in teachers' joint planning of joint instructional work for the purpose of attaining joint goals. In this second level of *coordinated* distributed instruction, teachers make joint plans for the pacing of specific instructional content that Spillane and Burch refer to as content coverage. This coordinated aspect of shared content coverage can be described as the pacing of instructional lessons from an already existent curriculum of joint lessons. This second level of *coordinated* distributed instruction by plan nests within it the first level of *collectively* distributed instruction by shared instructional materials, student groupings and academic tasks. In particular,

coordinating when to teach a lesson with other teachers has embedded within it the curriculum and instructional materials necessary to teach that lesson.

The third construct and last level of shared instructional practice is *distributed instruction by shared adjustment to student thinking* between a teacher and instructional leader. This third level of distributed instruction includes dimensions of instruction Spillane and Burch refer to as classroom discourse and teaching strategies that teachers use with students around the content. When a teacher adjusts to student thinking in a similar pattern with an instructional leader it is due to the teacher's instructional collaboration with the instructional leader. As a result, distributed instruction by shared adjustment to student thinking represents a *collaborative* aspect of shared instructional practices. Additionally, *collaboratively* distributed instruction by shared adjustment to student thinking nests within it the two prior levels of distributed instruction. What is noteworthy regarding the third level of distributed instruction is that since it includes the two lower levels of distributed instruction, it describes a shared instructional practice that encompasses all dimensions of instructional practice described by Spillane and Burch (2006). Perhaps, more salient still, is that shared adjustment to student thinking encompasses the feature of teachers' work with students that is most directly related to the attainment of schools' organizational goal of higher student achievement, i.e. teacher and student interaction around content (Cohen et al., 2003; Cohen, 2011; Stein & Coburn, 2008). As a result, an analysis of shared adjustment to student thinking can provide a snapshot of where on a continuum of instructional policy and practice alignment a given teacher's instructional practice exists in relationship to the instructional leaders' instructional practice.

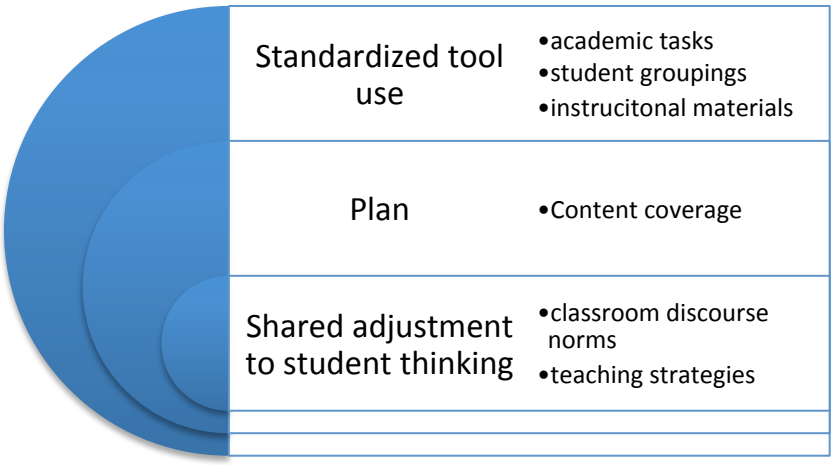


Diagram 1: Nested dimensions of distributed instruction

Given that previous research shows that distributed leadership can influence teachers' instruction in varied ways, the logical conclusion then is that *what* school leadership changes about instruction matters as much as the more researched question of whether or how different configurations of school leadership influences instruction (Rowen, 2002; Camburn & Han, 2009). Consequently, the problem my dissertation seeks to work on is further developing a conceptual model of *what* within distributed leadership influences *what* about instruction. Clarity regarding hypothetical connections between mechanisms within distributed leadership and dimensions of instructional practice can support a deeper understanding of the relationship between distributed leadership and instruction.

Overarching Research Questions

The primary overarching research question addressed by this dissertation is, "Is there a plausible or defensible construct of distributed instruction? If so, what is it and how is this construct of distributed instruction related to distributed leadership?"

The secondary overarching research question is if the first question is adequately addressed, “How might further visibility garnered by a conceptual model and analysis of distributed instruction support further alignment between instructional policy and practice in the iterative process of instructional improvement in schools?”

In service of these overarching research questions I ask the following subsequent research questions:

1. Does the construct of collectively distributed instruction offer a framework for analyzing teachers’ use of shared academic tasks and instructional materials?
    a. If so, does this framework illuminate whether, and to what extent similar and different academic tasks and instructional materials occur across teachers?
2. Does the construct of collaboratively distributed instruction offer an analytic framework that identifies the instructional leader’s adjustments to student thinking and its spread across teachers with whom the leader works with closely?
    a. If so, does the analytic framework illuminate whether and to what extent the spread of the instructional leader’s adjustments to student thinking varies between two teachers with whom she works with closely?
3. Does a conceptual model of distributed instruction enable researchers to connect mechanisms within distributed leadership to factors teachers say influence varying levels of distributed instruction between the instructional leader and two teachers with whom she works closely?

In the conceptual framework in Chapter 2, I return to the organizational science origins of distributed leadership. I define terms such as administrative core, technical core, and interdependence, and discuss the varying types of distribution at both administrative and technical levels of organizations, more broadly. I apply these organizational concepts to school leadership and instruction more specifically. Embedded in defining how administrative and teaching practices can be distributed are explanations of the divergent means by which professional (Shulman, 1987) and folk (Lortie, 1975) teaching practices are distributed across teachers' teaching. The conceptual framework in Chapter 2 also provides the conceptual basis that identifies which specific aspects of the administrative core are intended to connect to the technical improvement of teaching. I conclude Chapter 2 with descriptions of how these hypothetical connections to the improvement of teaching would be identified within multiple dimensions of teacher-student instructional interactions along a continuum or spectrum of distributed instruction. In Chapter 3, I describe how I use a grounded theory approach with observational data from a case study conducted within the context of a school's and district's attempt to influence 7th grade mathematics teaching, in order to develop the conceptual model and framework provided in Chapter 2, and to identify what a construct of distributed instruction would look like in practice in Chapter 5. In Chapter 5, I provide an analysis of a progression of distributed instruction from *collective* aspects of instruction such as shared academic tasks, instructional materials and student grouping use and *collaborative* aspects of instruction such as teachers' shared adjustments to student thinking. I claim that the detection of this progression can in and of itself provide further and necessary insight to the distributed leadership work of improving teaching

across a network of teachers. I likewise claim that the analysis of this progression of distributed instruction is partial evidence of connections between policy mechanisms and the performance of 7th grade mathematics teaching at the level of instruction. In Chapter 5, I use teachers' voices regarding the factors that influence teachers' teaching as the means of pointing towards partial evidence that observed shared instructional practices are due to one or many coordinating mechanisms within distributed leadership. I conclude in Chapter 6 with a discussion on the last overarching research question regarding how further visibility garnered by a concept and analysis of distributed instruction may support ongoing alignment between instructional policy and practice in schools. I conclude with implications and applications of a conceptual model of distributed instruction as useful construct for bolstering distributed leadership's capacity to influence instructional change -- instructional policy's 'holy grail.'

CHAPTER 2

CONCEPTUAL FRAMEWORK

In this chapter I address the first overarching research question of whether there is a plausible or defensible construct of distributed instruction? And if so, what is it and what is its relationship to distributed leadership? I address this overarching research question in an effort to use ideas and evidence to further develop a theory regarding how and in what ways distributed leadership may influence instruction. I begin this conceptual investigation by first reviewing the organizational science origins of distributed leadership. I posit that elaborating a conceptual framework based on a review of organizational science literature is important for advancing future empirical work on the comparative advantage that distributed leadership hypothetically holds over traditional leadership to influence instructional change. I use organizational science literature to provide a hypothesis of how policy mechanisms within distributed leadership connect to specific dimensions of instruction, as well as what the hypothetical outcome on instruction would be if leadership's instructional policy and teachers' instruction were connected or coupled. This hypothesis of how instructional policy mechanisms might influence instruction is used to introduce and elaborate the particulars of a conceptual model of distributed instruction. A conceptual model of distributed instruction also

includes the desired outcome of these mechanisms' influence on instruction by elaborating a construct of distributed instruction that details the specifics of what aspects of instruction are distributed across teachers.

In Chapter 3, I use the conceptual framework I provide in this chapter regarding the construct of distributed instruction to develop an analytic lens that can partially detect whether the hypothetical influence of policy mechanisms on dimensions of instruction exists across two teachers who work closely with an instructional leader who is part of a distributed configuration of leaders at the teacher level. In Chapter 4, I use observations of teachers' instruction to detect the existence of the hypothetical connections between leadership's policy mechanisms and all six dimensions of instruction defined by Spillane and Burch (2006): academic tasks, instructional materials, student groupings, content coverage, teaching strategies and classroom discourse norms. I argue in this dissertation that the detection of the desired pedagogical routines (involving all six dimensions of instruction) across multiple teachers' instructional practice can be used to detect the existence of a construct of distributed instruction. Detecting the construct of distributed instruction can subsequently support the development of a conceptual model of a spectrum of instructional policy and practice alignment. In Chapter 5, I use post-observation interviews to confirm whether teachers' perceive their shared instructional practices as connected to policy mechanisms based on teacher's narratives. I conclude in Chapter 6 that the detection of distributed instruction across multiple teachers' instructional practice or pedagogical routines can be used as an indicator of instructional policy and practice alignment.

The purpose of this chapter is to build a conceptual model of distributed instruction through a review of seminal concepts in organizational science literature that hypothetically enable the administrative core to influence practice within the technical core of organizations, more broadly. I review such concepts as the administrative core, technical core and the mechanisms within distributed configurations of leadership that the administrative core can use to influence technical practice in organizations, more broadly. I apply these organizational concepts to the schooling organization, in particular, in order to provide a hypothesis of how different coordinating mechanisms within distributed leadership influence specific dimensions of instruction and what instruction connected to leadership would look like. I, likewise, describe how a researcher can go about determining school leadership's instructional policy based on an analysis of the formal mechanisms leadership uses as ostensive structures to support instructional improvement.

I then use an analysis of the instructional leader's pedagogical routine in order to detect or "see" the leadership desired pedagogical routine. I argue that based on a researcher's capacity to "see" the desired pedagogical routine, this capacity can be used to detect and support the leadership-desired pedagogical routine's spread or distribution across a group of teachers working closely with an instructional leader. It is in this way that providing evidence of the construct of distributed instruction between the instructional leader's and teachers' instruction can serve as a means of detecting alignment between instructional policy and practice.

Literature Review

According to Daft (1978), the primary apparatus a professional organization has to influence the professional practice used within its technical core is the administrative

core. The administrative core is above the technical core in hierarchy and responsible for procuring and designing the human and material resource arrangements necessary for carrying out the technical functions (Daft, 1978; Thompson, 1967). The technical core constitutes the largest interface with the environment (Daft, 1978) and is shaped by "the materials which must be processed and the kinds of cooperation of different people required to get the job done effectively" (Thompson, 1967). By the very nature of this arrangement, the technical core is dependent on the arrangements of material and human resources necessary to carry out its technical function, just as the administrative core is dependent on the technical core in order for the organization to maintain its legitimacy. When the administrative core is able to influence technical practices, it is said that the two are "tightly coupled," and this coupling is substantiated by observable evidence that the administrative core has exerted such influence (Weick, 1976).

To be clear, the tools available to the administrative core to influence practice within the technical core or performance level of the organization are commodities, people with technical expertise, and the organization (Abbott, 1998). In the educational context, the commodity is the curriculum and the instructional materials necessary for conveying the content of the curriculum to students within instructional interactions. The curriculum has within it representations of the content knowledge that are thought to be necessary for students to learn. The curriculum also requires people with technical expertise. Such people are teachers who have pedagogical skills that support teachers' interaction with student thinking while maintaining the cognitive demand of the intended curriculum. In what theorists take to be a rational school organization, teachers' differing levels of pedagogical skill in interaction with students around content are used to identify

a teacher as having greater or lesser professional expertise (City et al., 2009). Where resources allow, this identification from the administrative core may take the form of a title and/or instructional leadership position, signifying the professional expertise embedded in that teacher. The teacher in this instructional leadership position then can be mobilized to observe classroom instruction and coach teachers while providing insights to district leadership regarding the implementation of the curriculum. In this way the instructional leader can be used as a boundary spanner to increase coupling between the administrative and technical cores through influencing the technical practices at the instructional level of schooling. Last, and of import to the shaping of this dissertation's research focus are the mechanisms within organizational routines that support instructional leaders' capacity to influence the practice of teachers with lesser expertise in an observably desired direction at the student-teacher interaction level in the classroom. I view these mechanisms as arms of instructional policy that can be used as levers to influence instructional practice.

Consequently, in the context of a professional or rational schooling organization, the administrative core is thought to have the design responsibility of: 1) selecting curriculum that has a rational basis for increasing student achievement to meet content standards set by the district in accordance with the state which may also be aligned to national standards[3] (commodities), 2) identifying teachers with expertise in teaching the curriculum selected and creating instructional leadership roles for them signifying this expertise (people), and 3) designing organizational routines that support the improvement

[3] Many states are adopting Common Core Standards (2009), which are also national standards.

of instructional practices in a manner that is distributed across a group of teachers (organization).

Teachers who work within the technical core are thought to have the parallel design responsibility of providing students with academic tasks and tools (commodities) within the curriculum and provided by the administration. Teachers also have available to them instructional leaders, other teachers, and students' prior knowledge (people) with whom to interact and use as resources in providing opportunities for students to learn content standards. Last, there are the organizational routines embedded in classroom discourse patterns and teaching strategies (organization) that influence students' access to the content made available through academic tasks and other instructional materials (Cohen, 2011; Lampert et al., 2010; Stein and Coburn, 2008).

The time, space and tools that constitute organizational routines are set into action by the administrative core and serve as ostensive structures that can influence the performative aspects of activity within the technical core (Feldman & Pentland, 2003). According to Thompson (1967) there are three primary coordinating mechanisms through which administrative policies can influence practice within the technical core of instruction. The three policy mechanisms are: 1) standardized tools and materials, 2) schedules, and 3) in-action communication routes. The traditional model of leadership may use the first two policy mechanisms of coordination to influence instruction. However, what sets distributed leadership apart from traditional leadership is that it uses *all three* mechanisms to influence instruction. I describe each mechanism below.

Standardized tools and materials refer to curriculum, lesson plans and instructional materials that are replicable and can be readily distributed to practitioners in

different settings. They are the replicable, explicit, and tangible aspects of practice stipulated and made explicit by school leadership. In the context of an accounting firm a standardized material might be the excel computer program that enables different accountants to have similarly structured accounting printouts. In the context of schooling organizations it means curriculum and instructional materials that have been given to teachers to enable common content coverage to students.

The coordinating policy mechanism of schedule is an opportunity for leaders and followers to come together to create joint plans. In the context of schooling organizations leaders and followers who meet weekly come together to create a shared pacing of lesson plans or content coverage for the week. They may decide on the timing of shared Unit Tests and shared lessons to prepare for the shared unit test. The mechanism of schedule can influence matters of shared instructional pacing or timing of classroom content coverage.

The coordinating policy mechanism of in-action communication routes solely regards the tacit and explicit forms of communication that occur when teacher leaders and teachers observe one another teaching. This is the primary way that the tacit aspects of the instructional leader's classroom discourse and teaching strategies are thought to be communicated to teacher followers. It is likewise in this way that teacher leaders can observe another teacher's developing capacity to teach using the desired classroom discourse norms and teaching strategies. By in-action communication routes I am solely referring to the structures of time and place that permit instructional leaders and teachers to see each other teaching. By solely referring to when instructional leaders and teachers observe one another teaching, I am excluding in-action communication routes that permit

instructional leaders and teachers to work side by side to plan lessons and assess student work, for example. In the schooling context in-action communication routes that involve teaching are typically referred to as opportunities for teachers to co-teach with an instructional leader or participate in classroom observations involving the instructional leader as either the one observed or the one doing the observing.

Additionally, leadership activities must involve salient phases of the quality improvement cycle (Deming, 1986) in order to have a rational basis for influencing instructional dynamics within the technical core of schooling. According to Deming, the salient phases of work that contribute to quality improvement within the performance of any organization entail devising a plan, implementing it, evaluating what went well or not so well, and reflecting on the evaluation and experience to inform the next phase of planning. Similarly, the phases of the improvement of professional practice of teaching occur in the planning of the lesson, teaching the lesson, assessing the teaching of the lesson and student learning, and reflecting on prior exchanges with students around the content to determine next steps within the next plan of interactions with students around content. These phases of supporting instructional improvement have been evidenced as useful in literature on communities of practice (Franke and Kazemi, 2001; Gallucci, 2003; Little 1982, 2003; McLaughlin and Talbert, 2001; Smylie and Hart, 1999; Stein and Brown 1997; Stein et al., 1998; Coburn 2001; Hill, 2001; McLaughlin and Talbert, 2001; Spillane, 1999).

In the context of distributed leadership, Spillane describes the commodity, people and organizational features the administrative core uses to influence instruction as work that is distributed across tools, leaders and followers, and organizational routines in

service of instructional improvement. Consequently, when distributed leadership activities are *connected to* a phase in the quality improvement cycle of instruction (planning, teaching, assessing, and reflecting), I hypothesize that the goal of these activities is to influence instructional policy and practice alignment. In this dissertation I focus solely on leadership work connected to observing teaching or co-teaching as a way to influence instruction. The desired outcome of this leadership work is the distribution of a desired professional/technical practice within the technical core that can be observed in teachers' interactions with students around the content. How effective the administrative core is at distributing the desired pedagogical practice within the technical core is a measure of how interrelated or tightly coupled the administrative and technical cores of instructional improvement have become. Said another way, how effective leadership is at influencing instruction is a measure of how aligned instructional policy and practice have become.

Evidence of this interrelation or alignment can be found in both the coordinating policy mechanisms within the administrative core that constitute distributed leadership and in the distribution of the desired technical practice, itself. In order to describe what this coupling or alignment might look like I further discuss: 1) three types of coordinating mechanisms within distributed leadership practice that serve as ostensive guides intended to influence the performative aspect of teachers' instructional practice, 2) what aspect of tools, people and the routines that structure space and time are specifically distributed within each coordinating mechanism, and 3) what is distributed within and across multiple dimensions of teachers' instruction as evidence of these policy mechanisms' influence on instruction. I describe the three coordinating policy mechanisms that can

serve as ostensive guides of instructional practice more fully in the below section titled "Distributed Leadership Practice." I describe three tiers of the distributive aspects of teachers' instruction that each of the dimensions of instruction specified by Spillane and Burch (2006) are nested within in the following section titled, "Distributed Instruction." I conclude that the hypothetical outcome of leadership's influence on instruction described in the section on "Distributed Instruction" can be used as a means of determining progressive levels of enacted instructional policy and practice alignment.

Feldman and Pentland (2003) refer to the ostensive and performative aspect of organizational routines. The ostensive aspect can include the tools, time and space for practitioners to do their work. Those aspects of the work are typically determined by the administrative core, and can shape the performative aspect of the work as it is being done. Consequently, I describe the three coordinating policy mechanisms of: 1) standardized content and tools embedded within the curriculum and other instructional materials, 2) schedules for joint planning between teachers, and 3) opportunities for classroom observations within distributed leadership as potential ostensive guides of performative work of instruction in the following section "Distributed Leadership Practice." I describe three performative and hypothetically nested levels of leadership's influence on instruction in the section "Distributed Instruction." In particular, within a conceptual model of distributed instruction I contend that all policy mechanisms within distributed leadership from the standpoint of having an influence on instruction can serve as ostensive aspects of instructional practices, while all forms of distributed instruction are performative. More specifically, the three policy mechanisms that I elaborate regard how products of administrators' work such as, instructional material/curriculum,

scheduling and organization of teachers' time for classroom observations that occur in the administrative core can be used to shape, guide and influence shared instructional practices of teachers. I describe this in further detail in the following sections.

Distributed Leadership Practice

Spillane (2001, 2006) describes interrelated activity across leaders and followers at a collective level of distributed leadership. He uses Weick and Roberts (1993) to describe the interrelation of activity between instructional leaders and teachers who see themselves as part of a collective practice. Based on Weick and Roberts work, I hypothesize that one way to ascertain that instructional leaders and teachers are acting within a collective practice of leadership or teaching is to determine whether instructional leaders and teachers teaching within the network: 1) have created social norms for how they act within the network, 2) act as though those norms exist, 3) construct their action by envisioning a system of joint action, and 4) connect that constructed action with the system they envision. One means for determining this is to examine the presence of a shared instructional goal, agreed upon strategy to attain that goal, collectively reflected on measures of the attainment of that goal and allow these debriefs to further inform their individual next steps within the technical core of instruction in the context of collective action (City et al., 2009; Wenger, 1999). Consequently, these four aspects of distributed leadership's support of technical or instructional practice can be used when seeking a site to investigate the influence of distributed leadership on technical practice.

As is the case in differing forms of distributed leadership specified by Spillane, this dissertation constructs differing forms of distributed instruction *within* the technical core. In the following section on "Distributed Instruction" I describe progressive levels

of alignment between the mechanisms of instructional policy provided by distributed configurations of leadership and observable dimensions of instruction. However, in order to support the novel lens of distributive instruction, I first enumerate the different uses of "distribute" in leadership practice. I do so that I may through comparison bring the uses of "distribute" within instructional practice into better view to support conceptual connections between the ostensive policy mechanisms embedded in distributed leadership practice and the specific performative dimensions of collective instructional practice across a group of teachers working closely with an instructional leader.

Distribute in distributed leadership defined

Spillane's use of the word "distribute" in the context of leadership` activity means to "separate and allocate [leaders] to distinct places or compartments." (OED, definition 5.) In this way, Spillane refers to three types of distributed leadership in relationship to where they are physically in the doing of the work.

> *Collective distribution* characterizes practice that is stretched over the work of two or more leaders who enact a leadership routine by working separately but interdependently. The interdependencies are akin to those in baseball or cricket, in which players at bat perform alone, but their actions in interaction with that of the pitcher or bowler collectively produce the practice.
>
> *Coordinated distribution* refers to leadership routines that involve activities that have to be performed in a particular sequence. The interdependency in this situation is similar to that in a relay race in track; the co-performance of the relay race depends on a particular ordered sequence.
>
> *Collaborated distribution* characterizes leadership practice that is stretched over the work of two or more leaders who work together in place and time to execute the same leadership routine, such as facilitating a faculty meeting. The co-practice in this situation is similar to that in basketball, in which players must interact with one another,

> passing to teammates when they stop dribbling and working to set one another up to shoot.
>
> (Distributed Leadership, 2006 italics mine)

Spillane credits his organization of levels of distributed work to an adaptation of Thompson's (1967) three-tiered levels of interdependence in organizational work, respectively.

> *Pooled interdependencies,* in which activities share or produce common resources but are otherwise independent.
>
> *Sequential interdependencies,* in which some activities depend on the completion of others.
>
> *Reciprocal interdependencies*, in which each activity requires inputs from the other.
>
> (Spillane, 2006)

However, in my use of Thompson (1967) I focus on what he refers to as three different types of coordinating mechanisms used by administrative policies to influence technical practice: 1) coordination by standardization, 2) coordination by schedule, and 3) coordination by in-action communication routes. Coordination by standardization and coordination by schedule can both be used by traditional and distributed leadership structures in schools. Recall that what separates distributed leadership as a leadership structure from traditional leadership is that it distributes leadership across teachers as instructional leaders who serve as instructional mentors and coaches to their peers. As a result, in the comparative context of research on distributed leadership and traditional leadership in schools, only distributed leadership has the coordinating mechanism of teachers observing other teachers in the action of teaching, i.e. in-action communication routes. In the context of distributed leadership classroom observations or in-action

communication routes are the means through which teachers' observe the desired pedagogical interactions embedded within an instructional leader's instruction. Hence, the rational basis upon which distributed leadership more effectively than traditional leadership supports teachers' adjustments to student thinking in ways desired by leadership is through the mechanism of formal classroom observations or co-teaching assignments in which instructional leaders mentor and coach teachers' pedagogical practice. .

Each of the three ostensive policy mechanisms intended to influence or guide instructional practice correspond to the above three types of interdependence intended to shape practice. I apply these three mechanisms Thompson specifies, to mechanisms that distributed leadership practice uses to *distribute* or "deal out" (OED, definition 1) an aspect of desired instructional practice. By doing so I further develop a conceptualization of how these policy mechanisms can influence and shape specific desired technical practices, or instructional moves that make up a pedagogical routine, across a group of teachers. In conclusion, I suggest that these three coordinating mechanisms at the administrative level correspond to three performative and hypothetically nested levels of distributed instruction that entail all six dimensions of instruction described by Spillane and Burch (2006) in the section titled "Distributed Instruction."

Administrative Policy Mechanism 1: Coordination by standardization, or in the schooling context, coordination by shared content tools and materials is captured by the administrative core's "establishment of routines or rules which constrain action of each unit or position into paths consistent with those taken by others in the interdependent relationship." (Thompson, 1967) The routines and rules are essentially ostensive *tools*

intended to influence practice in any of the four domains of teaching (planning, instruction, assessing and reflecting). Such tools may take the form of a worksheet, book, curriculum, rubrics, grading scale, and so on. Functions of standardized tools are to communicate a shared and consistent path among teachers within any of the four domains of teaching. Likewise, these tools are replicable, explicit, and tangible aspects of practice stipulated and made explicit by school leadership. The use of these tools in separate classrooms indicates pooled interdependence across three teachers' instructional practice. However, for the purposes of understanding how the mechanism of shared content tools and materials contributes to a construct of collectively distributed instruction, this dissertation's analysis solely focuses on the instruction domain of teaching.

The below diagram illustrates the leadership mechanism, coordination by shared content tools and materials by way of the 'doling out' or distributing tools from the administrative core to teachers in their separate classrooms. Three classrooms are depicted by three grayed circles, each of which contains within them the instructional triangle that Cohen et al. (2003) use to depict teachers' interactions with students around content. The arrows with the word "tools" denotes the standard curriculum content tools and other instructional materials that have been selected by leadership to constrain teachers' instructional actions into paths consistent with other teachers teaching the same content. Recall that coordination by standardization can exist in both traditional and distributed school leadership

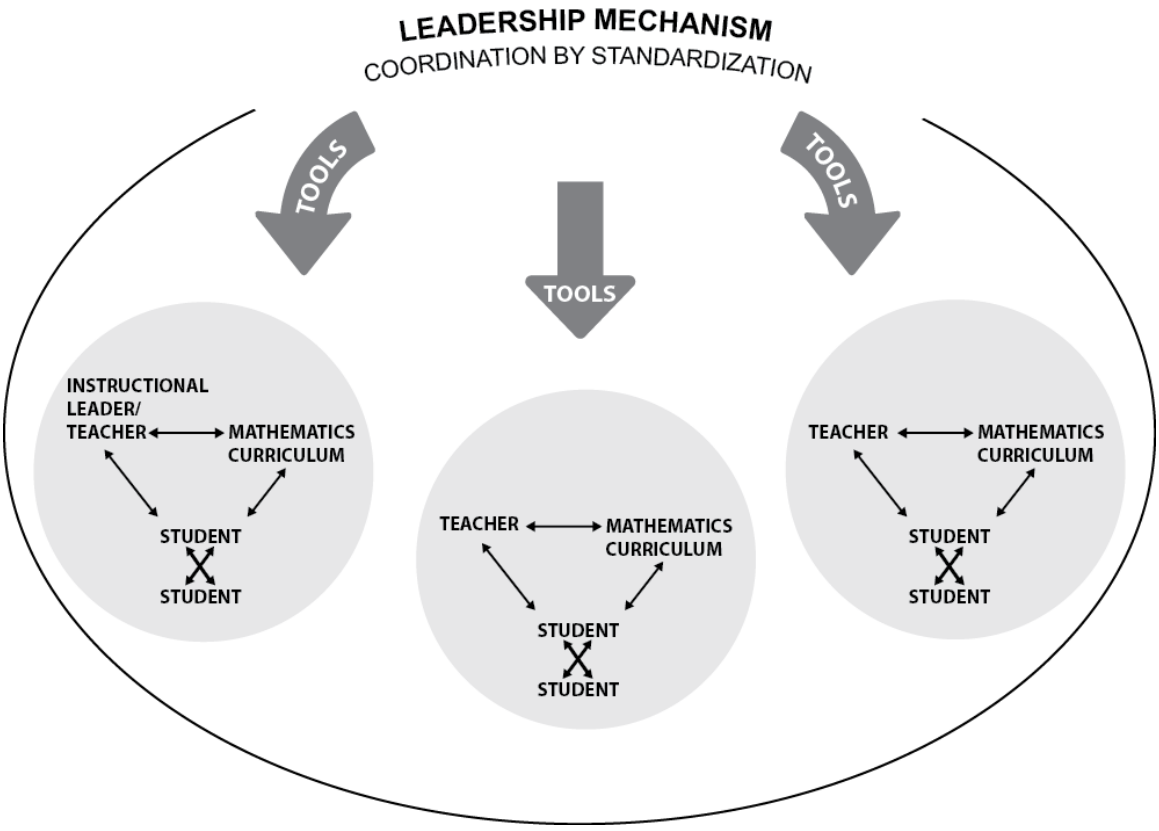


Diagram 2: Policy Mechanism 1, Coordination by Shared Content and Tools

Administrative Policy Mechanism 2: Coordination by schedule "involves the establishment of [joint] schedules for the interdependent units by which their actions may then be governed." (Ibid) This occurs through the administrative core's establishment of teacher *schedules* for joint planning routines involving joint lesson pacing, or any time to plan coordinated joint action. As a result, because the teachers and instructional leaders meet to jointly plan work it indicates sequential interdependence since joint planning is in sequence to joint action.

In order to illustrate the leadership's policy mechanism of coordination by schedule (that exists in both the traditional and distributed leadership) the below diagram shows teachers being taken out of their time with students to meet with other teachers and

instructional leaders. This meeting with other teachers requires the administrative core to have coordinated the schedules of teachers and instructional leaders. This leadership function of coordinating joint schedules for teachers working as a group affords them the opportunity to joint plan or joint pace upcoming lessons or tests. It is in this way that by creating time and space for teachers and instructional leaders to jointly plan that the leadership intends to coordinate teachers' actions with one another. This ostensive coordination is done in sequence, i.e. the administration coordinating joint schedules for teachers to meet, leads to teachers actually meeting.

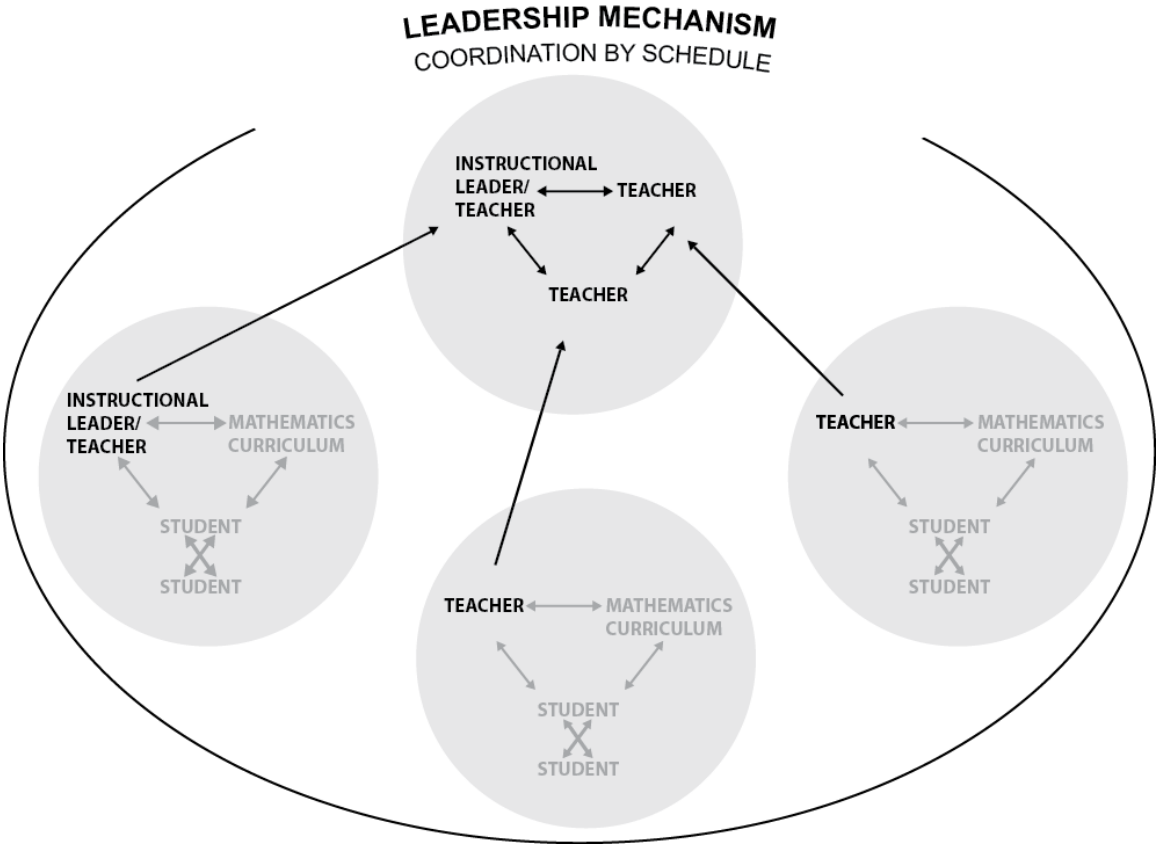


Diagram 3: Policy Mechanism 2, Coordination by Schedule

Administrative Policy Mechanism 3: Coordination by in-action communication or in the schooling context *Coordination by classroom observations* "involves the

transmission of new [or tacit] information during the process of action." (Ibid) In-action communication routes can apply to any instance of joint work between leaders and followers in which tacit aspects of the doing of the work can be transferred across individuals. However, in this dissertation I am focused on the action of instruction, and therefore apply the mechanism of in-action communication to the tacit communication of salient aspects of instruction that can occur when teachers and the instructional leader observe one another adjusting and responding to student thinking inside classrooms.

It is through observations of instruction that tacit communication routes regarding teachers' pedagogical routines are set into place. My use of the phrase coordination by classroom observations is broadly defined as classroom time between an instructional leader and teacher that can involve co-teaching or observations of instruction. The primary criteria I use for naming time shared between an instructional leader and teacher as classroom observation time is that it can transmit tacit aspects of what the leadership-desired pedagogical routine entails (when teacher observes instructional leader), or what aspects of the desired pedagogical routine have been acquired by given teachers (when instructional leader observes teachers). Especially salient to the coordination of in-action communication routes or classroom observations is that observations of teachers' and instructional leaders' instruction allow both the teacher to observe the instructional leader and the instructional leader to observe the teacher. As a result, classroom observations can enable reciprocal interdependence between the instructional leader and the teacher. In particular, when a teacher observes an instructional leader teach she may notice specific instructional moves within the instructional leader's pedagogical routine that she wants to use within her own instructional practice. When the instructional leader

observes a teacher the instructional leader can learn how to better support teachers' learning specific instructional moves by observing what aspects of the desired pedagogical routine were implemented in teachers' instruction and which aspects of their pedagogical routine remain uninfluenced. Such observations of teachers' instruction can enable an instructional leader to be more reflective on what approaches he/she is using with teachers and what more needs to be included to support teachers' implementation of the desired pedagogical routine.

It is in this way that reciprocal interdependence can occur within the instructional policy mechanism of classroom observations. The intended function of these classroom observations is to support the distribution of leadership's desired adjustments to student thinking from more expert teachers to less expert teachers. Recall that patterned adjustments to student thinking are instructional moves that occur within instructional dynamics and constitute what I also call pedagogical routines. Pedagogical routines are a recurring combination of instructional moves used in interaction with students around the content.

I illustrate Coordination by In-Action Communication or Coordination by Classroom Observations in the below diagram. Each of the teachers are taken out of their isolated classrooms and come together with the instructional leader to observe the instructional leader teach, co-teach a lesson with the instructional leader, or have the instructional leader observe one of the teachers teach. Such opportunities to observe one another's instruction can coordinate a pattern of shared instructional adjustments across teachers through the use of joint tools, and tacit information transfer regarding how to use those tools during observations. Such instances of tacit information transfer are especially

salient to the work of teaching, since much of the work embedded in instructional interactions lacks explicit and precise language. Therefore, much of what is critical to instructional change is dependent on being able to see the desired instructional change so that tacit forms of communication can support teachers' understanding of what specifically needs to change. By tacit, I mean those aspects of instruction that are embedded in instructional behaviors and actions that have not yet been made explicit. Hence, it is within tacit communication available through co-teaching with the instructional leader, observing the instructional leader's teaching, and having an instructional leader observe teachers' teaching that these salient aspects of pedagogical routines for adjusting to student thinking are communicated and can be shared across a group of teachers. Recall that coordination by instructional observation is of critical import to understanding the hypothetical basis for distributed leadership's comparative advantage to traditional leadership's capacity to influence instruction and thereby attain the organizational goal of improved student achievement.

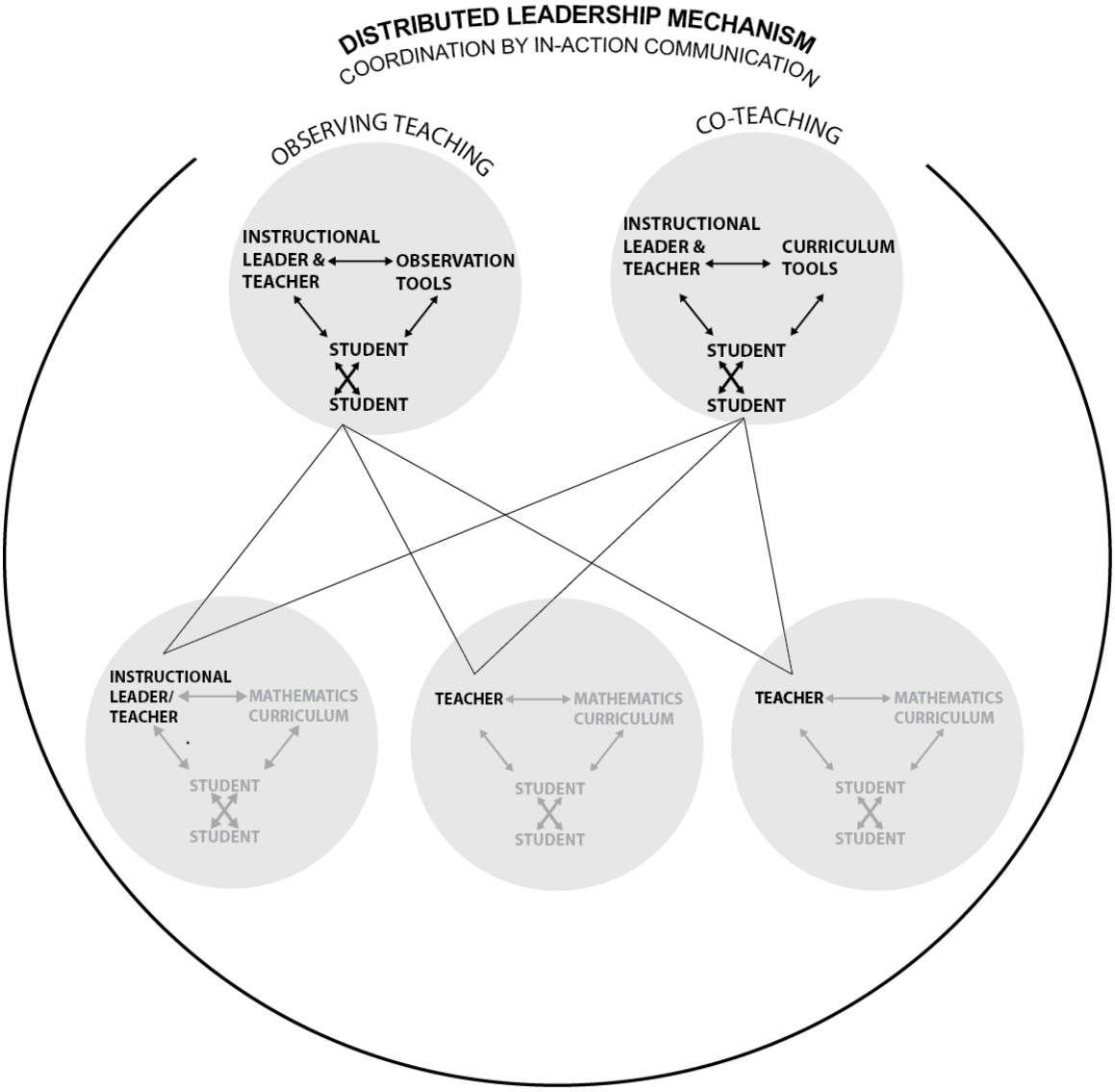


Diagram 4: Policy Mechanism 3, Coordination by Classroom Observation

Evidence that the above distribution of standardized *tools*, *schedules* and *classroom observations* have influenced instruction can be detected by analyzing teachers' instruction. However, an analysis of instruction requires that one knows what one is looking for in order to detect it. I provide a specific description of what a practitioner or researcher can expect to change about instruction as a result of policy

mechanisms' influence. These descriptions serve as hypotheses for how policy mechanisms can influence instruction that can later be confirmed to be related to a policy mechanism through teacher interviews and further research. In particular a policy mechanism can be said to influence the distribution of a desired instructional practice or pedagogical routine to the extent that teachers credit a specific observable aspect of their instruction to a coordinating policy mechanism used by the administrative core,

Consistent with organizational scientists Daft, Thompson, March and Simon, I describe the above *tools*, *schedules* and opportunities for *classroom observations* as belonging to the administrative core since they are products of administrators' work that can be used to coordinate material and human resources around the technical core to support effective practices within it. As a result, I am putting forward a concept of ostensive that views these specific administrative mechanisms as products of administrators' work that serve as the ostensive means by which distributed leadership intends to shape and support teacher learning of a desired, performative pedagogical routine. The performative aspect of pedagogical routines is the routine used by teachers when they teach students in isolation of other teachers and instructional leaders. When there are similarities of how practitioners or professionals interact with their siloed environment, I describe this activity as distributed across professionals and tools in environments. Consequently, while classroom observations are performative as they are occurring, they become ostensive guides that can support teachers instructional practices in isolation of one another.

In the following section I provide a conceptual investigation of whether there is a defensible construct of distributed instruction and what it looks like in practice. I explore

whether there is a defensible conceptual model of distributed instruction that elaborates its relationship to distributed leadership by providing a direct map of ostensive mechanisms of coordination from the administrative core to specific aspects of the construct of performative distributed instructional practices. This conceptual exploration provides a hypothetically nested tier of the performative construct of distributed instruction as an outcome indicator of progressive levels of instructional policy and practice alignment. In subsequent chapters I bring evidence and analysis to bear on this construct of distributed instruction.

Distributed Instruction

According to research on teacher-student interactions over the past 100 years, the dominant mathematics pedagogical routine in American schools is Initiate-Respond-Evaluate (IRE) (Hiebert & Stigler, 1999/2009). IRE describes a recurring pattern of interaction between mathematics teachers and students around the content. First, a teacher Initiates interaction with a student around the content by posing a question. Second, the student Responds. Third, the teacher Evaluates whether the student's response is correct or incorrect. In particular, in the industrial era the IRE pedagogical routine sufficiently taught students mathematics in a way that met the demands of that era. Interestingly, IRE is not a recommended pedagogical routine for the learning demands posed by the information economy requirement of critical thinking and reasoning in the 21st century (NCTM, 2001; Porter et al., 2011).

Nevertheless, current research on teaching still evidences IRE pedagogical routines as a normed practice in American mathematics teaching (Stigler & Hiebert, 2000/2009). The pedagogical norm of IRE and its means of distribution throughout the

instructional practices of the nation's teachers have led me to label it a non-professional teaching practice of the 21st century rather than a professional teaching practice (Shulman, 1987). Nowhere is it written that the IRE pedagogical routine found in American mathematics teaching in the industrial era is the desired teaching that a professional organization of teachers prescribes for the 21st century. Rather, according to Lortie (1975) and Shulman (1987) the distribution and prevalence of the IRE pedagogical routine in American teaching is primarily a byproduct of the way teachers were taught mathematics as students, themselves. This is at least one explanation for the persistent dominance of the IRE pedagogical routine in mathematics classrooms in the United States. Namely, the IRE pedagogical routine is dominant because it is the pedagogical routine of teaching mathematics that has been most used and observed by mathematics teachers as a matter of historical context. My use of distribute in the context of the IRE pedagogical routine is "spreading or dispersing abroad through a whole space." (OED, definition 2.)

The administrative core's work of intentionally designing the distribution of a desired teaching practice across a network of practitioners is typically done with the purpose of disrupting the dominant IRE pedagogical routine found in American mathematics teaching. My use of "distribute" in the context of intentional design by the administrative core means "to employ in its full extension, so that it includes every individual of the class [e.g. class of teachers]" (OED, definition 6). This concept of an intended technical practice being distributed by policies of an administrative core harkens back to March and Simon's (1958/1993) *performance program*. However, the specification level of the desired technical performance -- and practitioners' capacity for

seeing the desired performance and how it differs from their own current practice -- has direct implications for how well coordinating policy mechanisms are likely to be able to distribute this performance across teachers.

In the context of schooling, teaching is a relatively underspecified performance compared to other professional performances (Shulman, 1987). Consequently, when the administrative core identifies a teacher with instructional expertise and gives that teacher the title of "instructional leader," it is enacting instructional policy by identifying that teacher as having the desired pedagogical routine. Namely, leadership is communicating that the desired instructional or pedagogical performance is embedded in her instructional practices. As a result, the instructional moves that make up the desired pedagogical routine can be identified by observing the instructional leader's pedagogical routine. It is in this way that classroom observations of the instructional leader can serve as a means of communicating the instructional policy of the administration. Namely, when leadership chooses a teacher to serve as an instructional leader based on the determination that a particular teacher has the desired pedagogical expertise, I hypothesize that leadership is enacting instructional policy, and thereby identifying the pedagogical routine it desires. While this may not always be the case when school leadership chooses an instructional leader, it is an aspect of site selection that I use to determine a site for an examination of how distributed instruction can function as a grounded theory approach to detecting instructional practice and policy alignment.

Given the underspecified nature of desirable pedagogical routines in most school settings it is unlikely that the coordination mechanisms of *standardized content tools* and *schedules* under the traditional model of leadership are sufficient coordinating

mechanisms to influence the historical inertia of the IRE pedagogical routine found in mathematics teaching in the United States. Rather, because of the underspecified nature of a more desirable pedagogical routine, it may be identified through observations of the embedded behaviors of teachers who have been identified as having instructional expertise. As a result, given that the desired pedagogical routines are more likely embedded in the instructional moves of the instructional leader than in an explicit document, the distribution of this practice necessitates the coordinating mechanism of *in-action communication routes* or classroom observations in ways that other organizations with further specified technical cores may not face.

Consequently, leadership with a rational and intentional design to distribute a leadership-desired pedagogical routine would distribute leadership to teachers who teach using the desired pedagogical routine. These identified instructional leaders would then serve as instructional mentors and coaches to their peers through the full utilization of all three ostensive coordinating mechanisms: standardized content tools, schedules, and classroom observations. These coordinating mechanisms could more likely influence instruction if they were to give other teachers access to the planning of a leader's instructional performance, observing a leader's instructional performance, assessing the differences in a leader's instructional performance compared to their own, and reflecting on one's own next action steps in relation to aligning one's own instructional practice to the instructional performance policy embedded in the instructional leader's practice. Evidence of alignment between instructional policy and practice occurs in a hypothetically nested progression of three tiers of instructional practice that I describe in the next section.

Distribute in distributed instruction defined

I describe the three tiers of instructional policy and practice alignment in the below table. The left column describes the coordinating policy mechanism that can be designed to influence one or more dimensions of instruction (Spillane and Burch, 2006) in the right column. According to a conceptual model of distributed instruction alignment between leadership's policy mechanisms in the left column and observations of shared dimensions of instruction in the right column, provide a progression of enacted instructional policy and practice. I describe each nested tier of distributed instruction below, as well as where the six dimensions of instruction described by Spillane and Burch (2006) fit in with respect to a specific level of distributed instruction. The three forms of the construct of distributed instruction are: *collective* distribution, *coordinated* distribution and *collaborative* distribution. I use these three forms of distribution found in the literature on distributed leadership and apply them to distributed instruction and connect them to the six dimensions of instruction that can be observed in teachers' instruction: academic tasks, instructional materials, student groupings, content coverage, classroom discourse norms and teaching strategies.

Table 1: Conceptual Model of Distributed Instruction

Distributed Leadership (Coordinating Mechanisms)	**Distributed Instruction (Dimensions of instruction)**
Policy Mechanism of Providing Standardized Content Tools and Instructional Materials (e.g. curriculum that includes academic tasks, instructional materials such as overheads or handouts or manipulatives, suggested student groupings)	*Collectively* distributed instruction by Shared Content and Tool Use (*i.e. teachers actual shared use of academic tasks, instructional materials such as overhead projections and/or manipulatives to convey the academic task or for students to use to work on the academic task, and student groupings*)
Policy Mechanism of Schedule (*i.e. providing shared schedules for teachers to plan shared pacing of content coverage with students*)	*Coordinated* distributed instruction by plan (*i.e. teachers' actual shared pacing of content coverage or lesson plans with students*)
Policy Mechanism of Classroom Observations (*i.e. providing schedules for teachers to observe the instructional leader and other teachers in the action of teaching*)	*Collaboratively* distributed instruction by shared pedagogical routines that adjust to student thinking (*i.e.* shared teaching strategies and classroom discourse norms that are aligned with the instructional leader)

Collective distribution of instruction by shared content tools and instructional materials. This is captured by the use of collective resources in the form of similar academic tasks from the curriculum, instructional materials, student groupings, and overall shared tool use across teachers' instruction. Collective distributed instruction by standardized content tools and instructional materials happens due to *leadership's* policy mechanism, coordination by standardized content tools and instructional materials. Note that there is no specification for how these tools are used at the level of collective distributed instruction. Namely, one teacher could use these tools in a manner reflective of the district-desired pedagogy, while another teacher could use these tools in a manner reflective of IRE pedagogy. Collective distributed instruction is a form of pooled interdependence across teachers. Recall from collective distribution described in the

distributed leadership section above that pooled interdependence refers to activities that share common or *collective* resources but are otherwise independent. At this level of interdependence or coupling how those collective content tools and instructional materials are used in one setting is independent of how they are used in another setting. This aspect of distributed instruction simply denotes that teachers are using common content tools in classroom teaching.

Coordinated distribution of instruction by plan or content coverage. This is captured by teachers teaching with an agreed upon pacing of lessons regarding who teaches what, and when. Whether teachers choose to teach at the same pacing or a slightly staggered pacing, the performance of a planned pacing of lessons and unit tests is related to the policy mechanism of coordination by schedule. The form of interdependence between coordination by schedules and teachers actually using a common pacing of lesson plan coverage (or content coverage) is sequential interdependence. Recall from coordinated distribution in distributed leadership that sequential interdependence denotes that some activities depend on the completion of others. In this case, teachers teach with a common pacing of lessons is dependent on teachers agreeing to coordinate their schedules to do so. Moreover, since teachers share curriculum materials and tools for the lessons they are developing a shared pace for covering, coordinated distributed instruction by content coverage has nested within it collective distributed instruction by standardized content tools and instructional materials.

Collaborative distribution of instruction by shared adjustment to student thinking. This is captured by whether teachers share observable patterns of adjustment to student thinking with the instructional leader. Due to the underspecified nature of teaching much

of how a shared pattern of adjustment to student thinking is distributed across teachers' instruction is through the policy mechanism of classroom observation. The form of interdependence between classroom observations and shifting teachers' adjustment to student thinking is reciprocal interdependence. I hypothesize that it is more likely through classroom observations and instructional *collaboration* between the teacher and the instructional leader that one can expect to see shifts in teachers' adjustments to student thinking that mirror that of the instructional leader. And it is within distributed leadership that leadership is distributed to the teacher-level and supported through classroom observations in which instructional leaders serve as instructional mentors and coaches through reciprocal observations of teaching or co-teaching as sites of teacher learning. It is for this reason that from an organizational science lens on the schooling organization that distributed leadership has a comparative advantage to influence instruction over traditional leadership. I hypothesize that nested within collaborative distributed instruction are both *coordinated* distributed instruction by content coverage and *collective* distributed instruction by shared content tools and instructional materials. Consequently, as a result of the reciprocal interdependence within collaboratively distributed instruction what is shared between teachers and an instructional leader is how tools and content are used in interaction with student thinking.

Differentiating levels of distributed instruction supports us to see the structures of human and material resources around the technical core that hypothetically bring about instructional change within specific dimensions of instruction. It likewise clarifies that distributed leadership studies on instructional change that solely refer to tool use and content coverage, alone, do not highlight the comparati.ve advantage that distributed

leadership hypothetically offers to efforts to influence instruction. What this conceptual exploration of a construct of distributed instruction attempts to articulate is more clarity about what distributed leadership can be expected to change about instruction as compared to what traditional leadership can be expected to change about instruction. By articulating clearer expectations of what specifically is likely to change about instruction, due to the influence of distributed instruction, we can become clearer about a desirable outcome for distributed leadership's influence on instruction compared to traditional leadership.

Moreover, the conceptual model of distributed instruction provided in this dissertation begins to provide a nested progression of instructional policy and practice alignment with respect to policy mechanisms and specific dimensions of instruction. Namely, teachers can use the same collective resources of standardized content or standardized tool in any given moment of instruction. Teachers could choose to use the same standardized content or standardized tool without considering when other teachers are using those same standardized content and standardized tools, and thereby not adhere to a coordinated distributed instruction by plan. Additionally, the use of standardized content and tools -- and consideration for when other teachers use standardized content and tools -- is still separate from how teachers use a standardized tool within an overall dynamic of adjusting to student thinking. Simply because teachers use the same standardized tool in a given moment of instruction, within an agreed upon pacing, does not mean they are using the standardized tool in a manner consistent with overall leadership/curriculum-intended instructional dynamic for which the standardized tool is intended. For instance, a teacher could use the same standardized content and tools,

within the same pacing of lessons as other teachers, and use it in a manner indicative of IRE pedagogy while other teachers use it in a manner indicative of the district-desired pedagogy. Consequently, research on distributed leadership that points to the teachers use of shared content and tools is clearly missing the mark of what is expected from distributed leadership versus traditional leadership. It also speaks to why research with a sole focus on shared content and tool use continues to leave the promise of distributed leadership as a worthwhile policy endeavor open to so much speculation and suspicion.

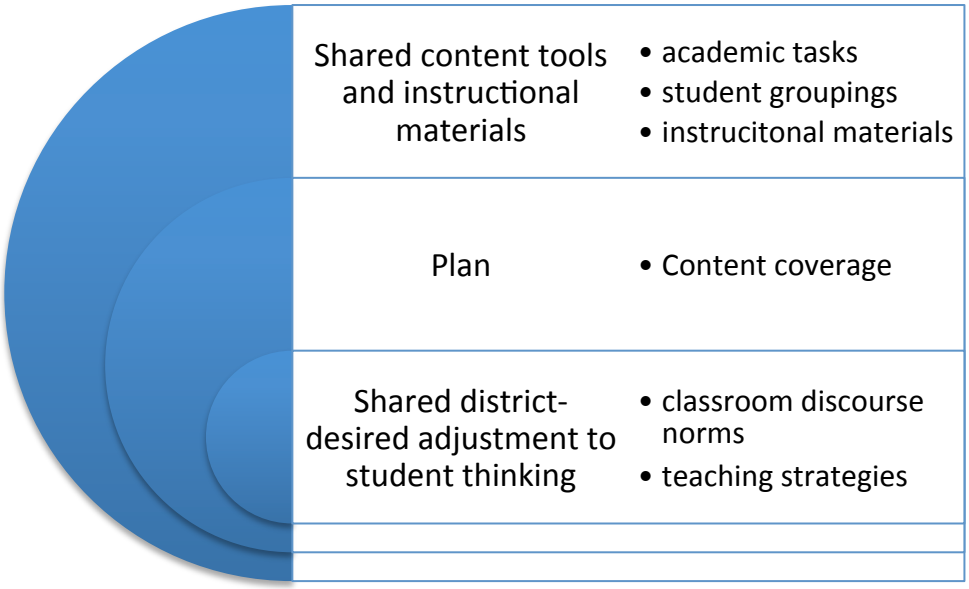


Diagram 6: Nested dimensions of distributed instruction

In fact, it is for this very reason that Spillane and Burch (2006) and Harris et al. (2009) find studies of distributed leadership's influence on instruction wanting of evidence on deeper aspects of instructional dynamics. Namely, to date, the best research we have on distributed leadership's influence on instruction stops at providing teacher self-report data on standardized content and tool use (e.g. Camburn and Han, 2009).

Contrasting distribute in leadership and instruction

In conclusion then, when I refer to the word distribute in the term distributed instruction I mean that the administrative core has distributed an aspect of identifiable shared instructional practices across teachers. When distribute is used in the term distributed leadership it is describing how leadership activity is shared across the work of two or more leaders. Please note that I use the word distribute in distributed instruction to describe shared instructional activity in a slightly different, though still analogous manner, to how the word distribute is used in distributed leadership to describe shared leadership activity. This difference is related to the differences in the nature of leadership activity versus instructional activity. In the case of collectively distributed leadership and collectively distributed instruction the word "distribute" is used in the same fashion. For example, collectively distributed instruction refers to the collective resources provided by the administrative core that teachers share in their instructional activity. Collectively distributed leadership refers to the same aspect of shared practice in that the leaders are using the same material tools though in different locations.

Coordinated distributed instruction, however, refers to teachers shared ordering or pacing of content coverage. In other words teachers agree to the sequential ordering of lessons and to teach them in sync with one another in a coordinated fashion. Conversely, coordinated distributed leadership refers to more of a relay race model between leaders in that one leader performs one leadership task before the other leader can perform another leadership task.

Last, collaboratively distributed leadership refers to two leaders performing a leadership activity in the same time and space as one another. In contrast collaboratively

distributed instruction refers to shared teaching strategies and classroom discourse norms that are embedded within teachers' adjustments to student thinking in relationship to the content in a similar manner as the instructional leader. Collaboratively distributed instruction and collaboratively distributed leadership are similar in that the aspects of shared work are distributed through the same coordinating mechanism of in-action communication routes that exist when two actors share the same space and time as is the case through classroom observations or co-teaching or jointly performing a leadership activity. Below I provide a table juxtaposing how the word "distribute" is used in a slightly different, though still analogous, manner based on differences in the sorts of work involved in leadership versus instructional activity.

Table 2: Contrasting Uses of Distribute

Contrasting Uses of Distribute	
Distributed Leadership	**Distributed Instruction**
Collective distribution characterizes practice that is stretched over the work of two or more leaders who enact a leadership routine by working separately but interdependently. The interdependencies are akin to those in baseball or cricket, in which players at bat perform alone, but their actions in interaction with that of the pitcher or bowler collectively produce the practice.	*Collectively* distributed instruction by Shared Content and Tool Use (*i.e. teachers actual shared use of academic tasks, instructional materials such as overhead projections and/or manipulatives to convey the academic task or for students to use to work on the academic task, and student groupings*).
Coordinated distribution refers to leadership routines that involve activities that have to be performed in a particular sequence. The interdependency in this situation is similar to that in a relay race in track; the co-performance of the relay race depends on a particular ordered sequence.	*Coordinated* distributed instruction by plan (*i.e. teachers first plan the pacing of lessons and then are able to demonstrate shared pacing of content coverage or lesson plans with students*). It is in this way that the shared planning time for teachers provided by the administrative core supports the ordered sequence of shared content coverage between teachers.
Collaborated distribution characterizes leadership practice that is stretched over the work of two or more leaders who work together in place and time to execute the same leadership routine, such as facilitating a faculty meeting. The co-practice in this situation is similar to that in basketball, in which players must interact with one another, passing to teammates when they stop dribbling and working to set one another up to shoot.	*Collaboratively* distributed instruction by shared pedagogical routines that adjust to student thinking encompasses shared teaching strategies and classroom discourse norms that are similar to the instructional leader. This form of shared instructional practices is theoretically distributed across teachers' instructional practice through sharing the same time and space when teaching either in the form of co-teaching or classroom observations.

Analytical Consideration

How one goes about analyzing instructional policy and practice alignment vis-à-vis constructs of collectively distributed instruction by shared content and tool use, and collaboratively distributed instruction by teachers' shared district-desired adjustment to student thinking are quite different from one another. The analysis of whether teachers

share content and instructional materials has been documented by other researchers (Porter, 2002; Porter et al., 2007; Camburn & Han, 2009). On the other hand an analysis of teachers' shared, district-desired adjustment to student thinking requires an analytical investment. The analytical investment this dissertation provides is a map or analytical framework of convergent practice across teachers' interaction with students through tools used, content delivered, and mathematical concepts to which teachers are attempting to support students to understand. The mathematical concepts to which I refer are also known as the mathematical goal to which teachers attend as they interact with student thinking (Ball, 1993). However, given the unseen properties of teachers' adjustments to student thinking (Lewis, 2006), I employ Cohen et al.'s (2003) instructional triangle as a technology in service of illustrating and making visible embedded instructional moves within the instructional leader's pedagogical routine. I further describe the methods through which I apply the analytical contributions of the dissertation to detect teachers' shared, district-desired adjustment to student thinking in Chapter 3.

Conclusion

At this time in American schools it is not uncommon for a district to take on a standards-based curriculum, and to establish joint planning time for the pacing of lessons, unit tests, and preparations for state or national assessments. However, what are less likely are formal classroom observations in support of patterns of shared adjustment to student thinking that underlie a desired pedagogical routine. In fact, such patterns of shared adjustment may not even be seen as desirable and may not be stated as an instructional goal for a group of teachers in most school settings. Such schooling contexts will emphasize the role of all teachers as professionals and experts and will

choose to not distinguish among their staff those teachers with more expertise than others. This is especially the case when the administration does not understand how to support learning from a teacher with embedded expertise even when the administration recognizes that expertise.

It can generally be said that in the era of standards- and test-based accountability districts are experiencing some success with efforts to distribute desired elements of instructional practice (Spillane and Kim, 2012). In particular, as a result of standards and test-based accountability teachers can use the same curriculum and instructional materials, though in vastly different ways (Cohen and Ball, 1990). And since, the curriculum and instructional materials do not teach students, themselves, what matters is how those academic tasks, instructional materials and student groupings are used by teachers in interaction with students around the content. Moreover, absent a strong focus on the coordinating policy mechanism of classroom observations that is available in distributed leadership, it is unlikely that changing teachers' instructional dynamics with students around the content – where the learning occurs – is adequately supported to occur.

Given this current context of American schooling, I set out to find a district engaged in efforts to influence what teachers actually do with students around content. Based on my conceptual investigation of what distributed instruction is and what coordinating policy mechanisms influence it, I found a district and a school within that district that had basic design elements that could, in theory, support the distribution of a desired instructional practice inclusive of shared adjustments to student thinking between the instructional leader and teachers she works with closely. In the next chapter,

"Methodology," I outline those site selection requirements of a district and school necessary for me to glean insights into the contextual and organizational factors constituting distributed leadership that plausibly influence the distribution of a desired pedagogical practice. I then describe the methodology I used to bring evidence to bear on what varying levels of distribution of a desired instructional practice by plan, standard tool use, and shared adjustment to student thinking look like in classrooms. Last, I explain how the semi-structured, post-observation interview protocols leveraged sites of convergence and divergence across teachers' instructional practice to glean insights from the teachers involved on how context and organizational routines influenced practice in a desired direction.

CHAPTER 3

METHODOLOGY

This chapter describes the grounded theory approach that I use to bring evidence to bear on the construct of distributed instruction and shed light on the conceptual model that describes its possible relationship to coordinating policy mechanisms within distributed leadership. The conceptual model provided in Chapter 2 emerged from my retroactive reflection on literature in mathematics teaching (Hiebert and Stigler, 1999), organizational science (Thompson, 1967), and distributed leadership (Spillane, 2006, 2001) that came to mind as I was collecting and analyzing data. It is from my consultation of the literature together with the data that categories of collectively, coordinated and collaboratively distributed instruction between teachers were conceptually connected to the administrative core's attempts to influence instruction through the distribution of content and tools, time for teachers' joint lesson planning and opportunities to observe one another's teaching through classroom observations and co-teaching began to emerge (Suddaby, 2006). It is in this way that my development of a conceptual model of distributed instruction that identifies plausible connections between conceptual structures in the administrative and technical cores of schooling reflect a key element of grounded theory by "identifying a slightly higher level of abstraction – higher

than the data itself" (Martin & Turner, 1983:147). Consistent with (Glaser & Strauss, 1967) the grounded theory constructed in this dissertation does not "make truth statements about reality, but, rather [serves] to elicit fresh understandings about patterned relationships between social actors and how these relationships and interactions actively construct reality." (Suddaby, 2006)

Second, I ground the detection of the construct of distributed instruction in the actual instructional practices of the instructional leader. It's not until I or a researcher sees how the instructional leader is teaching and see that she is teaching in a way that is different from IRE and how it is different from IRE that I or a researcher can begin the process of detecting whether that instruction is distributed across or shared by teachers with whom she works. It is in this way that distributed instruction as a means of detecting a relationship between distributed leadership and instruction is grounded in the particulars of practice at a given site in which an instructional leader works closely with other teachers.

My view of distributed instruction as a construct containing three nested forms of distribution described in Chapter 2 emerged out of my immersion in the data. Recall that I created units of analysis based on instructional moves the instructional leader made to detect similarity or difference between teachers' instructional moves in order to identify a construct of distributed instruction. Reflecting on Spillane's (2006) three forms of distribution helped me to see how similarities within instructional moves could be one of three forms of distribution within instruction. Moreover, it wasn't until an extended period of analyzing teachers' instructional practices that I began to see the nested nature of the three categories of distributed instruction. It is in this way that the construct of

distributed instruction as a nested construct came through a process of analysis and reflection that further clarified initially fuzzy categories that then evolved into clearer conceptual structures (Suddaby, 2006). Given my approach to detecting the construct of distributed instruction I view it as a site-specific, grounded construct that exists in the particulars of practice belonging to a specific instructional leader and the teachers whom work closely with her.

Overview

The focus of this approach is to elaborate an expectation of what can change about teachers' instruction, because of distributed leadership, based on observations of the instructional leader's instruction. This chapter is organized in three main sections: 1) site requirements, 2) data collection and 3) data analysis. I use post-observation interviews to explore whether teachers perceive connections between a coordinating policy mechanism and an instance of distributed instruction that I observed in teachers' classroom teaching. In Chapter 4, I provide a description of key characteristics of the school site selected to participate in this study. Due to the exploratory and conceptual nature of this dissertation further research is necessary to confirm connections between specific forms of distributed instruction and coordinating policy mechanisms within distributed leadership. The central task of this chapter is to describe a grounded theory approach that can be used to identify and illustrate the presence of distributed instructions across the instructional leader and two teachers she works with closely as a plausible means of analyzing instructional practices' alignment to instructional policy.

In the section on *site requirements* I describe three required functions that the administrative core and its extended form, distributed leadership, must have in order for

the site to be viable for detecting and making visible collectively distributed instruction and collaboratively distributed instruction. Recall that collectively distributed instruction by shared content and tools regards the independent use of collective resources in classroom teaching. Recall that collaboratively distributed instruction by shared adjustment to student thinking in a manner desired by the district occurs through collaboration between the instructional leader and teachers she mentors with classroom observations.

In the section on *data collection*, I describe the types of data collected and the means through which the data was collected in service of illustrating the presence of collectively and collaboratively distributed instruction between an instructional leader and two 7th grade teachers' instruction. In the section on *data analysis*, I describe the analytic lens I used to illustrate collectively and collaboratively distributed instruction. Instances I perceived in my observations of teachers' instruction of either collectively distributed instruction by shared content and tools, or collaboratively distributed instruction by shared adjustment to student thinking were used to inform post-observation interviews. Post-observation interviews were semi-structured in order to confirm whether teachers' perceived the connections I hypothesize exist between a policy mechanism and an aspect of the teachers' distributed instruction that I observed. In the following chapter on *site selection*, I describe the broader context of the site I selected and the three functional criteria this site possessed.

Recall that collectively distributed instruction by shared content and tools refers to teachers' shared academic tasks (also referred to as content) and instructional materials (also referred to as tools) with the instructional leader. Collaboratively distributed

instruction by teachers' shared adjustment to student thinking refers to the distribution of the instructional leader's pattern of interacting with student thinking around the content across one or more other teachers.

The primary overarching research question this dissertation addresses is whether there is a plausible or defensible construct of distributed instruction? If so, what is it, and what is its relationship to distributed leadership? The subsequent research questions bring the analysis of classroom instruction to bear on this broader question:

1. Does the construct of collectively distributed instruction offer a framework for analyzing teachers' use of shared academic tasks and instructional materials?
    a. If so, does this framework illuminate whether, and to what extent similar and different content of academic tasks and instructional materials occur across teachers?
2. Does the construct of collaboratively distributed instruction offer an analytic framework that identifies the instructional leader's adjustments to student thinking and its spread across teachers with whom the leader works with closely?
    a. If so, does the analytic framework illuminate whether and to what extent the spread of the instructional leader's adjustments to student thinking varies between two teachers with whom she works with closely?

The secondary overarching research question this dissertation addresses is how might the construct of distributed instruction and a conceptual model of how distributed instruction

is related to distributed leadership support efforts to align instructional policy and practice in the iterative process of instructional improvement in schools? The subsequent research question brings an analysis of post-observational interviews with teachers to bear on this broader question:

3. Does a conceptual model of distributed instruction enable researchers to connect mechanisms within distributed leadership to factors teachers say influence varying levels of distributed instruction between the instructional leader and two teachers with whom she works closely?

Recall that the central task of this chapter is to describe a grounded theory approach that can be used to identify and illustrate the presence of distributed instruction across the instructional leader and two teachers she works with closely as a plausible means of analyzing instructional practices' alignment to instructional policy. However, being able to identify and illustrate the hypothetical construct of distributed instruction requires first identifying the conditions under which distributed instruction is likely to occur. Consequently, the sub-section on site requirements has embedded within it the conceptual basis for the conditions under which distributed leadership may influence instruction. The data analysis sub-section describes how I have determined the unit of analysis by which to identify and illustrate the existence of distributed instruction between the instructional leader and teachers with whom she works closely. The data analysis sub-section also describes my analysis of post-observational interviews. I use post-observational interviews to examine whether factors that teachers attribute to

specific instances of distributed instruction that I observed are related to a specific policy mechanism that can be attributed to distributed leadership.

Site Requirements

Abbott (1998) specifies mechanisms through which the administrative core influences the technical core of an organization. Based on Abbott (1998) I determined three functional criteria that would be necessary for the school site selected to be a viable site for further study of whether, how and when the administrative core influences shared practices of instruction, i.e. the technical core of schooling. With Abbott (1998) in mind I set out to find a district and a school within a district that had selected commodities, persons, and organizational routines with the design intent (according to district level instructional leaders) that they would work together to influence instruction in schools. Commodities represent the material resources necessary for carrying out the technical work of the organization. Persons represent experts at using the material resources to produce the organization's desired outcomes. Last, organization or organizational routines refer to the human and material resources of the organization that are organized around the technical core in an attempt to influence practitioners' use of material resources to accomplish organizational goals. I describe each of these in further detail in the following subsections.

Commodities

The administrative core can influence instruction through commodities of curriculum and instructional materials. This curriculum would need to be used district

wide by teachers teaching 7th grade mathematics, in order to have a critical mass of instructional leadership within the district to support teaching it (Copland, 1993; City et al, 2009). The curriculum would likewise need to have evidence that the curriculum does in fact provide students with the opportunity to learn the content standards listed in the State or Common Core Standards as evidence of vertical alignment by design. By providing such a standardized and standards-based curriculum the distributed leadership team provides the means through which Coordination by Standardization, or shared content tools and instructional materials may occur.

Persons

According to Abbott (1998) the person function takes the form of someone who knows how to use commodities provided by the organization to achieve the organization's desired outcomes. In a professional schooling organization this would take the form of instructional leaders trained specifically on how to use the curriculum to teach students the content standards listed. Namely, the curriculum does not teach itself. Teachers require training on how to support students' learning content standards by maintaining the cognitive demand of instructional tasks through interaction with student thinking (Cohen et al., 2003; Cohen, 2011; Stein, Silver, Smith, 2000).

Initiate-Respond-Evaluate pedagogical routine has already been documented as insufficient engagement with students around content embedded in instructional tasks (Hiebert and Stigler, 1999). Therefore, experts at using the curriculum (persons) would be practitioners who have a wider repertoire of instructional moves with students around the content than the IRE pedagogical routine. These added instructional moves would thereby give students greater opportunity to learn the content standards embedded in the

curriculum. Moreover, these persons would have titles that signify recognition of their expertise by the administrative core (City et al., 2009). Such titles might take the form of instructional leader and math coach, to name a few.

Likewise, these persons would be trained on how to train others in the district's schools to teach in a manner that diverges from the IRE pedagogical routine and converges with a desired, and broader pedagogical routine that provides increased opportunity for students to learn the content named by the district. That is not to say that these persons with titles signifying instructional expertise are somehow master teachers. It merely means that the district has taken care to choose persons with observable instructional practices that provide a more visible bridge between student thinking and the content than the traditional form of the IRE pedagogical routine.

Organizational Routines

The primary function of formal and informal organizational routines is to coordinate material and human resources around and within the technical core to distribute a desired technical practice to a class of practitioners. Such organizational routines or coordinating mechanisms have been described by Thompson (1967) as *Coordination by Schedules* and *Coordination by In-Action Communication Routes*. Coordination by Schedules may take the form of administratively determined time for instructional leaders and teachers teaching the same content to come together to plan joint action. Coordination by In-Action Communication Routes refers to an administratively determined time for teachers to share space and time with other teachers and instructional leaders who are in the midst of performing functions within the technical core of instruction, i.e. teaching.

The specific form of Coordination by Schedules that I am looking for in the context of a three-teacher network of 7th grade math teachers is that they meet formally at least once a week. The existence of a formal structure in which teachers teaching the same content meet to plan joint action lends itself to other socially normed practices of meeting informally throughout the week. Consequently, I view the existence of formal structures of meeting at least on a weekly basis as a pre-requisite for selecting a site that may have informal routines of coming together to plan joint action, though I may not know of the informal routines prior to selecting the site. Another aspect of Coordination by Schedule is whether the instructional leader and two 7th grade teachers established collective goals that their planned joint action would achieve. Last, in accordance with City et al.'s (2009), I investigated whether the this group of 7th grade math teachers was held accountable in any way to the achievement of collective goals listed and whether the district could measure those collective goals.

The specific form of Coordination by In-Action Communication Routes that I required of a site was that its administration provided opportunities for teachers and instructional leaders to observe one another teaching. This could come in two forms: co-teaching and classroom observations. These classroom observations would need to occur on a weekly or bi-weekly basis, in a consistent manner in order for these forms of In-Action Communication to have a plausible impact on collaboratively distributed instruction. In particular, I was interested in whether the teachers had an opportunity to either observe or teach with the teacher with a title signifying instructional expertise. To this end, I was also interested in whether the teachers had individual goals regarding their

instruction, or learning goals, and whether these individual goals were heeded in their co-teaching or observational time with the instructional leader.

Data Collection

Data

Based on my conceptual framework, evidence that distributed leadership is seeking to influence instruction occurs through three policy mechanisms: 1) *standardized* curriculum content tools and instructional materials, 2) *schedules* for teachers to meet and engage in joint planning or joint instructional work, and 3) *in-action communication route, or classroom observations*. In order to detect partial evidence that joint lesson plans are connected to coordinated distributed instruction by content coverage, I observed, videotaped, and took field notes of the 7th grade's weekly team meetings; and conducted post-observation interviews after these meetings as well. In order to detect partial evidence that the policy mechanism of providing standardized curriculum content tools and classroom observations between teachers and instructional leaders is connected to instruction I observed teachers' teaching the same lesson to focus more carefully on the presence of collectively distributed instruction by content tools and collaboratively distributed instruction by shared adjustment to student thinking with the instructional leader.

I conducted semi-structured, post-observation interviews to allow participants to confirm or disconfirm my understanding of the people (teachers and instructional leaders), tools (commodities) and contextual factors (e.g. organizational routines, training, and teaching experience, to name a few) that shaped connections between policy

mechanisms and shared aspects of instruction between teachers. I provide the observation and interview protocols that I modified from Jim Spillane's study on distributed leadership in Appendix A. Finally, these interviews served as the data source that confirmed if teachers agreed with my hypothesis that the presence of patterns of shared adjustment to student thinking with the instructional leader that go beyond the IRE pedagogical routine and is shared by the instructional leader is due to teachers' access or openness to the policy mechanism of classroom observations to influence their instruction. Below, I provide a table of all data collected and describe what specific aspects of data I analyzed to determine policy mechanisms connections to different forms of distributed instruction (in the following section on data analysis).

Table 3: Observation Data Chart

	CMP Classroom Observations	Non-CMP Classroom Observation	7th Grade Team Meetings	Math Department Meetings	Prof Learning Community Meeting
How many	5	4	5	1	1
How long	1 hour ea.	1 hour ea.	1 hour ea.	1 hour	1 hour
With whom	Joanne (1 lesson) Veronica (2 lessons) Stacey (2 lessons)	Joanne, Veronica, Stacey individually +1 co-taught by Joanne and Stacey	Joanne, Veronica, Stacey all present for three, fourth Joanne called in, fifth Veronica and Stacey working with NT	Joanne, Veronica, Stacey and 6th grade thru 8th grade math teachers	Joanne, Veronica, Stacey and 6th grade thru 8th grade math teachers

Table 4: Interview Data Chart

	Post CMP Classroom Observations	Post Fraction Day Observation	Post 7th Grade Team Meetings	Instructional Leadership Interviews	Post PLC Meeting
How many	3 on CMP Lesson 3.2	3	5 = Joanne (2), Veronica (2), Stacey (1)	3	1
How long	30 minutes	.5hr – 1 hr	Joanne (.5 hr, 1.5 hours) Veronica (42 min, 25 min) Stacey (1 hr)	1 hour	1 hour
With whom	Joanne, Veronica, Stacey	Joanne (40 min), Veronica (35 min), Stacey (51 min)	T1 (2), T2 (2), T3 (1)	Joanne/Instructional Leader, Director of Instruction, and Curriculum Coordinator	Joanne

Data Analysis

The primary overarching research question this dissertation addresses is whether there is a plausible or defensible construct of distributed instruction? If so, what is it, and what is its relationship to distributed leadership? The subsequent research questions bring the analysis of classroom instruction to bear on this broader question:

1. Does the construct of collectively distributed instruction offer a framework for analyzing teachers' use of shared academic tasks and instructional materials?
    a. If so, does this framework illuminate whether, and to what extent similar and different content of academic tasks and instructional materials occur across teachers?

2. Does the construct of collaboratively distributed instruction offer an analytic framework that identifies the instructional leader's adjustments to student thinking and its spread across teachers with whom the leader works with closely?
    a. If so, does the analytic framework illuminate whether and to what extent the spread of the instructional leader's adjustments to student thinking varies between two teachers with whom she works with closely?

In order to address the two subsequent research questions above, I structured my data analysis around observations of three teachers' classroom instruction. In this section I describe how I analyzed the instructional leader's instruction and the two other teachers' instruction in order to detect collectively and collaboratively distributed instruction among them in the section titled "Collectively distributed instruction and collaboratively distributed instruction."

The secondary overarching research question this dissertation addresses is how might the construct of distributed instruction and a conceptual model of how distributed instruction is related to distributed leadership support efforts to align instructional policy and practice in the iterative process of instructional improvement in schools? The subsequent research question brings an analysis of post-observational interviews with teachers to bear on this broader question:

3. Does a conceptual model of distributed instruction enable researchers to connect mechanisms within distributed leadership to factors teachers say influence varying levels of distributed instruction between the instructional leader and two teachers with whom she works closely?

In order to address the third subsequent research question in service of the two broader research question I dedicate the second sub-section to how I analyzed the post-observation interviews of instruction. These interviews were used to capture teachers perceptions of what they think contributed to instances of distributed instruction that I observed. Through these interviews I was able to tie teachers' perceptions of what influences distributed instruction to specific policy mechanisms within distributed leadership.

Since the district in this study designated the instructional leader at the school level as the district's math coach with the intention of using this new role as a way to influence teachers' instruction to look more similar to the investigative method she herself practices, the first step in the analysis of classroom instruction is to identify the instructional leader's pedagogical routine. The unit of analysis I use is each instructional move that the instructional leader makes in a recurring and patterned manner across academic tasks she initiates with students. I distinguish between instructional moves by attending to the type of question the instructional leader asks, or declarative statement that she makes. The two types of questions I noticed in my observations of the instructional leader are that she first asks a question as part of the instructional prompt that initiates an academic task (or that she asks a student to read a question in an academic task posed from the curriculum), and second asks a clarifying question about a student's understanding of an answer or the academic task, itself, after a student responds to the academic task posed. Likewise, there are two types of declarative statements that I noticed Joanne use in her instruction. The first informs a student of the correct reasoning necessary for ascertaining the correct answer, and the second is a declarative statement

regarding whether the student stated the correct answer. I used these distinctions between two types of questions and two types of declarative statements to make judgments as to when one instructional move was used versus another instructional move that was being used by the instructional leader. I then used these four recurring instructional moves that emerged from my observations of the instructional leader's pedagogical routine across lessons to perform an analysis of similarity and difference between each of the instructional leader's instructional moves and each of the other two teachers' instructional moves for a given mathematics lesson. I do so in this study by observing all three teachers: Joanne (the instructional leader), Veronica and Stacey teach Lesson 3.2 from Connected Mathematics. The description of the analysis below describes how I made determinations of descriptions of collectively distributed instruction by shared content and tools, and collaboratively distributed instruction by shared adjustment to student thinking with the instructional leader. I begin with a description of each instructional move of the instructional leader as a unit of analysis of distributed instruction between the instructional leader and the two teachers with whom she works closely.

Distributed Instruction's Unit of Analysis

In this section I describe the grounded theory approach I used to determine the unit of analysis. In particular, I ground the detection of the construct of distributed instruction in the actual instructional practices of the instructional leader. It's not until I or a researcher sees how the instructional leader is teaching and can detect that she is teaching in a way that is different from IRE, and how it is different from IRE, that I or a

researcher can begin the process of detecting whether that instruction is distributed across or shared by teachers with whom she works. It is in this way that distributed instruction as a means of detecting a relationship between distributed leadership and instruction is grounded in the particulars of practice at a given site in which an instructional leader works closely with other teachers.

Consequently, the unit of analysis for detecting collectively distributed instruction by shared content and tools is each of the instructional leader's instructional moves that constitute her overall pedagogical routine. The determination of recurring instructional moves occurred from a judgment call that I made based on observations of the instructional leader teaching multiple lessons. I do not make any claims of validity regarding my observations of when one instructional move began and stopped versus when another instructional began and stopped. I simply provide a description of my observations of what I deemed constituted an instructional move as a way to shed light on how one might go about identifying both a pedagogical routine possessed by a given instructional leader and the extent of the distribution of that pedagogical routine across the teachers that instructional leader works with. As a result, each of the instructional moves made across lessons by the instructional leader combine to constitute the means by which I was able to detect a pedagogical routine for adjusting to student thinking practiced by the instructional leader, and thereby desired by distributed leadership.

In order to attend to matters of collectively distributed instruction by shared content and tools (also known as instructional materials) *within* each of the instructional leader's instructional moves, I chose a single lesson to observe similarity and dissimilarity within each instructional move between the instructional leader and two

teachers with whom she works closely. Again, how I determined what constitutes similarity and difference within a given instructional move between a teacher and an instructional leader is a judgment call on my part for the purpose of suggesting an approach for being able to identify distributed instruction between an instructional leader and a teacher she works with closely. After doing an analysis of similarity and difference for each individual instructional move made by the instructional leader and another teacher, I then performed a combined analysis *across* all of the instructional moves to provide evidence of whether and to what extent a given teacher's adjustment to student thinking is similar or dissimilar to the pedagogical routine of the instructional leader for a given lesson. That is, the distribution of the instructional leader's content and tools *within* a given instructional move allows me to know the extent to which the mathematical content of academic tasks and instructional materials or tools used by the instructional leader are used by the other 7th grade math teachers. By combining analyses of the instructional leader and another teacher *across* each of the instructional moves an overall pattern of shared or unshared adjustments to student thinking begins to emerge. It is in this way that my analysis of instructional policy and practice alignment uses shared content and tool use as a nested construct within my analysis of the instructional leader's and another teacher's pattern of adjustment to student thinking.

Collectively distributed instruction by shared content and tools.

As mentioned above, the unit of analysis for determining shared content and tool use between the instructional leader and another teacher is each of the recurring instructional moves the instructional leader makes that constitute an identifiable pedagogical routine that occurs across multiple lessons taught by the instructional leader.

I use the individual instructional moves that constitute a pattern of the instructional leader's recurring instructional moves as a heuristic to guide my detection of similar or dissimilar content and tool use between the instructional leader and a teacher within a given instructional move, for a given lesson. It is in this way that the instructional leader's pedagogical routine is important for detecting distributed instruction because it serves as the heuristic through which determinations of shared or distributed district-desired content and tool use occurs between the instructional leader and a given teacher for a particular lesson.

In my analysis of the instructional leader's instruction across lessons I uncovered four recurring instructional moves: (1) initiation of an academic task (task posing question); (2) student response to academic task (gesturing to a specific artifact, or creating a drawing or mathematical representation of the student's answer); (3) the follow-up prompt (clarifying question regarding student reasoning and answer); (4) communicating a take-away point from teacher-student interactions around the content to the whole class (declarative statement that covers both the desired mathematical reasoning and correct answer). I refer to these four instructional moves made by the instructional leader as the IRFT pedagogical routine (Initiate academic task-Student Response-Follow up-Take away point).

Note that these four instructional moves contrast with the three instructional moves that constitute the IRE pedagogical routine: (1) initiate academic task (task posing question), (2) student response, (3) teacher evaluates whether student response is correct or incorrect (declarative statement regarding correctness of answer). According to Schoenfeld (2002), the IRE pedagogical routine "can be implemented with a fair amount

of latitude, in that the student response and the teacher's evaluation of it can range from a word or a phrase to lengthy expositions. However, the stereotype – grounded in reality – is that in traditional didactic mathematics lessons, short IRE sequences are ideal vehicles for fostering student mastery of procedural skills." Consequently, this dissertation contrasts the desired pedagogical routine with the stereotypically short instructional moves that constitute the IRE pedagogical routine. In this conception of the IRE pedagogical routine, the short instructional moves provide the stating of the question, a student's response and the teacher's declarative statement of whether the student's response is correct. Absent in this conception of the IRE pedagogical routine are clarifying questions and declarative statements that describe the mathematical reasoning behind how a student reached the answer they provided.

Again, I use the four recurring instructional moves in the IRFT pedagogical routine to specify the instructional leader's pedagogical routine that I observed was used across lessons for managing the complexity of instructional dialogue with students around content (Lampert et al., Chapter 9, 2010; Feldman and Pentland, 2003; Leinhardt and Steele, 2005). It is through identifying a series of recurring and separate instructional moves that I identify the instructional leader's pedagogical routine that would be observable to teachers when they observe the instructional leader teach a lesson. The specifics of content and tool use within each of the instructional leader's instructional moves for a particular lesson can be used for determining the performative similarity and dissimilarity between the instructional leader and the teachers with whom she works. The combined analysis of similarity and difference across instructional moves provides a description of the extent to which the teachers share the overall pedagogical routine of the

instructional leader. The main question being to what degree are the instructional leader's instructional moves shared by the other teachers and to what degree is there similar content and tool use within these instructional moves across teachers in their instructional performance.

In order to better see the instructional leader's instructional moves I developed a conceptual map of each instructional move using composites of the instructional triangle. I used these conceptual maps to determine categories of similarity or difference within each of the instructional moves. To create these conceptual maps of each instructional move I imagined different sides of the instructional triangle as corresponding to three different dimensions of teachers' interactions with students around the content. The two dimensions of any instructional move that I heeded in the concept mapping of an instructional move onto the instructional triangle were, at first, content and tool use. However, there are two different forms in which I began to see content shaping the instructional leader's instructional moves. One form in which I see content shaping the instructional leader's moves is through attending to the intended mathematical goal or understanding of the mathematical content that the teacher wants students to attain in the course of interacting around the content through probing and clarifying questions that occurred in the follow-up prompt (Ball, 1993; Sleep, 2009). This stood in contrasts to the second form in which I saw the use of content in interaction with students as directly delivered to the student by the teacher using declarative statements regarding the appropriate reasoning or answer in a given moment of interacting with the content, which typically occurred in the instructional leader's take-away point to the whole class. I decided to use the third remaining side to represent the tools a teacher used in interacting

with a student around the content. Instructional materials also known as the tools used could be a transparency, book page, photocopy, and so on. It is this conceptualization of the instructional moves that created the below representation of the instructional triangle as a way to support my ability to see these three categories of content and tool use within a given instructional move made by the instructional leader.

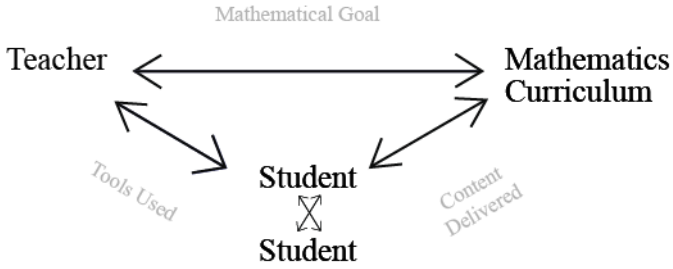


Diagram 5: Re-purposed Instructional Triangle

The concept mapping I provide of a given instructional move is similar to Lampert's 2001 work in Chapter 14 of her book "Teaching Problems and the Problems with Teaching." She uses the instructional triangle as a way to elaborate a model of social complexities embedded within instructional practice at a more macro level of overall instructional dynamics. In this dissertation I use composite illustrations of the instructional triangle to focus in on instructional dimensions within a given instructional move. That is, as I attempt to "see" an instructional leader's instructional practice I elaborate a visual model that provides a conceptualization of the aspects of the instructional triangle that I perceive as engaged for a given instructional move made by the instructional leader. Each component of the instructional triangle that is represented as activated by the instructional leader then serves as a category to track on similarity and

difference between the instructional leader's content and tool use and that of another teacher. These categories then allow me to create a table that represents degrees of similarity within each dimension of a given instructional move made by the instructional leader.

To avoid redundancy I provide one example for how I go about determining similarity or difference between the instructional leader and another teacher for one instructional move. I do so by providing a qualitative description for a given instructional move made by the instructional leader. After providing a description of the components of what I saw within a given instructional move the instructional leader made, I describe how I mapped that conceptualization onto a specific composite of the instructional triangle. I then describe how the mapping of the instructional move onto a corresponding composite of the instructional triangle became an analytic tool that allowed me to visually compare what I observed as similar, partially similar or dissimilar across teachers' use of shared content and tool use for a given instructional move. Providing a conceptual mapping of instructional moves onto the instructional triangle is a critical aspect of identifying the construct of distributed instruction, since what this grounded theory approach sets out to do is address the problem of observers' perception bias (Lewis, 2006) and capacity to track on an instructional leader's adjustment to student thinking, as well as a pattern of shared or unshared district-desired adjustments to student thinking across teachers.

Next, I describe my criteria for determining similarity and difference using a tripartite scale of: similar, partially similar, and dissimilar as a means of representing the degree of shared content and tool use by a teacher and the instructional leader for a given

instructional move. I then describe how I model the tripartite scale of similarity with three corresponding degrees of shading arrows within the composites of the instructional triangle that represent the instructional move. In particular I use a corresponding bold arrow, present arrow, and gray arrow, respectively to illustrate similarity, partial similarity and dissimilarities of content and tool use between the instructional leader and another teacher for a given instructional move.

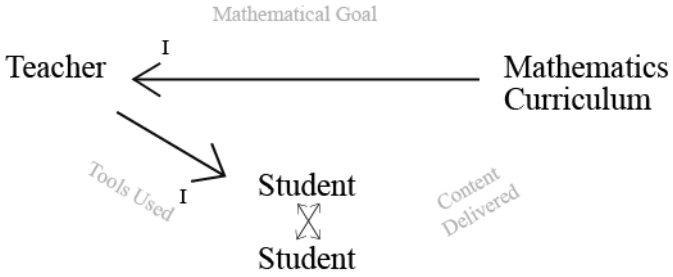
My rationale for using an ordinal three-interval scale for similarity is that distinctions of similarity, partial similarity and dissimilarity are important distinctions to track on at the most minimal level. Perhaps with further study of instructional dynamics I could devise an ordinal 5-interval scale similar to the conventional Likert scale. However, as a first attempt at a means of modeling similarity (pooled interdependence) across teachers within instructional moves I deemed a tripartite scale of similarity (at the most basic level) as necessary to track on whether and to what extent the instructional leader's content and tool use was shared by other teachers. I elaborate my criteria for determining similarity, partial similarity and dissimilarity for each unit of analysis, i.e. each instructional move, in each subsection named after each instructional move. I then provide a table that uses categories that emerged from my concept mapping of an instructional move onto a composite of the instructional triangle that represents the visual representation of shared content and tool use with a tripartite numeric scale of similarity. The tripartite numeric scale of similarity used in the tabular representation of shared content and tool use is: similar = 2, partially similar = 1, dissimilar = 0, within a given category represented in the corresponding visual composite of the instructional move.

My method of analyzing similarity and dissimilarity in the content and tools used by teachers is the means through which I address the research question of whether and to what extent collectively distributed instruction by the instructional leader's shared content and tool use exists across one or more teachers. After this discussion I address my method of analysis through which I determine whether and to what extent collaboratively distributed instruction by the instructional leader's adjustment occurs as an aggregate of distributed instruction by the instructional leader's shared content and tool use, in order to answer the second research question in a section titled "cohesiveness."

Initiate Academic Task.

Recall that the instructional move, Initiate academic task, is the 'I' in the IRFT pedagogical routine that I determined is practiced by the instructional leader. In my observations of the instructional leader's initiation of an academic task I noticed that she asked students to get out a piece of work (referred to something on the transparency, book page, or chalk board – i.e. tool use) and then verbalized what it was within that artifact or tool that she wanted students to attend to, in order to address a question she posed (i.e. verbalized the content she wanted students to attend). The academic task is the question posed, as verbalized either by the teacher or a student with prompting from the teacher. Embedded within the academic task is the mathematical goal or point that the prompt intends students to understand through working on it (http://connectedmath.msu.edu/teaching/teaching.shtml). Consequently, for the academic task I imagine two aspects of the instructional triangle engaged or activated. The first is the mathematical goal that the academic task intends for students to understand through

working on it. The second is the artifact or tool to which the teacher refers in order to communicate the academic task. To this end, in *Composite 1: Initiate Academic Task*, I map the academic task onto a composite of the instructional triangle that includes the mathematical goal of the academic task from the mathematics curriculum and the tools used to convey the academic task to students.



Composite 1: Initiate Academic Task

Criteria for similarity or dissimilarity.

The first thing I notice in order to determine similarity or dissimilarity between a teacher's academic task with respect to the academic task as performed by the instructional leader is whether the teacher is using the same academic task as the instructional leader. To do this, I look at the statements the teacher and the instructional leader use to provide the academic task. If two teachers are asking students to do the same academic task then I see the mathematical goal to which the teachers intend to direct students as similar. Another way of gauging similarity in the event that an academic task is referred to indirectly by the teacher is by determining whether the academic task the two teachers pose asks students to do the same mathematical work. At its most basic level the mathematical goal is determined to be similar if the academic task used by two teachers is identical. If the academic task is different between two teachers though similar enough that they both ask students to do the same mathematical work (e.g.

both teachers ask students to do double-digit addition without needing to compose a 10) then the prompt could theoretically be related to a similar mathematical goal or partially similar goal depending on the specific academic tasks used (however this did not come up in the data analyzed below). If two teachers use different academic tasks that ask students to do different mathematical work then I see the mathematical goal of the two prompts as dissimilar. For example, in the upcoming analysis one teacher asks students to determine the probability of finding treasure in Level 1 of the Mansion, and another teacher asks students how many times a student played a game over the weekend, these prompts by the teachers are dissimilar in their mathematical goal. In the first case, the teacher is reviewing how students determine probability. In the second case, the teacher is reviewing how she wants students to think of and write down specific probabilities.

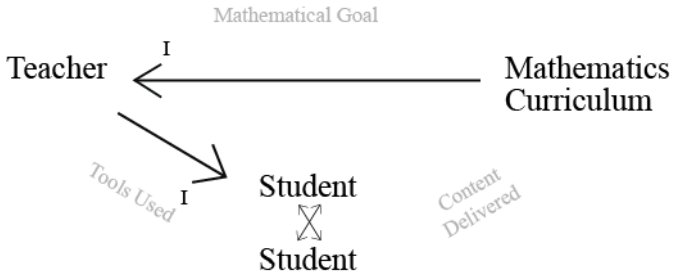
The second thing I notice is similarity, partial similarity, or dissimilarity in the tools a teacher makes available to students compared to the instructional leader when the two began the academic task. If the instructional leader and the teacher provide the exact same tools (e.g. book page and transparency) then I determine they have similarity. Or if the instructional leader and teacher provide some of the same tools, for example, a teacher provides a book page and the instructional leader provides a book page and a transparency, then I determine that they have partial similarity. The main criterion for partial similarity is that there is some overlap of tool use but not total overlap of tool use. If the instructional leader and the teacher do not provide any of the same tools to students during the academic task then I see the two teachers as not having any similar tool use.

Mapping and quantifying similarity and dissimilarity.

In order to pictorially represent distributed instruction by the instructional leader's standardized content and tool use within the instructional move of the academic task, I use varying degrees of shading arrows in the composite of the instructional triangle labeled *Composite 1: Initiate Academic Task*. I illustrate similarity, partial similarity and dissimilarity in the initiation of the academic task between the instructional leader and the other teachers with either a bold arrow (similar), present arrow (partially similar), or gray arrow (dissimilar) on the "Mathematical Goal" side of Composite 1. I illustrate similarity, partial similarity and dissimilarity between two teachers' tool use when initiating a given academic task either with a bold arrow (similar), present arrow (partially similar), or gray arrow (dissimilar) on the "Tools Used" side of Composite 1. It is in this way that I provide a visualization of whether and to what extent content and tool use are similar within the instructional move of the *initiate academic task* between a teacher and the instructional leader.

I quantify the above qualitative description of the tripartite scale of similarity I developed in a table. Again, the table has categories of similarity taken from sides represented in my conceptual mapping of an instructional move onto a composite of the instructional triangle. If an arrow was bolded or an aspect of the instructional move was determined to be similar then in the table this similarity is indicated with the numeric value of 2. If an arrow in the composite was present or an aspect of or category within the instructional move determined to be partially similar then in the table this partial similarity is indicated with the numeric value of 1. If an arrow in the composite was

grayed or a specific category of similarity was determined to be dissimilar then in the table this dissimilarity is indicated with the numeric value of 0.



Composite 1: Initiate Academic Task

Table 5: Initiate Academic Task

Initiate Academic Task Instructional Leader compared to Teacher A Similar = 2; Partially Similar = 1; Dissimilar = 0			
	Mathematical Goal	Tools Used	Total
Similarity Scale			Out of 4

To avoid redundancy I provide qualitative descriptions of my observations of each of the instructional leader's other instructional moves, the accompanying visual model of a composite of the instructional triangle, and criterion for similarity and dissimilarity within each instructional move between the instructional leader and another teacher in the analysis provided in Chapter 5.

Cohesiveness of distributed instruction by shared adjustment to student thinking.

The second research question regarding whether an analysis of collaboratively distributed instruction identifies the spread of the instructional leader's adjustments to

student thinking across the instructional leader's instructional moves is captured by the label, cohesiveness. I labeled the overall shared adjustment to student thinking, "cohesiveness" since it combines all four instructional moves in an attempt to signify the state of shared instructional moves between the instructional leader and another teacher cohering or uniting to match a particular pedagogical pattern of adjusting to student thinking. That is, cohesiveness refers to the degree to which teachers share content and tool use *across* instructional moves as a whole. In the cohesiveness of shared adjustment sub-section there is an identifiable pattern of teachers' interactions with student thinking, but only at an aggregate level at which all instructional moves are seen as a coherent whole. As a result, cohesiveness combines all four instructional moves to represent an overall shared pattern of IRFT adjustments to student thinking shared between the instructional leader and another teacher.

Recall from the conceptual framework in Chapter 2 that shared content and tool use has been captured in teacher surveys in other work on distributed leadership's influence on instruction (Camburn & Han, 2009). However, how that shared content and tool use is used in the overall instructional dynamic has yet to be captured by research studying the influence of distributed leadership on instruction. I claim that deeper aspects of instruction inclusive of discourse norms and teaching strategies are captured by a construct of teachers' instructional adjustments to student thinking. That is, teachers could have observable shared content and tool use, while still engaging an overall instructional dynamic that matches much more closely to the IRE pedagogical routine than to the district-desired pedagogical routine. To address this gap in current research on how to capture shared patterns of instructional dynamics -- rather than capturing discrete,

disconnected instances of shared content and tool use -- the fifth subsection titled cohesiveness provides an analytic overview of all four instructional moves. In doing so, the cohesiveness subsection (for a given analysis of teacher-student interactions around an academic task) provides a way of representing shared content and tool use across a teacher's instructional moves with that of the instructional leader. This analysis across a given teacher's instructional moves for a given academic task is compared to that of the instructional leader to determine whether the IRFT pedagogical routine is shared between a given teacher and the instructional leader. In this way the subsection on cohesiveness describes whether and to what extent the distribution of adjustment to student thinking within the context of the IRFT pedagogical routine (or the overall district-desired instructional interactions) exists.

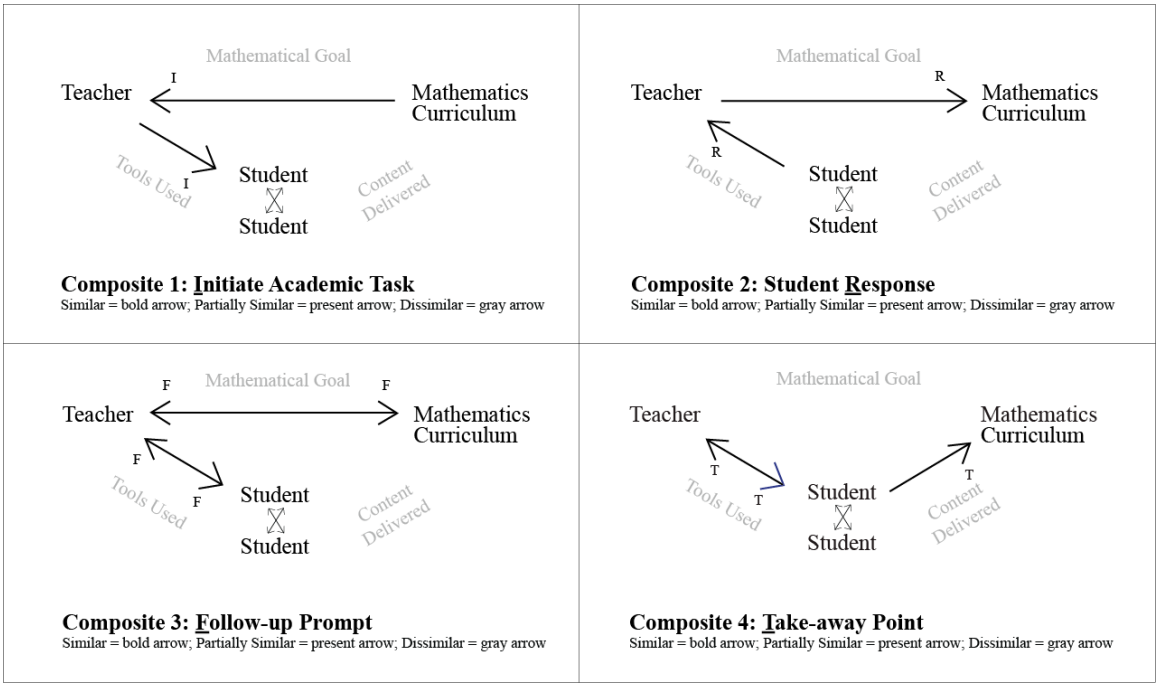
Capturing a teacher's overall adjustment to student thinking and its distribution is of critical import to the conceptual model of distributed instruction since knowledge of a teacher's discrete content and tool use does not give us a clear indication of how teachers are interacting with students around the content more holistically. That is, the rational basis for teachers' instruction influencing student learning is not a claim that the presence of specific content and tools influences student learning, but that how the content and tools are used by the teacher in interactions with student thinking is what influences the organizational goal of student learning. Hence, without a way of capturing how a teacher or teachers use content and tools in interaction with student thinking leaves out a salient aspect of what instructional policy intends to influence about instructional practice. As a result, developing an analysis that can capture the desired instructional adjustment to student thinking and its spread across teachers who work closely with an instructional

leader can provide valuable feedback. In particular it can provide feedback on the effectiveness of policy mechanisms (i.e. reciprocal observations of teacher and instructional leader) to align instructional practice to instructional policy in a manner that better bridges student thinking with content as compared to the IRE pedagogical routine.

Again, the construct of "cohesiveness" addresses the second research question: Does the analysis of collaboratively distributed instruction offer an analytic framework that identifies the instructional leader's adjustments to student thinking and its spread across two teachers with whom the instructional leader works closely? If so, does the analysis illustrate whether and to what extent the spread of the instructional leader's adjustments to student thinking varies across two or more teachers with whom she works with closely? As a result, the construct cohesiveness is an aggregate of the four instructional moves used to illustrate the four dimensions of shared content and tool use across teachers' instructional adjustments to student thinking. That is, cohesiveness is a feature of shared content and tool use that indicates varying degrees of a teacher's cohesive fit to the overall instructional adjustments to student thinking supported by distributed leadership in the school and district. In the event that all four instructional moves are not present across two teachers, then two teachers' practice can have shared content and tool use, but from an aggregate or cohesive perspective, that shared content and tool use is not necessarily reflective of the district-desired pedagogical routine.

Recall, in the first construct of distributed instruction by instructional leader's content and tool use, one analyzes strength of similarity of practice between the instructional leader and another teacher *within* any one of the four dimensions to identify a comparative level of distributed instruction by standardization. In cohesiveness, it is an

analysis of similarity *across* the four instructional moves that constitute IRFT's adjustments to student thinking as performed by the instructional leader. Below I provide a 2x2 with the four instructional moves followed by a table that represents how these four instructional moves combine to depict a level of cohesiveness across all four instructional moves. I have also provided a table that combines the tables for each instructional move to provide a cohesive view of the overall shared adjustment to student thinking between the instructional leader and a particular teacher.



All Composites: IRFT Pedagogical Routine 2x2

Table 6: Cohesiveness

Cohesiveness of Overall Shared Pattern of Adjustment to Student Thinking Instructional Leader and Teacher A				
Tripartite Scale of Similarity Similar = 2; Partially Similar = 1; Dissimilar = 0				
	Math Goal	Tools Used	Content Delivered	Total
Initiate Academic Task			NA	Out of 4
Student Response			NA	Out of 4
Follow-up Prompt			NA	Out of 4
Take-away Point	NA			Out of 4
Cohesiveness Score Across Instructional Moves				Out of 16

Below I provide an example of how strength of collectively distributed instruction by the instructional leader's shared content and tool use and cohesiveness of collaboratively distributed instruction by the instructional leader's adjustment to student thinking identify two different constructs of pooled interdependence between a hypothetical pairing of teachers.

Contrasting constructs.

Imagine there are an Instructional Leader and two teachers, Teacher B, and Teacher C. Now imagine there are 6 similarities in the initiation of the academic task between the Instructional Leader and Teacher B and the tools used to communicate it (e.g., they use the same academic task, overhead, handout, and overhead pens, and ask students to turn to the same page in the textbook, etc., when stating the prompt). However, this is where the similarity between Instructional Leader A and Teacher B stops. On the other hand, Teacher C had 4 similarities in common with the Instructional

Leader, though only one similarity along each of the four instructional dimensions listed. Next, I describe how strength of similarity of collectively distributed instruction and cohesiveness of collaboratively distributed instruction can be applied to an analysis of this hypothetical scenario.

Similarity of shared content and tool use is illustrated by simply looking at the similarity, partial similarity or dissimilarity within a given category along the instructional triangle that represents an aspect of a particular instructional move between the instructional leader and one of the teachers she works with closely. Similarity is illustrated by both the content communicated and the purposed tool use to communicate that content within any one of the dimensions, i.e. collectively distributed instruction by shared content and tool use. Hence, applying the collectively distributed instruction by shared content and tool use to the above scenario, there is stronger shared content and tool use between Instructional Leader A and Teacher B within the initiation of the academic task than between the Instructional Leader and Teacher C.

In contrast, cohesiveness of collaboratively distributed instruction by shared adjustment to student thinking is illustrated by simply looking at similarities across instructional moves. Hence, applying the aggregate analysis of the overall adjustment to student thinking, there is more cohesiveness between the Instructional Leader and Teacher C than there is between the Instructional Leader and Teacher B. This greater cohesiveness is because the similarities between the Instructional Leader and Teacher C span all four instructional moves, whereas similarities between the Instructional Leader and Teacher B only involve the initiation of the academic task.

Given that content and tools do not teach students, themselves, the feedback provided by discrete instances of shared content and tool use doesn't give us salient information regarding how teachers use the content and tools provided to them by the district. As a result, information regarding shared content and tool use alone could be misleading to those conducting research on whether and to what extent instructional policy is implemented as intended, and thereby the subsequent matter of instructional policies' effectiveness on student achievement. That is, if we have no way to gauge how well instructional policy is being implemented we are very limited as to determining its impact. As a result, the major conceptual contribution provided by distributed instruction is its distinction between discrete instances of collectively distributed instruction by shared content and tool use and collaboratively distributed instruction within the context of a pedagogical routine.

An added benefit to analyzing collectively distributed instruction by shared content and tool use apart from collaboratively distributed instruction by the instructional leader's adjustment to student thinking is that these analyses can provide feedback on the utility of tools used in instructional planning and on the robustness of tacit communication present in classroom observations for influencing instructional practice. Such feedback can play a useful role in communicating to instructional leaders those aspects of teachers' instruction that are connected or disconnected to leadership's current use of policy mechanisms to support practice within the technical core. Furthermore, detailed feedback on which aspects of instructional practice are aligned to instructional policy and which aspects are not can enable deeper post-observation debriefs that support teachers' metacognition as it relates to their own development of instructional skill

supported by distributed leadership's efforts. In Chapter 5, I use post-observational interviews to uncover teachers' conceptions of how their instructional skill development has been supported or impeded by policy mechanisms within distributed leadership.

Analysis of Interview Data

The analysis of interview data is consistent with using a grounded theory approach (Suddaby, 2006) that is built on two key concepts: constant comparison and theoretical sampling. In particular I analyzed the post-observation interviews with an emphasis on: 1) teachers' awareness of similarity and difference among their instructional practices, and 2) teachers' narratives for why such forms of similarity and difference occur. If teachers were unaware of one another's instructional practices, or their awareness of practice contradicted my observations this would have provided information that would have impeded my ability to attribute an influence on one teacher's instructional practice from another teacher's instructional practice. If teachers were aware of one another's instructional practices and could state how and in what ways their instructional practices were similar or dissimilar in a way that was consistent with my observations then the site requirement that they envision their instruction as part of the work of an instructional team could then be confirmed to be in place. Second, I wanted to determine if teachers narratives for why such forms of similarity and difference occurred was the result of one of Thompson's coordinating mechanisms. Through a process of constant comparison between teachers' narratives I was able to identify a coordinating mechanism that tied all of the factors listed by teachers that they perceived influenced the similarity and difference within their instructional practices.

In order to confirm whether the teachers would describe similarities and differences between the teachers' instructional practices in a manner consistent with what I observed I asked open-ended questions about what teachers thought was similar or different about how each of them taught the same lesson. It is in this way that I was careful to not ask leading questions that would bias the teachers' answers in a way that would agree with my observations. That teachers were aware of the differences and similarities they shared in their instructional practices confirmed for me that they have some awareness of what the other teachers do with their students.

Provided teachers were in fact aware of how their instructional practice is similar or dissimilar to the instructional leader, the second purpose of the post-observational interviews is to further clarify a conceptual model of the relationship between distributed leadership (instructional leader's coaching) and distributed instruction based on teacher narratives for what has contributed to observable similarities and differences they believe exist in one another's instructional practices. I analyzed the specific factors teachers said supported them to have practices that are similar to or different from the instructional leader in order to determine whether those factors were connected to one of the three coordinating mechanisms mentioned by Thompson. It is in this way that the narratives are intended to further articulate and clarify the hypotheses that exists within the conceptual model regarding the relationship between specific aspects of shared instructional practices teachers believe they possess and the factors they believe contribute to those shared practices.

Connecting the factors teachers provided for similarity and difference between their instructional practices to a coordinating mechanism provided by Thompson serves to address the third research question:

3. Does a conceptual model of distributed instruction enable researchers to connect mechanisms within distributed leadership to factors teachers say influence varying levels of distributed instruction between the instructional leader and two teachers with whom she works closely?

The analysis of interviews to determine the factors that teachers' attribute to varying levels of distributed instruction involved a process of semi-continuous content analysis that allowed themes to arise from teachers' narratives. When I identified the themes that emerged in a given teacher's narrative, I then looked to see the extent to which similar themes arose in other teachers' narratives through a process of constant comparison. For example, if a teacher cited her training as a reason for similarity or dissimilarity in her adjustment to student thinking as compared to the instructional leader, I sought to discover whether the matter of training came up in other teachers' narratives. I, likewise, sought to identify whether two or more teachers similarly viewed the influence of a given factor, e.g. training, on specific teachers' instructional adjustments to student thinking. However, the final form through which these narratives are communicated in Chapter 6 is by individual teachers. Namely, I provide the factors a given teacher states influenced her instructional practices, along with other teachers' narratives for what factors they believe influenced that specific teacher's instructional practices. Consequently, what is

indicated in the interviews in Chapter 6 is the extent to which teachers are aware of one another's instructional practices and how, they themselves, or other teachers came to teach in the ways identified in the analysis of classroom observations I provide in Chapter 5. After identifying themes in the factors teachers' attribute to influencing their teaching I determine whether and to what extent these factors connect to one or more of the policy mechanisms within distributed leadership. While the connections between instruction and policy mechanisms are not conclusive in this study they do provide insights that can guide further research on identifying evidence of connections between instruction and policy mechanisms.

Summary

This study is structured to inform the overarching research questions of:

Is there a plausible or defensible construct of distributed instruction? If so, what is it and how is this construct of distributed instruction related to distributed leadership?

How might further visibility garnered by a conceptual model and analysis of distributed instruction support further alignment between instructional policy and practice in the iterative process of instructional improvement in schools?

To answer these questions, this dissertation first provides a conceptual framework in support of identifying a construct of distributed instruction as an expected outcome of what distributed leadership's influence on instruction would look like (Chapter 2). To illustrate the desired instructional outcome of distributed instruction, I conducted a

qualitative case study that uses descriptive and comparative analysis to identify varying levels of distributed instruction between two 7th grade math teachers who work closely with an instructional leader (Chapter 5). Once the forms of distributed instruction are identified and illustrated within specific examples of teachers' instructional practices in Chapter 5, the question of whether policy mechanisms within distributed leadership are potentially connected to a specific form of distributed instruction observed are discussed with the use of teachers' post classroom observation interviews (Chapter 6).

Consequently, in Chapter 6 I use teacher narratives to learn about influences on instruction, in order to determine whether teachers' perceive policy mechanisms supporting or hindering their capacity to learn the desired pedagogical routine. Recall that since curriculum and instructional materials do not teach students themselves, the effectiveness of any curriculum implementation to shift student achievement is dependent on how teachers use them in interaction with students around the content. Based on teachers' self reports of what influences their instruction, I conclude that there are varying degrees of teachers' access to specific policy mechanisms that serve to explain the identified varying degrees of collectively and collaboratively distributed instruction identified and illustrated in Chapter 5.

In Chapter 7, I conclude with how a conceptual model of connections between distributed instruction and distributed leadership, and its analysis can be applied in other contexts. By enabling this conceptual model to be applied to other contexts it can support furthering our understanding of whether policy mechanisms within distributed leadership influence instruction. A central contribution of this work is providing an analytic framework that makes visible deeper aspects of instruction that leadership wants to

distribute across teachers' instruction. Increased visibility of desired interactions between teachers and students around the content can both support teachers' learning and leadership's support of that learning in the cyclical and iterative process of instructional improvement. It is in precisely this way that the conclusion addresses the second overarching question of how further visibility garnered by a conceptual model of distributed instruction and its analysis may support further alignment between instructional policy and practice in schools.

At this point in the dissertation I now turn to Chapter 4 Site Selected to describe the specific details of the site identified for this study. I chose the site for this study based on the characteristics it possessed that were in line with my conceptual framework's prediction of what would enable leadership structures in a district and school to support distributed instruction. Namely, in the following chapter I outline the specific attributes of the people, commodities and organizational routines that were in place for a specific school within a district that led me to believe it would be a fruitful site for examining the construct of distributed instruction.

CHAPTER 4

SITE SELECTED

In this section I describe the broader school and district context of the 7th grade math teachers. I selected them to participate in the study based on curriculum materials, a perceived pedagogical routine that accompanied the curriculum by district leaders, instructional leader roles, and organizational routines that structured their work with the intent of influencing instruction. However, what drew me to this specific set of three 7th grade math teachers I study in this dissertation was that a school-level instructional leader from the school district had been in contact with a University instructor with whom I was working on a Masters level instructional leadership course. In particular, this instructional leader (who I refer to as Joanne) was contacting the University instructor regarding the work she was engaged with in order to support teachers' instructional practice to look more like the pedagogical routine district leaders perceived as accompanying the curriculum. The instructional leader was drawing heavily on City et al.'s (2009) book "Instructional Rounds," and other coursework covered in the instructional leadership course we were teaching. Consequently, given the match between this instructional leader's theory of action and my conceptual framework regarding how distributed leadership could influence instruction, I was interested in

studying her work with two other 7th grade math teachers, Veronica and Stacey. As a result, their work together became a site for identifying and illustrating collectively and collaboratively distributed instruction and possible connections between these forms of shared instructional practices and policy mechanisms within distributed leadership.

The instructional leader was leading an entire department of math teachers 6th, 7th, and 8th grade in a Title I school. She had been trained extensively on the pedagogical routine (i.e. the recurring, patterned instructional moves) by curriculum developers of Connected Mathematics at Michigan State University over nine years prior to the study. Of all the positions that had been created to influence instruction, it was the instructional leader whose position was housed in the school with the other teachers. According to interviews with both the instructional leader and the district's curriculum coordinator, it was also the instructional leader's job to influence other teachers' instruction in a direction more closely aligned to the pedagogical routine that accompanies Connected Mathematics. Below, I provide a description of the site's demographics and how this site met the study's criteria of: 1) a specified curriculum with district-desired pedagogical routine, 2) instructional leaders trained in both the curriculum and desired pedagogical routine, and 3) organizational routines designed with the intent of shaping other teachers' instructional practices to fit more closely to the desired pedagogical routine through interaction with instructional leaders and other teachers.

Demographics

The district is described as a large, suburban, mid-western school district by the National Center for Education Statistics (NCES). The socio-economic setting of the district is demonstrably middle class. However, the district started receiving students in

need of food assistance sometime within the past 10 years, such that 20% of their total expenditures are used to this end (NCES).

According to the National Center for Education Statistics, the teachers I selected to participate in this study teach in one of the district's Title I schools, though the school does not have a Title I School-Wide Program. Roughly 32% of students in the middle school are eligible for free and reduced-priced lunches (Common Core of Data/CCD). The Black population in the school is roughly 14.4%, Hispanic population is roughly 2%, Asian population is 7%, Other non-White population of the school is roughly 3% (CCD).

The curriculum that the district selected for all teachers teaching 6^{th} - 8^{th} grade mathematics is the Connected Mathematics Project. According to interviews with instructional leaders at the district level, this curriculum was selected to ensure that all students in the district would be taught content aligned to the state standards, regardless of their backgrounds. The instructional leader roles supporting teachers' instruction consist of three layers of hierarchical support that will be discussed further in the Instructional Leaders sub-section. The organizational routines consist of weekly meetings between the three teachers to plan joint action for the following week(s), classroom observations of or by the instructional leader or co-teaching with the instructional leader on a near daily basis.

Curriculum and Desired Pedagogical Practice

Connected Mathematics Project (CMP) is a standards-based[4] curriculum developed by math education researchers at Michigan State University. CMP is a National Science Foundation funded curriculum that has been associated with increases in student achievement (Reys, et al., 2003) on measures of content knowledge that are aligned to the State standards according to instructional leaders in the district. Curriculum developers of CMP used knowledge of theory and research in the areas of cognitive science, mathematics education, education policy and organization theory in the development of the curriculum (http://connectedmath.msu.edu/pnd/theory.shtml).

The influence of cognitive science, education policy and organization theory on this curriculum is reflected in the explicit instruction-level discourse structure recommended by curriculum developers for teachers to use when using the curriculum with students. The instructional-level discourse structure is referred to as "an inquiry-based model that is best suited for the problem-centered curriculum." The instructional moves embedded within it described by curriculum developers provide more teacher-student interaction around the content than exists within the IRE pedagogical routine.

In so doing, curriculum developers outline a professional practice of instruction that varies from the cultural practice of teaching captured by the IRE pedagogical routine within the instructional materials themselves. It also makes clear that the goal of using an inquiry model of instruction (rather than the dominant IRE pedagogical routine described in previous chapters) is to increase students' opportunity to learn the content by providing

[4] Content aligned to National Council on Mathematics (NCTM) standards as education defined by math researchers, mathematicians at Michigan State University.

more opportunities for students to engage with other students and the teacher around the content. This description of the inquiry model of instruction could plausibly provide the basis for distributed instruction by shared adjustment to student thinking across teachers using the curriculum provided two things: 1) teachers intended to learn it, and 2) persons with inquiry model instructional expertise were in proximity to other teachers' instructional practices through organizational routines involving in-action communication routes for the planning and doing of the work of teaching.

As a result, through selecting this curriculum the district also selected a desired instructional practice that it intended to guide teachers' instruction with students. Below is a block quote from the curriculum developers that describes the instructional moves embedded in an inquiry model of instruction. From the description below one can see how this pedagogical routine varies from the highly-resistant-to-change IRE pedagogical routine found in most mathematics classrooms around the country (Stigler and Hiebert, 1999).

> The role of the teacher in a problem-centered curriculum is different from the curriculum in which the teacher explains ideas clearly and demonstrates procedures so students can quickly and accurately duplicate these procedures. A problem-centered curriculum such as *Connected Mathematics* is best suited to an inquiry model of instruction. As the teacher and students investigate a series of problems, it is through discussion of methods of solutions, embedded mathematics, and appropriate generalizations that students grow in their ability to become reflective learners. Teachers have a critical role to play in establishing the norms and expectations for discussion in the classroom and for orchestrating discourse on a daily basis. It is through the interactions in the classroom that students learn to recognize acceptable mathematical practices, and those needing explanations or justifications.
>
> The CMP materials are designed in ways that help students and teachers build a pattern of interaction in the classroom, as they become a community of mutually supportive learners working together to make sense of the mathematics. This is done through the problems themselves, the justification students are asked to provide on a regular

basis, student opportunities to discuss and write about their ideas, and the help provided to the teacher through the assessment package and the embedded problem-centered instructional model. In addition, the following are useful:

- To help teachers think about their teaching, the three-phase instructional model contains a *launch* of the problem, an *exploration* of the problem, and a *summary* of the problem. (See a detailed discussion of the instructional model in Teacher Materials)
- The teacher is provided with detailed help- Investigation by Investigation, and Problem by Problem. The Teacher's Guide contains a discussion of the Launch, Explore, and Summarize phases for each Problem. These discussions contain specific help on the focus for each Problem, how to build on previous Problem(s) or Investigation(s), what strategies or misconceptions students might have, and connections to other mathematical concepts. Also included are suggestions for specific questions to ask during each phase of instruction. Before you engage your class in a Problem, you will find it helpful to read the detailed teaching notes for it.
- The discussion on Organizing the Classroom (see Classroom Environment) contains helpful suggestions for organizing the classroom and encouraging student participation. (http://connectedmath.msu.edu/teaching/teaching.shtml)

When I interviewed the curriculum coordinator of the district on matters of curriculum implementation she conceived instructional policy, the policy regarding the pedagogical routines teachers use when they teach, as an aspect of curriculum implementation.

Curriculum Coordinator: Connected Math isn't a traditional math program so the way the textbooks are laid out, um, doesn't really start with here's the concept here's the example now work through these problems – its really much more problem based, so it's just a different instructional approach, it's much more student based, inquiry driven and based in real world applications.

Me: So the training you are providing is specifically about how they can…

Curriculum Coordinator: Both how to use the program and how to run a classroom using this CMP program, how to ask the right question of students, how to really guide their learning, so it's not really that didactic, teacher-as-the-expert sort of instruction.

District Curriculum Coordinator Interview

I mentioned to the district curriculum coordinator that I had heard different terms used by teachers to describe the pedagogical routines they use to teach the curriculum. In particular, I was thinking of Joanne (the instructional leader) and Veronica who describe their instruction as the "Investigative Method," and Stacey who describes her instruction as the "Reader's Digest version" of CMP.

I listed three different terms I had heard teachers use to describe their instruction and asked the curriculum coordinator if those terms meant anything to her, and whether she saw each as equally viable ways of teaching the curriculum as a matter of the instructional policy she envisioned as an essential component of curriculum implementation.

> Me: I have heard different terms for different types of instructional methods. To name a few, I've heard mentioned: Investigative Method, Direct Teach, and Reader's Digest. Do those terms mean anything to you? Can you define what they mean to you when you hear them? Do you know where or how a teacher would learn to teach using these methods?
>
> Curriculum Coordinator: Reader's Digest I've never heard of.
>
> Direct instruction was one of them? I see that as sort of your trickish little way of teaching again kind of didactic where it's the teacher as the expert, and they are the ones sort of on the stage and students are seen as passive recipients. I don't know that that's ever taught or espoused, in teacher ed programs I think we are trying to steer away from that. So hopefully we don't have that going on.
>
> What was the third?
>
> Me: Investigative Method
>
> Curriculum Coordinator: Investigative Method, so I might think of that as sort of similar to Inquiry Based where it's sort of the opposite of teacher directed where it's more student directed and centered. Of course the teacher has certain goals and objectives in mind but they see themselves as a facilitator instead of the experts so they are kind of guiding students to develop their knowledge and to kind of guide their learning and understanding.
>
> Me: Does the district favor one of these teaching methods or are each equally favored?

> Curriculum Coordinator: Um, I think that we, now let me pull up our definition of effective instruction [did not pull it up, it was almost said in jest] I think we are more interested in student based and Investigative. [said with a smile]
>
> District Curriculum Coordinator Interview

From the curriculum coordinator's perspective Direct Teach, which was another way in which Stacey described the Reader's Digest of CMP, is indicative of the sage-on-the-stage pedagogical routine that is similar to descriptions of the IRE pedagogical routine. In contrast the Investigative Method is indicative of the pedagogical routine desired by the district. In particular, the Investigative Method is perceived by leadership's interpretation of the research to accompany the curriculum's promise of increasing student achievement, based on interviews with the curriculum coordinator and the instructional leader.

When I asked the curriculum coordinator how the district adapts to feedback on curriculum implementation she mentioned the dynamic role of the district's newly created Math Coach position. Namely, the Math Coach is a person designated by the district with instructional expertise teaching the mathematics curriculum who then oversees the implementation of the curriculum and supports administrators to perform meaningful observations. This is significant since Joanne, the instructional leader of the group of teachers I studied, was promoted to the district-level position of Math Coach. As a result, not only was she recognized as an instructional leader at her middle school's building level for teaching Connected Mathematics, but she was also recognized by the district as one with the instructional expertise to oversee math instruction for K-12 grades. Namely, Joanne is an instructional standard bearer for both teaching Connected

Mathematics and the teaching of Mathematics in the district, more broadly. I describe Joanne's role as instructional leader in the next section.

Instructional Leaders

The instructional leaders that the district distributed leadership to in order to support math instruction in classrooms listed hierarchically are: Director of Instruction (district level), Math and Science Curriculum Coordinator (district level), Instructional Leader (at the school level in Title I schools), and Math Department Head (school level). According to interviews with instructional leaders, the Director of Instruction is responsible for outlining the district's vision for instructional improvement. To this end, it was the Director of Instruction that enlisted all instructional leaders in a book club centered on City et al's 2009 "Instructional Rounds." It was also out of the office of the Director of Instruction that a vision for using Title II funds to add a Curriculum Coordinator and District Math Coach position to provide needed teacher learning supports to improve instructional quality was born and later realized.

According to interviews with the Math and Science Curriculum Coordinator, Director of Instruction and school-level instructional leader, the Math and Science Curriculum Coordinator is responsible for implementing the Director of Instruction's vision of instructional improvement as it applies to mathematics and science. The Curriculum Coordinator works closely with the instructional leaders in each of the schools and oversees the creation of curriculum maps. Curriculum maps are district-level pacing guides of Connected Mathematics lessons and the Unit Tests students will take and when. Unit tests that are provided by the Connected Mathematics curriculum

materials are altered by the Curriculum Coordinator and school-level instructional leaders in district-level meetings to ensure that tests are aligned to State Assessments.

According to interviews, the instructional leader (whether the Math Department Head or a designated instructional leader for the needs of a Title I school) is responsible for overseeing teachers' collective and individual instructional goals. The school-level instructional leader is responsible for heading the Professional Learning Community (PLC) meetings that occur once a month and are intended to track collective progress on collective goals teachers are pursuing. The school-level instructional leader is also responsible for designing a curriculum to support the instructional improvement of the teachers within the PLC, complete with peer observation protocols, post-observation debriefs, and teacher evaluation write-ups.

> Curriculum Coordinator: …So we now have a K-12 math coach. This individual helps to support all of our math programs, and again, it is too much work for one position, but it is starting to kind of bridge some of those needs and meet some of those needs in terms of not knowing about implementation and what's going on in the classrooms [instruction]. *Now she can be the eyes and ears.* So her full time job is to work with the buildings, administrators, and teachers on the implementation of our CMP program in the middle school, everyday math in elementary and then with our high school math. Again it's too much work for one teacher or one coach but when we know there are issues, so when administrators see a problem they call us and we have the teacher *collaborate* with the coach and kind of iron out any issues. (Italics mine)
>
> Curriculum Coordinator Interview

I confirm my understanding of the district's instructional policy as including a desired pedagogical routine for teaching Connected Mathematics from an interview with Joanne about her conception of her new role in the position of district level Math Coach. Recall that pedagogical routine refers to the recurring patterned instructional moves that occur across academic tasks. Again, Joanne is both the instructional leader of the group

of teachers I observed, as well as the teacher the district promoted to the position of Math Coach at the time of my study's data collection. According to Joanne, the district cannot expect to attain its organizational goal of increasing student achievement if teachers do not teach using the investigative method's pedagogical routine since all of the research on the effectiveness of Connected Mathematics to increase student achievement was done with teachers using the investigative method. According to Joanne, if a teacher teaches differently than the investigative method then that teacher is implicitly claiming the research says something that it does not. More specifically, by teaching in a way that does not use the investigative pedagogical routine a teacher is implying that the curriculum can effectively increase student achievement regardless of the pedagogical routine employed by teachers. If they are implicitly making such claims by teaching counter to the investigative method she sees it as her role to: 1) call them on it, and 2) support their learning of how to teach the investigative method.

> Joanne: [Reader's Digest or Direct Teach] is not teaching CMP, because it's really interesting because as I have been thinking, you know, through and making notes, that's something I am going to have to really tackle in my new job is being true to the heart of CMP. When you change [the instruction] you are changing what the *research is based upon and you're changing the results possibly. And really asking hard questions about if [the investigative pedagogical routine] is based on research then why are you thinking you know better than the research? Have you done your research to prove differently?* I think is what I am going to have to be asking. Do you have current research to prove, you know? That's going to be tough but I think that is something we are going to have to deal with, because I think that's something we are going to have real strain. I think that working at [Walter Johnson Middle School] has been really good for me because we do get these struggling learners in there and they are the kids that really benefit [from the investigative pedagogical routine]. And I think all kids benefit from this, but kids from a particular socio-economic educational group, have so many supports that you don't know what they do and what they don't know and what they can do with the math. I don't know that they [the kids] know and understand the math.

> So you've got some real interesting walking to do with these teachers to get them to understand the difference between doing and understanding, and deeply knowing. I think there's a lot of people that come out of high school that can do math, but don't know it really well. Which is why I think a lot of them hate it, so um, and the Reader's Digest version is just one variety of [a teacher knowing how to do the math but not deeply understanding the math], you know. [Reader's digest is] a variety that's out there in the district, there's other [instructional] varieties out there in the district.
>
> Instructional Leader Interview 1-31
> (Italics mine)

I view the above envisioned instructional policy that sees instructional practices as part and parcel of curriculum implementation as something that is more commonly seen as part of a rational design for increasing student achievement. In particular, rational designs for increasing student achievement will have a specific curriculum and pedagogical routine for teachers to use with students around the curriculum so that teachers may more reliably increase student achievement. However, what tends to accompany such envisioned instructional policies is vague language to capture what the instructional policy's desired pedagogical routine entails and limited means for detecting the spread of the desired pedagogical routine across a group of teachers or district, more broadly (City et al., 2009). In the previous chapters on methods I describe how I attempt to provide an analytic lens onto the desired pedagogical routine by analyzing the instructional leader's instructional moves. I then use each of these instructional moves as units of analysis to improve understanding and the capacity to see both the desired instructional practice and whether and to what extent it has spread across other teachers' instruction in the section on data analysis.

Teachers' willingness to learn a research-based, or district-desired pedagogical routine that accompanies a given curriculum, alone, is not enough to support teachers' learning the desired pedagogical routine. It is thought that teachers need thoughtful

school environments that are conducive to teacher learning and allow teachers to observe the pedagogical routine that leadership believes accompanies the curriculum (Cogburn, 2008, Cobbs, 2003, 2010; City et al., 2009; Lampert, 2010). Hence, I focus on both instructional leaders and organizational routines present in the district and school to this end, in the following sections. In teachers' narratives I focus on factors that influenced the usefulness of the organizational routines present to shape their own instructional practice.

Organizational Routines

In this section I describe the formal and informal organizational routines that comprised the context of teachers' instruction in the school. These organizational routines are instances of either Coordination by Schedules or Coordination by In-Action Communication Routes as described by my theoretical framework. I list them under each sub-heading below.

Coordination by Schedules

Teachers in the selected three-teacher network met formally every week, typically on Mondays, to plan the pacing for the upcoming lessons, Unit Tests, and State Assessments. They were also functioning within a larger Professional Learning Community of all math teachers in the middle school. PLC meetings occurred once a month, and served as a time to discuss benchmarks on collective goals stated and agreed to in prior PLC meetings.

Coordination by In-Action Communication Routes or Classroom Observations

The three forms of in-action communication routes are co-teaching and classroom observation of either the instructional leader's instruction or the instructional leader's observation of a teacher's instruction. In particular, the newest member of the three-teacher network (to whom I refer to as Stacey) taught in the district for 4 years and at this school for 2 years prior to the study. At the time of this study Stacey co-taught a lower-level 8th grade math class with the instructional leader. This provided Stacey formal, daily opportunities to observe the instructional leader teach 8th grade math using the investigative or inquiry based method pedagogical routine, which has been said to be consistent with the teaching of CMP by the Math and Science Curriculum Coordinator. At the time of this study Stacey didn't teach 8th grade math and taught four sections of 7th grade math.

The other teacher in the three-teacher network, to whom I refer to as Veronica, had a part-time 7th grade math teacher appointment and had worked with the district for 9 years. Veronica shared a classroom with the instructional leader who also had a part-time teaching appointment that was split with other leadership responsibilities. The instructional leader typically taught for first hour and second hour of the school block schedule. Veronica typically taught second hour and third hour. However, Veronica tended to come in before second hour to go over paperwork, lesson plans or other materials at her desk while the instructional leader was teaching. As such, Veronica informally and casually observed the instructional leader teach the very lesson she was about to teach during second hour daily.

The instructional leader had regular opportunities to observe all math teachers in the building and typically met with 4 or 5 teachers a week. Hence, she performed near daily observations of teachers' teaching mathematics in grades 6th-8th. As for the 7th grade math team, she observed the newest member, Stacey, at least once a week, and observed Veronica with less formal frequency.

Conclusion

In this chapter I described the curriculum, the district-desired pedagogical practice, Joanne's district-recognized pedagogical expertise, Joanne's role to support teachers to teach with the desired pedagogical practice, and the organizational routines the district created and school implemented to support Veronica and Stacey to learn how to teach using the district-desired pedagogical practice from Joanne. Due to these five organizational characteristics I viewed this site as possessing Abbott's (1998) criterion of people, commodities, and organizational routines that are necessary for the leadership structure to influence technical practices. As a result I determined that observations of this set of three teachers were a plausible site for being able to identify a construct of distributed instruction and learn whether teachers' perceived share instructional practices as related to policy mechanisms within distributed leadership.

CHAPTER 5

A COMPARATIVE ANALYSIS OF DISTRIBUTED INSTRUCTION BY TEACHERS' SHARED CONTENT, TOOL USE, AND ADJUSTMENT TO STUDENT THINKING

In this chapter I address the overarching research question of "Is there a plausible or defensible construct of distributed instruction? If so, what is it and what does it look like across teachers' instructional practices?" Recall from the conceptual framework in Chapter 2 that the conceptual model of distributed instruction describes the hypothetical relationship between policy mechanisms and collective, coordinated and collaborative forms of distributed instruction. The construct of distributed instruction, itself, involves specific aspects of shared instruction that constitute different forms distribution across teachers' instructional practices (tools, schedules and adjustments to student thinking). This chapter sets out to identify evidence of collectively distributed instruction by shared content and tool use and collaboratively distributed instruction by shared adjustment to student thinking within teachers' observed shared instructional practices. Collectively distributed instruction by shared content and tool use refers to the similarity across two teachers' instruction that can be attributed to the common use of collective resources that come in the form of content and instructional materials or tools provided by the district.

These collective resources may be provided as part of the curriculum or as tools and materials the district recommends teachers use to accompany the teaching of the curriculum. Collaboratively distributed instruction by shared adjustment to student thinking refers to the similarity across two teachers' instruction that can be attributed to shared instructional moves that hypothetically come from teachers who collaborate on their instructional approaches with students. As a result, whenever the reader sees the term collectively distributed instruction, it regards the use of collective resources. Whenever the reader sees the term collaboratively distributed instruction, it regards the shared use of instructional moves that can emerge from teachers collaborating on instructional approaches to teaching the curriculum. The focus of my analysis in these exchanges is to provide comparative, descriptive specifics that allow the reader to see whether and to what extent collectively distributed instruction by shared content and tool use exists within the exchanges that constitutes the follow-up prompt between Joanne and a teacher she works with closely. I emphasize the role of the analysis of the follow-up prompt since it is the instructional move that so clearly marks when the IRFT pedagogical routines diverges from the IRE pedagogical routine.

At the start of my work to explore and identify the construct of distributed instruction in the teaching of Connected Mathematics at Walter Johnson Middle School, I began doing observations of weekly team meetings between Joanne (instructional leader), Stacey and Veronica. These meetings were typically used as a site for the shared pacing of lesson plans. During one such meeting, Stacey stated that she would use the same materials the other two teachers were using, but that she would teach the "Reader's Digest" version of the Connected Math lesson. I sought clarification of Stacey's

instructional plan in an interview. She explained that the "Reader's Digest" version was "more to the point," which I understood to mean that the Reader's Digest version was an abbreviated version of the district-desired pedagogical routine to teach the Connected Math lesson. In the analysis of shared academic tasks (content), instructional materials (tools) and instructional moves between Joanne and the two teachers in this chapter, I identify the ways in which Stacey's practice was different from or similar to the instructional practices of Joanne. I likewise identify the ways that Joanne and Veronica's instructional practices are dissimilar or similar to one another. My analysis of similar or dissimilar instructional practices between Joanne and the other two teachers examines whether and to what extent their similarity diverges from the IRE pedagogical routine while converging with an identifiable pedagogical routine embedded in an analysis of Joanne's (the instructional leader's) instruction. As explained in Chapter 3, based on my grounded theory approach for analyzing Joanne's teaching I have named her pedagogical routine IRFT pedagogy for the purposes of this dissertation. Stacey's "Reader's Digest" version of teaching CMP was notably different from Joanne's IRFT pedagogical routine, whereas Veronica's pedagogical routine was notably similar to Joanne's IRFT pedagogical routine. The contrast between Stacey's and Veronica's pedagogical routine as compared to Joanne's pedagogical routine helps to clarify whether and to what extent distributed instruction exists between each of the teacher's instructional practices and Joanne's instructional practices.

In order to address the overarching researching question of whether "there is a plausible or defensible construct of distributed instruction? If so, what is it and what does

it look like across teachers' instructional practices?" the analysis in this chapter provides answers to the following research questions:

1. Does the construct of collectively distributed instruction offer a framework for analyzing teachers' use of common academic tasks and instructional materials?
    a. If so, does this framework help to identify whether, and to what extent different academic tasks and instructional materials occur across teachers?
2. Does the construct of collaboratively distributed instruction offer an analytic framework that identifies the instructional leader's adjustments to student thinking and its spread across teachers with whom the leader works with closely?
    a. If so, does the analytic framework help to identify whether and to what extent the spread of the instructional leader's adjustments to student thinking varies between two teachers with whom she works with closely?

Analysis of Distributed Instruction

Connected Mathematics Investigation 3.2: Two Vignettes

This chapter is organized into two instructional vignettes that divide the lesson into: 1) Review of Prior Work, and 2) Discussion Post Group Work. I have provided the complete transcription of Joanne's, Veronica's, and Stacey's teaching of Lesson 3.2 instruction in Appendix A, B, and C, respectively. I provide the full transcript in an effort to be transparent about where I have made judgments regarding when one phase of instruction has ended and the other has begun.

As mentioned in Chapter 3, my tripartite analysis of similarity (dissimilar=0, partially similar=1, similar=2) across teachers' instructional practice within Review of Prior Practice and Class Discussion post group work is organized around four

instructional moves for a given academic task. Individually, these moves are used to identify the strength of content and tool similarity or distribution between Joanne and one of the teachers she works with closely. For the remainder of the chapter I will refer to the content similarity and instructional material use or tool use for a given academic task as content and tool distribution. Content and tool distribution are an abbreviated way of referring to the content similarity and instructional material use similarity within a particular instructional move. Combined, these moves are used to identify the cohesive fit of overall patterns of adjustment to student thinking.

The first and second vignette, Review of Prior Work and Discussion Post Group Work, analyze similarities within instructional dynamics for a given academic task used by Joanne and the two teachers she works with closely. Each academic task in each vignette is organized into five sections that map onto the strength of similarity within the instructional leader's four instructional moves and the cohesiveness of fit across all four instructional moves between Veronica and Joanne, and then Stacey and Joanne. Hence, the sections are: 1) initiation of academic task, 2) student response, 3) follow-up prompt, 4) take-away point, and 5) cohesiveness across all four instructional moves constituting the IRFT pedagogical routine. The first four sections of each vignette regard the collectively distributed instruction by shared content and tools or instructional materials. The last, and fifth section, regards the collaboratively distributed instruction by shared adjustment to student thinking.

Vignette 1: Review of Prior Work

In this vignette, I provide an analysis of shared instructional practices between Joanne and two teachers she works with closely. In particular, I begin with an analysis of

shared content and tool use within each of the four instructional moves that constitute the instructional leader's IRFT pedagogical routine for a given academic task. Recall from Chapter 3's discussion of the unit of analysis that the these four instructional moves consist of 1) posing a question in the form of initiating an academic task, 2) listening or representing what a teacher hears the student say in response to the academic task, 3) providing a clarifying question regarding the student's answer or reasoning in determining the answer in the follow-up prompt and 4) a declarative statement about the correct reasoning for determining the answer and stating the correct answer in the instructional move of the take-away point. I then provide an analysis across each of these instructional moves in a section titled "cohesiveness" of shared adjustments to student thinking between Joanne and the other two teachers. Recall from the conceptual framework in Chapter 2 that distributed instruction is a conceptual model that describes and provides language for the use of shared instructional dynamics across teachers' classroom teaching. I claim in my conceptual framework that distributed instruction (i.e. shared aspects of instructional dynamics) is both observable and something that can be mapped. In particular, I claim that by attending to the socially organized practice of distributed instruction one can more clearly "see" or identify how and in what ways particular shared content and tool use by teachers matches the culturally-dominant IRE pedagogical routine or a district-desired pedagogical routine, inclusive of teaching strategies and classroom discourse norms. In my conceptual model of distributed instruction I offer that partial evidence of distributed leadership's capacity to shape instructional dynamics between teachers and students around the content is evidence that

distributed instruction across a group of teachers diverges from the IRE pedagogical routine while converging to a district desired pedagogical routine.

In this regard, what becomes clear in this analysis is that Joanne and Veronica have stronger levels of collectively distributed instruction by shared content and tool use and more cohesive levels of collaboratively distributed instruction by shared adjustment to student thinking in their review of prior work than Stacey does with Joanne. This provides comparative evidence that an analysis of distributed instruction enables the reader to see varying levels of collectively distributed instruction by shared content and tool use and collaboratively distributed instruction by shared adjustment to student thinking for a given pairing of teachers. Moreover, the following analysis provides insights into how these varying levels of collectively distributed instruction by shared content and tool use, and collaboratively distributed instruction by shared adjustment to student thinking might be mapped or tracked on through the use of composites of the instructional triangle and a table that quantifies similarity between two teachers for a given instructional move. These findings tend to support affirmative answers to my two research questions, and to indicate that the hypothetical construct of distributed instruction also has empirical content. In so doing, this analysis provides language and contributes an analytic framework for identifying collective and collaborative aspects of instructional dynamics within a given group of teachers. I conclude this section with an analysis of the cohesiveness of collaboratively distributed instruction by shared adjustment to student thinking as it relates to the cohesiveness of teachers' instructional moves to the IRFT pedagogical routine performed by the instructional leader.

The organization of the analysis within each instructional move follows this form: I first provide a claim regarding a comparative level of similarity between Joanne (the instructional leader) and Veronica, and then second, Joanne and Stacey. After providing the claim I provide evidence supporting that claim by applying the criterion of similarity described in Chapter 3 to the data in sub-sections titled "Content distribution" and "Tool distribution." Content distribution regards shared mathematical content of academic tasks across teachers. Tool distribution regards shared instructional materials or tools across teachers. Both of these sections are indicative of collectively distributed instruction by content and tool use. After which, I describe a means of mapping and tracking the observable shared content and tool use within an instructional move for a given pairing of teachers using both composites of the instructional triangle and tables, respectively. Each Composite is accompanied by a table that utilizes the categories of content and tool use unearthed from the conceptual mapping of instructional moves onto the instructional triangle composites. The accompanying tables provide added visual support in representing collectively distributed instruction by shared content and tool use. The visual aid provided by the composites and tables for each instructional move informs the aggregate analysis of overall adjustment to student thinking. These visual aids allow us to see whether shared tool and content use is occurring in the context of the IRE pedagogical routine or the IRFT pedagogical routine modeled by the instructional leader.

Initiate Academic Task.

In the following analysis of initiation of the academic task I focus on shared content and tool use between Joanne (the instructional leader) and the other two teachers

in the way they go about posing the academic task to students. I do so to explore whether and to what extent an analysis of collectively distributed instruction enables the reader to "see" or identify distributed instruction by shared content and tool use for a given group of teachers. The first thing to notice about the academic task in the Review of Prior Work is that the mathematical content is quite similar between Joanne and Veronica. That is, both Joanne and Veronica initiate a review of how students determined the probability the treasure would be hidden in a given room for Level 1 of the Mansion from Lesson 3.1.

On the other hand, Stacey's academic task in her review of prior work is on an entirely different aspect of the mathematical content. In Stacey's review of prior work she asks students to give probabilities using whole numbers, by prompting students to think about how many times they played a particular game over the weekend. Consequently, the strength of shared content within collectively distributed instruction by shared content use is greater between Joanne and Veronica than the shared content between Joanne and Stacey.

Below, I provide the first academic task in each teacher's review of prior work. The aspects of the instructional triangle that I conceive as being engaged by the instructional leader initiating an academic task are the mathematical goal that the academic task intends for students to learn and the tools teachers use to communicate the academic task to students. I provide practice-based specifics of what constitutes shared content and shared tool use between Joanne and Veronica and then Joanne and Stacey in subsections titled "Content distribution" and "Tool distribution." After which, I provide a visualization of the comparative levels of distribution both through the use of the

accompanying instructional triangle composites for a given instructional move and a table to quantify the observed similarity in the subsection “Mapping and quantifying similarity and dissimilarity."

Academic task

Joanne: [Transparency of Level 1 with different colored room borders displayed.] You are not sure how to find the probability if all the rooms have a different probability. So how would you answer Hillary’s question? She's saying how would you find the probability for the great hall? How would you find the probability for the servant’s chamber if all the rooms have a different probability? So what would you say to Hillary?

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Veronica: Make sure you have your 3.1 classwork out, along with your lab sheet. And we're on page 34 [because students had their books out I noticed them also referring to page 33]. Okay. So, Landon wasn't here yesterday. So can somebody tell him what we did? What did we do? Let's summarize what we did yesterday quickly. Jason, thanks.

**

Stacey: Ryan, since you can play Call of Duty quite often from what I'm hearing, Ryan, if I asked you how many times you played, let's say, the whole game. I don't understand Call of Duty, so you have to ignore my ignorance on this. So, how many times did you play last night? Or, in the weekend? Put it that way.

Content distribution.

My criterion for determining similarity or dissimilarity of the mathematical goal of the academic task is based on whether a teacher uses the same academic task as the instructional leader. Or, second, in the event that a teacher indirectly refers to an academic task I determine whether the instructional leader and another teacher’s prompting asks a student to do the same mathematical work.

In the case of the academic task in the Review of Prior Work, Joanne directly initiates the academic task “She's saying how would you find the probability for the great

hall? How would you find the probability for the servant's chamber if all the rooms have a different probability? So what would you say to Hillary?" while Veronica indirectly initiates the academic task by asking, "So, Landon wasn't here yesterday. So can somebody tell him what we did? What did we do? Let's summarize what we did yesterday quickly. Jason, thanks." Both Joanne and Veronica are prompting students to begin a review of the mathematical work of determining the probability of the treasure chest being hidden in a room on Level 1 of the Mansion. As a result, I see the mathematical goal of both teachers' academic task as similar since they are both asking students to describe the mathematical work of determining the probability of the treasure being hidden in a room on Level 1 of the Mansion. What this similarity in content for the academic task between Joanne and Veronica indicates is that content distribution is an aspect of collectively distributed instruction that does exist between these two teachers and is observable.

Conversely, the mathematical content of Stacey's first academic task was intended to draw students' attention to writing probabilities in terms of whole numbers representing how many times out of how many possible times, not in fractions of a time. Stacey initiates the academic task in the following way, "Ryan, since you can play Call of Duty quite often from what I'm hearing, Ryan, if I asked you how many times you played, let's say, the whole game. I don't understand Call of Duty, so you have to ignore my ignorance on this. So, how many times did you play last night? Or, in the weekend? Put it that way." In particular, by asking Rick how many times he played a game over the weekend the mathematical goal to which she was directing students' attention to write probabilities down as whole numbers. Meaning she wanted students to give the

probability of something happening with a whole number communicating the odds of something happening, and not a fraction of a time of it happening. Using a question that asked how many times students played a game, Stacey used students' lived experiences to support them to heed this aspect of mathematics in their own answers of how many times someone did something. To achieve this, she initiated the academic task by asking students how many times they played a specific game over the weekend. What this indicates is that the mathematical content to which she was directing students in her review of prior work was very different from the mathematical content that Joanne directed her students to as a way of reviewing prior work. This is a clear indication of a dissimilar mathematical goal for the review of prior work between Joanne and Stacey. As a result, this comparison identifies that collectively distributed instruction by shared content does not exist between Joanne and Stacey in their review of prior work.

Tool distribution.

My criterion of tool similarity is determined by whether the instructional leader and another teacher provide the same tools (e.g. book page, transparency and photocopy). Partial similarity is determined when there are only some of the same tools used. Dissimilar is determined when another teacher doesn't use any tools or entirely different tools from that of the instructional leader. By applying my criteria of similar tool use between the instructional leader and another teacher teaching the same lesson in different classrooms, I am exploring whether and to what extent collectively distributed instruction by shared tool use exists between the instructional leader and a particular teacher's academic task.

The similarity of instructional material or tool use between Joanne and Veronica concern both asking students to turn to page 34 in their book and to think about how they did the work of finding the probability for Level 1 of the Mansion. Since both asked their students to get their books out, I noticed that both teachers' students turned to page 33 which had a picture of Level 1. However, they did have some distinct differences in tool use as well. In particular, while Joanne asked students to look at page 34, she also put up a transparency of Level 1 for the whole class to view, whereas Veronica did not use the transparency.

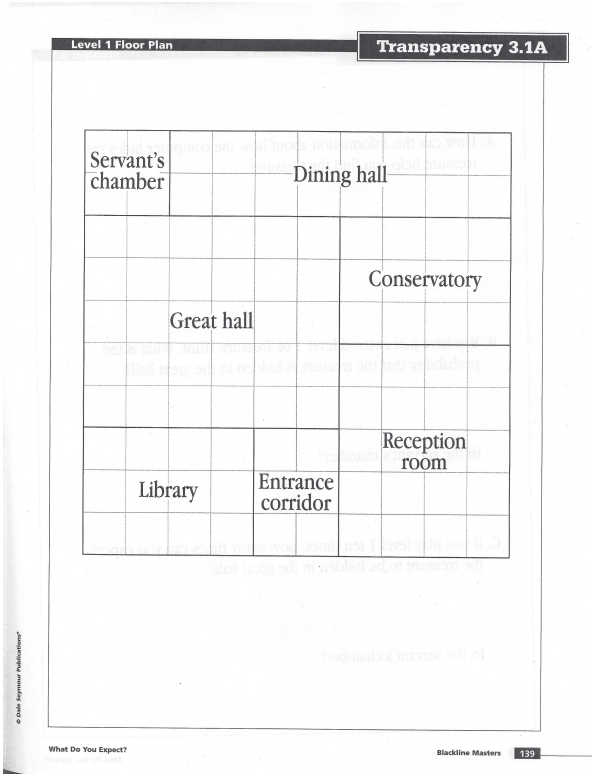
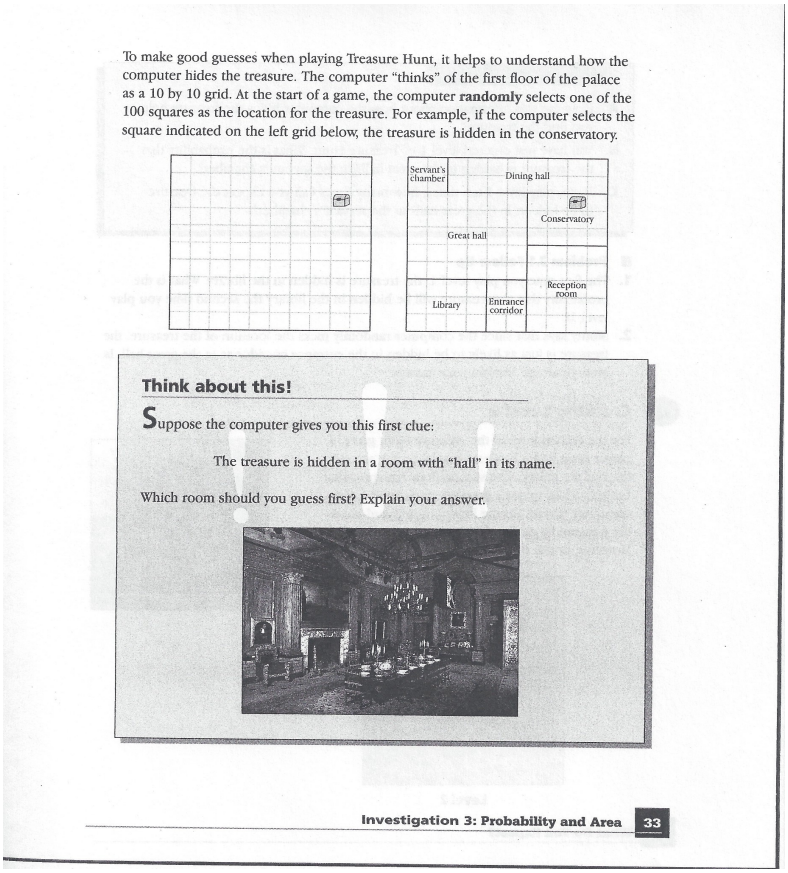


Figure 1: Transparency of Level 1 of Mansion

This transparency depicted the border of each room in the Mansion in a different color than the other rooms. Joanne pointed to corresponding aspects of the transparency as she

stated the academic task. That is, when she referred to the great hall she pointed to the great hall, and so on.

In Veronica's case she told students to have their 3.1 classwork out, along with lab sheet, and to turn to page 34. Again, I noticed that since Veronica's students had their books out some of them referred to page 33 since it had a picture of Level 1 of the Mansion. In this way both Veronica and Joanne provided tools that had the picture of Level 1 of the Mansion, though in somewhat different ways.



To make good guesses when playing Treasure Hunt, it helps to understand how the computer hides the treasure. The computer "thinks" of the first floor of the palace as a 10 by 10 grid. At the start of a game, the computer **randomly** selects one of the 100 squares as the location for the treasure. For example, if the computer selects the square indicated on the left grid below, the treasure is hidden in the conservatory.

Think about this!

Suppose the computer gives you this first clue:

The treasure is hidden in a room with "hall" in its name.

Which room should you guess first? Explain your answer.

Figure 2: Book page 33

In particular, Veronica did not use a transparency, and unlike Joanne, Veronica did not point to corresponding aspects of Level 1 as she prompted her class to begin the Review of Prior Work. Consequently, directing students to corresponding aspects of a

transparency of Level 1 of the Mansion was not an instructional move that was shared between Joanne and Veronica in conveying the academic task to the whole class.

This has instructional significance since in Veronica's case she requires a student to follow directions and to be attentive in the moment an academic task is provided, and assumes a student should know where to look on the picture in order to determine the answer. In contrast, the instructional leader, Joanne makes no such assumptions and demands far less of students in order for them to understand the academic tasks used in the Review of Prior Work. In particular, regardless of whether a student opened his/her book to a specific page Joanne provides a transparency that has the picture students need to use in order to do the work in the academic task. Moreover, she points to specific rooms as they are mentioned, which supports students' attention to the academic task at hand, more so than merely asking students to turn to a specific page in a book. As a result, while Joanne and Veronica have some aspects of shared tool use they do not have fully shared tool use. It is in this way that Joanne and Veronica identify partially similar tool use or partial collectively distributed instruction by shared tool use.

Conversely, Stacey's lack of overlap of mathematics content in the academic task for the review of prior work may be responsible for a continued lack of shared tool use to convey content. Instead of using material tools to communicate her academic task, Stacey relies on student's lived experience of playing a game to determine the odds of playing a game and how a fraction of a time playing would not make sense in that case. Stacey's lack of tool use does not provide an opportunity for shared tool use between Stacey and Joanne. Consequently, the lack of shared tool use indicates dissimilar tool use or a lack

of collectively distributed instruction by shared tool use between Joanne and Stacey's academic task in the review of prior work.

Mapping and quantifying similarity and dissimilarity.

In this section I provide a visualization of what is similar and dissimilar for the initiation of the academic task across the two pairing of teachers, Joanne and Veronica and Joanne and Stacey, in their respective reviews of prior work. Recall that this aspect of collectively distributed instruction plays a role in supporting instructional observers' ability to "see" or identify whether and to what extent collectively distributed instruction by content and tool use exist between an instructional leader and another teacher. The purpose of providing this visualization is that it can enable shared "seeing" which aspects of the desired pedagogical routine modeled by the instructional leader are performed by the teachers she mentors. By doing so, it can serve as a tool to support needed dialogue about what elements of instruction are needed to be distributed and what elements of instruction do not need to be distributed as a matter of instructional policy alignment (either at the administrative or instructional levels). That is, simply saying to a teacher your instruction is not aligned to instructional policy isn't necessarily informative or helpful to supporting teacher learning. Providing a visualization of what aspects of a teacher's instruction are not aligned and what aspects are aligned can, in theory, support a dialogue with a teacher that supports her capacity to see how her content and tool use can be improved to look more like what the district desires as indicated by the instructional leader's instructional practices. It is in this way that I suggest that the below visualizations can become conversation starters for post-observations of teachers'

instruction in a manner that can yield productive conversations regarding the use of particular content and tool choices in support of instructional improvement.

Joanne and Veronica

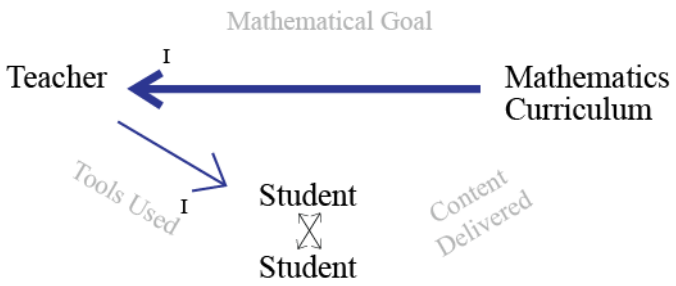
I applied a criterion of similarity in the content distribution section above that indicated that Joanne and Veronica's academic task shared a similar mathematical goal. That is, Joanne and Veronica both initiated the review of how students determined the probability that a treasure chest would be found in a given room on Level 1 of the Mansion. This similarity is indicated in a conceptual mapping of the academic task below in Composite 1. Specifically, it is indicated with the presence of a bold arrow from Mathematics Curriculum to Teacher on the Mathematical Goal side of the instructional triangle.

Likewise, recall that I applied a criterion of similarity in the tool distribution section above that indicated that Joanne and Veronica had partial similar tool use. Partially similar tool use was determined since Veronica did not use all the tools Joanne used to initiate the review of prior work. In particular, while they both told students to open their books to page 34, and some of their students referred to page 33, only Joanne used a transparency of the picture of Level 1 that was on page 33. The partial similarity of tool use between Joanne and Veronica's academic task is indicated with the presence of an arrow from Teacher to Student on the Tools Used side of the instructional triangle.

In the table that follows I represent the similarity with respect to both the "Mathematical Goal" and "Tools Used" categories for the initiation of the academic task between Joanne and Veronica. In particular, I indicate a 2 for similarity of mathematical goal and a 1 to indicate partial similarity in tools used. This provides Joanne and

Veronica with a similarity score of 3 out of 4 for their initiation of the academic task in their review of prior of work.

Joanne and Veronica



Composite 1: Initiate Academic Task

Similar = bold arrow; Partially Similar = present arrow; Dissimilar = gray arrow

Table 7: Instructional Leader and Veronica Academic Task 1

Academic task Joanne (Instructional Leader) compared to Veronica Similar = 2; Partially Similar = 1; Dissimilar = 0			
	Mathematical Goal	Tools Used	Total
Similarity Scale	2	1	3 Out of 4

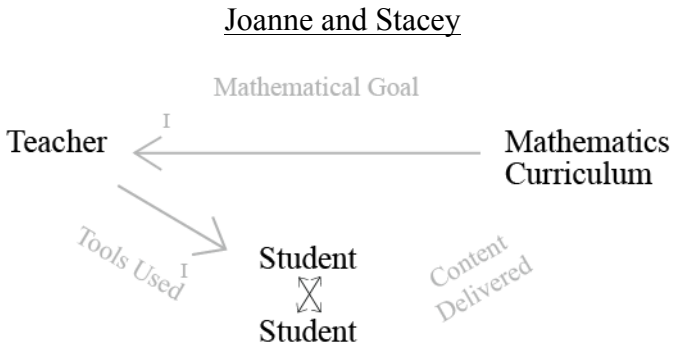
Joanne and Stacey

Recall that I applied a criterion of similarity in the content distribution section above that indicated that Joanne and Stacey had a dissimilar mathematical goal within their review of prior work. That is, Joanne prompted the review of how student's determined the probability that a treasure chest would be found in a given room on Level 1 of the Mansion, while Stacey prompted a review of how to write down probabilities with whole numbers. This dissimilarity is indicated in a conceptual mapping of the academic task below in Composite 1. Specifically, it is indicated with the presence of a

gray arrow from Mathematics Curriculum to Teacher on the "Mathematical Goal" side of the instructional triangle.

Likewise, recall that I applied a criterion of similarity in the "Tool distribution" section above that indicated that Joanne and Stacey had dissimilar tool use. Dissimilar tool use was determined since Joanne used a page out of the book and a transparency of the picture of Level 1 from page 33, while Stacey used no tools at all. The dissimilarity of tool use between Joanne and Stacey's initiation of the review of prior work is indicated with the gray arrow from Teacher to Student on the Tools Used side of the instructional triangle.

In the table that follows I represent the similarity between Joanne and Stacey's academic task with respect to both the Mathematical Goal and Tool Used in their academic tasks. In particular, I indicate a 0 for the dissimilarity of the Mathematical Goal and a 0 to indicate dissimilarity in Tools Used. This provides Joanne and Stacey with a similarity score of 0 out of 4 for their academic task in their review of prior of work.



Composite 1: Initiate Academic Task

Similar = bold arrow; Partially Similar = present arrow; Dissimilar = gray arrow

Table 8: Instructional Leader and Stacey Academic Task 1

Academic task Joanne (Instructional Leader) compared to Stacey Similar = 2; Partially Similar = 1; Dissimilar = 0			
	Mathematical Goal	Tools Used	Total
Similarity Scale	0	0	0 Out of 4

Student response.

The first thing that I notice as I observe the instructional leader listening to a student's response to the academic task is whether the instructional leader is pointing to something on a transparency or chalk board as a way to refer to or represent what the student is saying. As a result, I decided that one dimension of the instructional leader listening to a student's response involved the tools she or the student referred to or gestured to as a student provided a response. In the section on tool distribution, I describe the similarity between the tools or materials the student or teacher refer to when the instructional leader and another teacher listen to a student response. I conclude this section with a summary statement regarding the extent to which an analysis of collectively distributed instruction by shared tools supports the reader to "see" whether and to what extent tool use is shared between an instructional leader and a teacher she works with closely.

The second thing I noticed was that the instructional leader was listening for the mathematical procedure a student performed to get the answer and whether the student provided reasoning for the procedure the student used. This listening or attending to the mathematical procedure isn't observable until the follow-up prompt. Though I use what I observed in the follow-up prompt to infer the mathematical goal the instructional leader

had as she was attending to the student's use of mathematical procedure and reasoning. I describe how I determine similarity in the mathematical content between the instructional leader and another teacher were listening to in the section on content distribution. I conclude this section with a summary statement regarding the extent to which an analysis of collectively distributed instruction by shared tools supports one to "see" or identify whether and to what extent tool use is shared between an instructional leader and a teacher she works with closely.

In the following sections, content distribution and tool distribution, I describe the specifics of shared content and shared tool distribution between each pairing of teachers that constitutes my claim that Joanne and Veronica have comparatively greater levels of distributed content and tool use than Joanne and Stacey in the instructional move of the student response. These descriptive specifics are intended to allow one to identify whether and to what extent collectively distributed instruction by shared content and tool use exists within the instructional move of the student response. Below, I provide the student response in each teacher's review of prior work. I provide practice-based specifics of what constitutes shared content and shared tool use across teachers in subsections titled content distribution and tool distribution. After which, I provide a visualization of the comparative levels of distribution both through the use of the instructional triangle composite for student response and tables in the subsection "Mapping and quantifying similarity and dissimilarity."

Student Response

Joanne: Chloe? Whoops, Chloe's up here, she's not paying attention, she's focused. Did you find it? All right, so what would you say to her, Chloe?
Chloe: I was kind of, you know.

Joanne: I know, but I'm going to reread it for you. So she's saying-- try it again, Chloe? How would you find the probability of-- are you listening?
Chloe: Yeah, I'm listening.
Joanne: How would you find the probability of the treasure being in the great hall?
Chloe: You would find out how much squares are in there [pointing to projected transparency] and which was the [mumble]. You would take that and put it at 10 [mumble].

**

Veronica: Make sure you have your 3.1 classwork out, along with your lab sheet. And we're on page 34. Okay. So, Landon wasn't here yesterday, so can somebody tell him what we did? What did we do? Let's summarize what we did yesterday quickly. Jason, thanks.
Jason: There was a whole bunch of different rooms in this mansion, and we had to find what would be the probability of the treasure chest being in each room.

**

Stacey: So, how many times did you play last night? Or, in the weekend? Put it that way.
Rick: Like how long?
Stacey: How many times did you play?
Rick: How many games? How many matches?
Rick: Maybe like 10.

Tool distribution.

In Joanne's case, the student who was chosen at random (picking sticks with students names on them) happened to be standing at the front of the room to the left of the screen onto which the rooms of the mansion were being projected. You can see supporting evidence of this from the transcript when Joanne says, "Chloe? Whoops, Chloe's up here, she's not paying attention, she's focused. Did you find it? All right, so what would you say to her, Chloe?" Below is an image of the transparency that came with CMP's instructional materials that Chloe was standing beside at the front of the class.

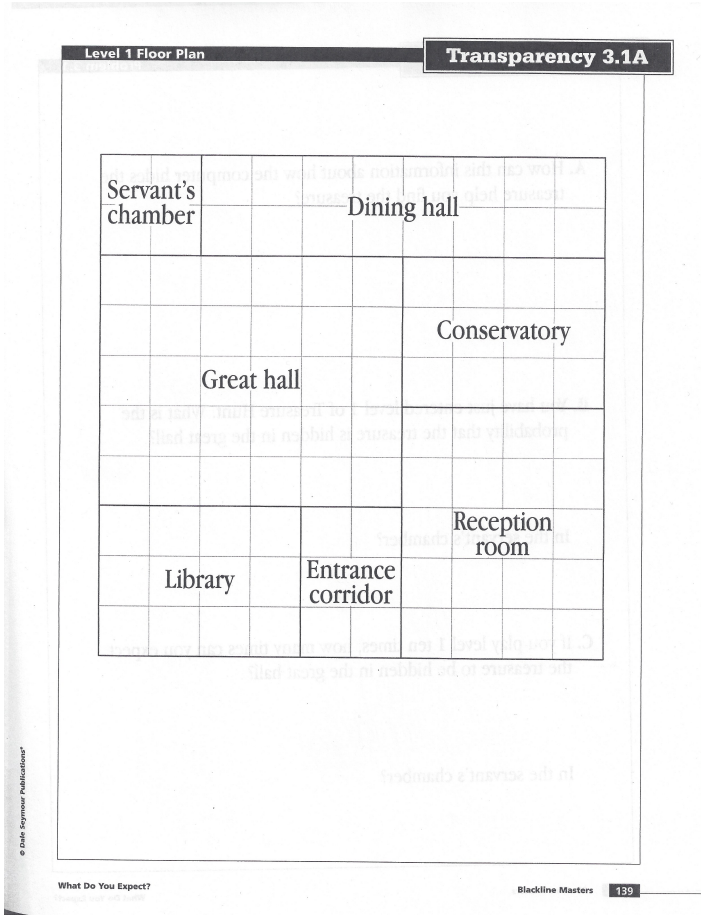
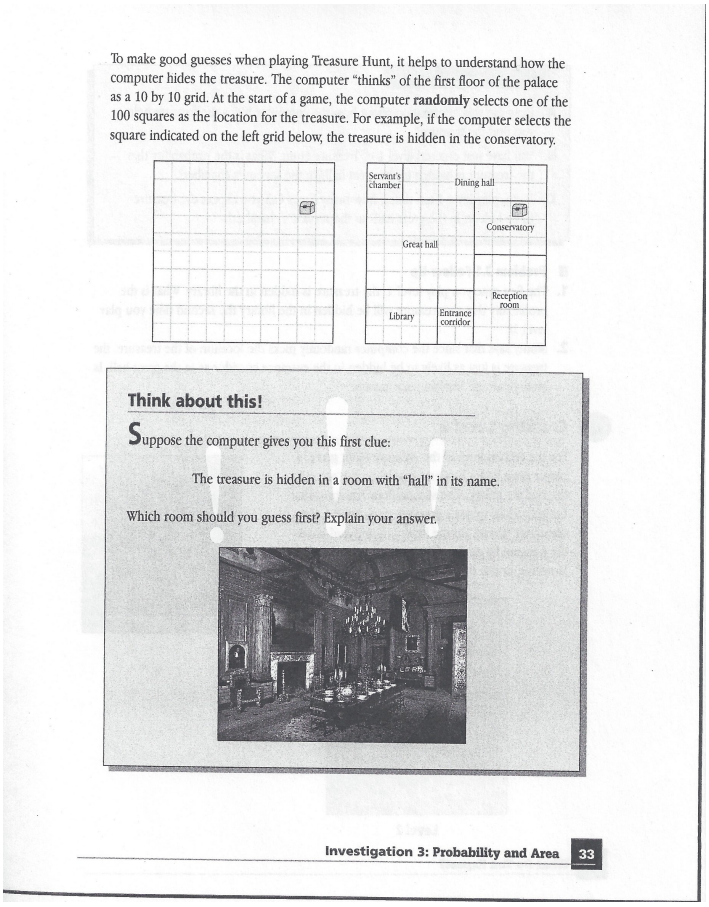


Figure 1: Transparency of Level 1 of Mansion

As a result, when the student responded, she also pointed to the projection that Joanne provided in the academic task. Though Joanne did not point to the transparency as she listened to the student, Joanne did provide the transparency that served as a tool for the student to refer to the whole class when she gave her response.

On the other hand, Veronica did not use the overhead in her academic task, so neither she nor the student had anything to point to for the whole class to view as the student responded. As a result, the tools used for a student or the teacher to refer to during the student response were different between Joanne and Veronica based on the tools made available for communicating the content in the academic task. In particular,

while Joanne's student could use the transparency as she gave her response, Veronica's student could have referred to the picture of Level 1 of the Mansion in the lab sheet Veronica referred to from the book. The student in Veronica's case did not explicitly refer to the lab sheet, but he was looking at it as he provided his answer.



To make good guesses when playing Treasure Hunt, it helps to understand how the computer hides the treasure. The computer "thinks" of the first floor of the palace as a 10 by 10 grid. At the start of a game, the computer **randomly** selects one of the 100 squares as the location for the treasure. For example, if the computer selects the square indicated on the left grid below, the treasure is hidden in the conservatory.

Think about this!

Suppose the computer gives you this first clue:

The treasure is hidden in a room with "hall" in its name.

Which room should you guess first? Explain your answer.

Figure 2: Book page 33

As a result, since both teachers provided a tool that would allow students to refer to the picture of Level 1, though in Veronica's case it was solely from page 33 and in Joanne's case it is from either the book or the transparency, I view this as partial similarity in shared tool use. The shared tool use is the picture of Level 1 of the Mansion. Given that the form of the tool, i.e. transparency versus book page, is different between

the two teachers I do not see this as evidence of similar shared tool use in Joanne and Veronica's instructional move of the student response.

In Stacey's case as she listens to a student's response, she nor her student refer or look to any tools when the student provides a response. Consequently, there is no opportunity for shared tool use between Stacey and Joanne. The lack of shared tool use between Stacey and Joanne is an indication of a lack of collectively distributed instruction by shared tool use between them within the instructional move of student response of their review of prior work. The comparative difference of collectively distributed instruction by shared tool use between Joanne and Veronica and Joanne and Stacey provides evidence that an analysis of distributed instruction can enable one to "see" or identify varying levels of collectively distributed instruction by shared tools within a group of teachers.

Content distribution.

The mathematical content to which both Joanne and Veronica attend as they listen to a student's response regards how a student describes how they determined the probability treasure would be found in a given room in Level 1 of the Mansion. In Veronica's case the student responded by saying, "There was a whole bunch of different rooms in this mansion, and we had to find what would be the probability of the treasure chest being in each room." In Joanne's case the student responded saying, "You would find out how much squares are in there [pointing to projected transparency] and which was the [mumble]. You would take that and put it at 10 [mumble]." Consequently, one can observe or "see" that the mathematical content to which both Joanne and Veronica are attending as they listen to the student response is quite similar. Namely, both are

listening for how students say they determined the probability treasure would be found in a given room in Level 1 of the Mansion from Lesson 3.1.

To confirm that Joanne and Veronica were attending to how a student describes how they determined probability in Level 1 of the Mansion, one can look at how each chooses to follow-up with the student's response in an attempt to re-direct the student to the specific intent for which they initiated the initial academic task. For now, though it is sufficient to point out the similarity in the mathematical content to which both Joanne and Veronica attend as they listen to the student response, namely they are listening for a procedure or a reasoning of how to determine the probability the treasure is in a given room for Level 1 of the Mansion. For this reason, the mathematical content in Joanne's and Veronica's student response can be said to be similar, and is a demonstration of how to observe collectively distributed instruction by shared content across two teachers.

In Stacey's case her student responded to a very different academic task than either Veronica's or Joanne's student. Stacey's academic task asked how many times a student played Call of Duty. Stacey's student responded saying, "Maybe like 10." What is observable is Stacey is attending to whether students give their answers in whole numbers or fractions. That this is what she is attending to can be confirmed by her follow-up prompt. The matter of student's providing probabilities in whole numbers is an aspect of mathematics for students to attend to as they give probabilities in Lesson 3.1. However, Stacey's attending to the use of whole numbers or fraction is very different from the shared content Joanne and Veronica are attending to as they listen for student's strategies for determining the probability of treasure being found in a given room in Level 1 of the Mansion from Lesson 3.1. Consequently, my analysis of shared content

between Stacey's student response and Joanne's student response indicates dissimilar content between Stacey and Joanne. As a result, the analysis of collectively distributed content indicates a lack of collectively distributed instruction by shared content between Stacey and Joanne. That Veronica and Joanne share content, and Stacey does not share content with Joanne indicates a varying level of shared content for the instructional move of student response between two pairings of teachers. It is in this way that a conceptual model of collectively distributed instruction allows one to "see" distributed instruction by shared content through an analysis of shared content between two pairings of teachers with an instructional leader for a given instructional move.

Mapping and quantifying similarity and dissimilarity.

In this section I provide a visualization of what is similar and dissimilar within the student response for Joanne and Veronica and then Joanne and Stacey. Recall that illustrating collectively distributed instruction plays a role in supporting instructional observers' ability to "see" whether and to what extent collectively distributed instruction by content and tool use exist between an instructional leader and another teacher. To illustrate that the content and tool distribution within the student response for each pairing of teachers can be mapped as a component of collectively distributed instruction by shared content, I use Composite 2. In particular, I use varying degrees of shading an arrow on the side of the instructional triangle I titled "Mathematical Goal" between Teacher and Mathematics Curriculum, as a way to illustrate a level of shared content between an instructional leader and a given teacher's instructional move of student response (dissimilar = gray arrow; partially similar = present arrow; similar = bold arrow). I do the same to illustrate a level of shared tool use between an instructional

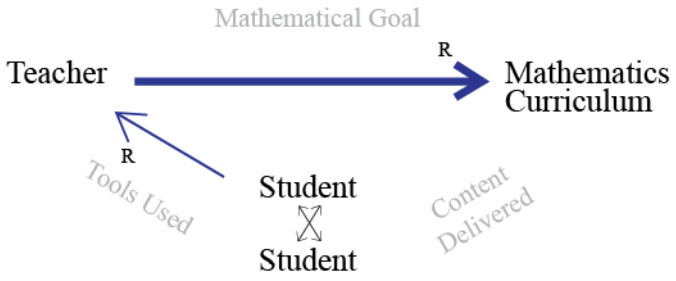
leader and a given teacher's instructional move of student response with varying degrees of shading an arrow on the "Tools Used" side of composite 2 of the instructional triangle (dissimilar = gray arrow; partially similar = present arrow; similar = bold arrow).

Joanne and Veronica

To indicate the complete similarity of content to which Joanne and Veronica were attending as they listened to the student response, I bold the arrow on the "Mathematical Goal" side of composite of the instructional triangle. In particular the arrow from Teacher to Mathematics Curriculum is bolded to indicate that they are attending to similar content as they listen to a student's response. To illustrate partial similarity of tool use between Joanne and Veronica there is a present arrow on the "Tools Used" side of the composite of the instructional triangle. In particular the arrow from Student to Teacher is present to indicate that there is partial similarity of tool use.

In the table that follows I represent similar content with a 2 in the category of Mathematical Goal. I represent partially similar tool use with a 1 in the category of Tool Use. This results in a similarity score of 3 out of 4 for the instructional move of student response between Joanne and Veronica.

<u>Joanne and Veronica</u>



Composite 2: Student Response

Similar = bold arrow; Partially Similar = present arrow; Dissimilar = gray arrow

Table 9: Instructional Leader and Veronica Student Response 1

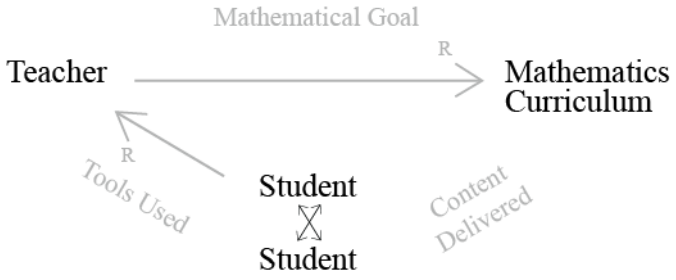
Student Response Instructional Leader compared to Veronica Similar = 2; Partially Similar = 1; Dissimilar = 0			
	Mathematical Goal	Tools Used	Total
Similarity Scale	2	1	3 Out of 4

Joanne and Stacey

I likewise use Composite 2 to illustrate dissimilar content and tool use between Stacey and Joanne. In the pairing of Stacey and Joanne I use a gray arrow along the "Mathematical Goal" side of the composite of the instructional triangle intended to illustrate the dissimilarity of content between Stacey and the instructional leader's instructional move of student response. As a result, for the pairing of Stacey and Joanne there is a gray arrow that goes from Teacher to Mathematics Curriculum in order to illustrate the lack of shared content to which the two teachers are attending to as they listen to a student's response. I similarly use a gray arrow along the "Tools Used" side of the composite of the instructional triangle to illustrate the dissimilar tool use between Joanne and Stacey as well. As a result, for the pairing of Stacey and Joanne there is a gray arrow that goes from Student to Teacher in order to illustrate the lack of shared tool use between Stacey and Joanne's student-response instructional move.

In the table that follows I represent dissimilar content with a 0 in the Mathematical Goal category. I represent dissimilar tool use with a 0 in the Tool Use category. The resulting similarity score between Joanne and Stacey is a 0 out of 4 for the student response.

Joanne and Stacey



Composite 2: Student Response

Similar = bold arrow; Partially Similar = present arrow; Dissimilar = gray arrow

Table 10: Instructional Leader and Stacey Student Response 1

Student Response Instructional Leader compared to Stacey Similar = 2; Partially Similar = 1; Dissimilar = 0			
	Mathematical Goal	Tools Used	Total
Similarity Scale	0	0	0 Out of 4

Follow-up prompt.

This section provides an analysis of the shared content and tools used in teacher-student interactions used to clarify a student's reasoning for a stated answer in the instructional move of the follow-up prompt between Joanne and Veronica and Joanne and Stacey. I describe the similarities between Joanne and the other two teachers' use of a follow-up prompt in order to explore collectively distributed instruction by shared content and tools used in sections titled, content distribution and tool distribution. In the next section on mapping and quantifying similarity and dissimilarity, I provide a visualization of collectively distributed instruction by content and tool use between

Joanne and Veronica and then Joanne and Stacey. I do so with the use of both Composite 3 and a table that quantifies a level of similarity between a given pairing of a teacher with the instructional leader.

Follow-up Prompt

Joanne
Chloe: You would find out how much squares are in there [pointing to the transparency] and which was the [mummble]. You would take that and put it over 10.
Joanne: We're just looking at general probability.
**

Veronica
Jason: There was a whole bunch of different rooms in this mansion, and we had to find what would be the probability of the treasure chest being in each room.
Veronica: Okay. And how? How did we find the probability of the treasure chest being hidden in each room?
**

Stacey
Stacey: Did anyone say, "I played eighteenths of a hundred times"?

Content distribution.

The mathematical content to which Joanne and Veronica indirectly redirect student thinking through a process of clarifying questions or restating the intended purpose of the academic task is to review how the student determined probability for finding the treasure chest in a given room in Level 1 of the Mansion. In Joanne's follow-up prompt, she restates the intended purpose of the academic task by stating, "We're just looking at general probability." Veronica's follow-up prompt uses a clarifying question, "Okay. And how? How did we find the probability of the treasure chest being hidden in each room?" One can see that they are both looking for the student to provide a generalization for how they found the probability in the previous work from Level 1 of the Mansion. This similarity in the mathematical content to which both Joanne and

Veronica re-direct student thinking indicates similarity of the mathematical goal in each their follow-up prompts.

Conversely, given the difference in mathematical content in Stacey's academic task, this dissimilarity of content between Stacey and Joanne continues in the follow-up prompt as well. Stacey's follow-up prompt asks the clarifying question, "Did anyone say, 'I played eighteenths of a hundred times?'" Again, Stacey is focused on the mathematical content of reporting probabilities as whole numbers, and not how the probability itself is determined by the student.

Tool distribution.

The tool use between Joanne and Veronica remains the same for the follow-up prompt as it was in the student response and initiating the academic task. Namely, the similarity of tool use is in their use of a picture of Level 1 of the mansion. The difference, again, is in Joanne's use of a transparency of the picture of Level 1 found on page 33 in the book, whereas Veronica only asks students to turn to page 34 in the book, and students chose to refer to page 33. Moreover, Joanne's transparency has each room in Level 1 of the mansion bordered with the use of a different color using an overhead pen. As a result, I determine that Joanne and Veronica have partial similarity of distributed instruction by tool use for the follow-up prompt. Conversely, Stacey does not use any tools and performs dissimilar tool use with Joanne. As a result, Stacey indicates an absence of distributed instruction by tool use within the instructional move of the follow-up prompt.

Mapping and quantifying similarity and dissimilarity.

Composite 3 of the instructional triangle conceptually maps the components of the follow-up prompt and illustrates content and tool similarity for a given pairing of teachers with different levels of shading the arrows. Composite 3 consists of a bi-directional arrow between Teacher and Student to illustrate a level of similar tool use in interaction with student thinking, and a bi-directional arrow pointing between Teacher and Mathematics Curriculum to illustrate a level of similarity regarding the mathematical goal to which the teachers' follow-up prompt is intended to redirect student thinking to heed.

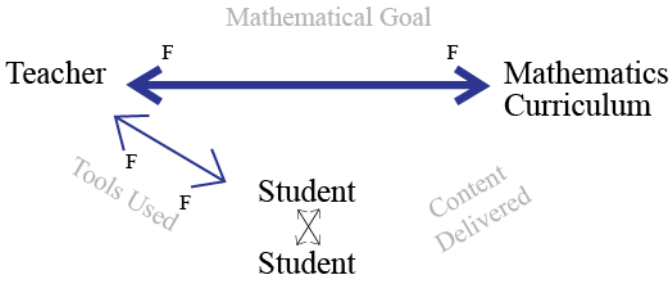
Joanne and Veronica

The mathematical content to which Joanne and Veronica redirect student thinking is to how the student more generally determined probability for finding the treasure chest in a given room. Consequently, there is a bold bi-directional arrow between Teacher and Mathematics Curriculum in the composite to illustrate similarity of distributed instruction by the mathematical goal Joanne and Veronica re-directed student thinking to attend. Given that Joanne and Veronica are using the same picture, though in different forms, the bi-directional arrow between Teacher and Student is present in their Composite 3 to illustrate partial similarity of distributed instruction by tool use. I use a present arrow to illustrate partial similarity in tool use because they are not using the same tools (i.e. Joanne is using a transparency and Veronica is not), but are using the same picture of Level 1 of the Mansion.

In the following table I represent similar content with a 2 in the Mathematical Goal category. I represent partially similar tool use with a 1 in the Tools Used category.

The resulting similarity score for the follow-up prompt between Joanne and Veronica is 3 out of 4.

Joanne and Veronica



Composite 3: Follow-up Prompt

Similar = bold arrow; Partially Similar = present arrow; Dissimilar = gray arrow

Table 11: Instructional Leader and Veronica Follow-up Prompt 1

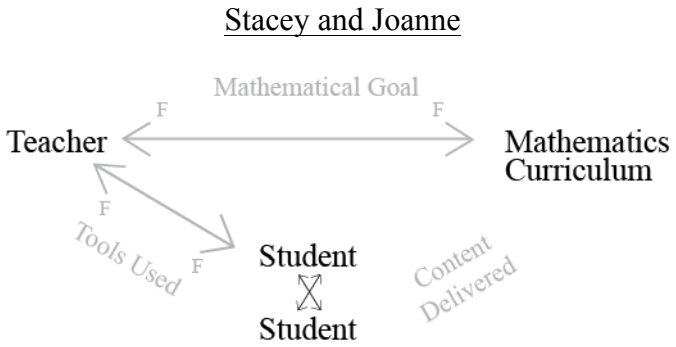
Follow-up Prompt Instructional Leader compared to Veronica Similar = 2; Partially Similar = 1; Dissimilar = 0			
	Mathematical Goal	Tools Used	Total
Similarity Scale	2	1	3 Out of 4

Joanne and Stacey

Conversely, given the difference in mathematical content in Stacey's academic task, this difference continues in the mathematical goal of her follow-up prompt as well. Hence, the corresponding Composite 3 that illustrates collectively distributed instruction by content and tools illustrates the dissimilarity in both content and tool use between Stacey and Joanne's follow-up prompt. For this reason there is a gray bidirectional arrows between Teacher and Student to illustrate dissimilar tool use. There is likewise a

gray bi-directional arrow between Teacher and Mathematics Curriculum to illustrate dissimilar content. This is not surprising given the dissimilarity in their initial academic task.

In the following table I represent dissimilar content with a 0 in the Mathematical Goal category. I represent dissimilar tool use with a 0 in the Tools Used category. The resulting similarity score for the follow-up prompt between Joanne and Stacey is 0 out of 4.



Composite 3: Follow-up Prompt

Similar = bold arrow; Partially Similar = present arrow; Dissimilar = gray arrow

Table 12: Instructional Leader and Stacey Follow-up Prompt 1

Follow-up Prompt Instructional Leader compared to Stacey Similar = 2; Partially Similar = 1; Dissimilar = 0			
	Mathematical Goal	Tools Used	Total
Similarity Scale	0	0	0 Out of 4

Take-away point.

I identify the take-away point as the declarative statement the instructional leader makes at the end of a series of exchanges with a student in the follow-up prompt that

provides what she says is the correct mathematical reasoning for the academic task and the correct answer. The first thing I notice in determining similarity, partial similarity or dissimilarity between the instructional leader's take-away point and another teacher's take-away point is in the tools used to convey the take-away point. Again, similarity in tools used regards similarity in both substance (e.g. picture) and form (e.g. from a page in a book or a transparency) of the tool. Partial similarity regards either the same substance (e.g. picture) though in different forms (one teacher uses a transparency and the other a page in the book), or they use the same page in the book, and perhaps refer to different things on the same page in the book. Dissimilarity in tool use between two teachers regards a teacher not using tools, or using completely different tools.

The second thing I notice in determining similarity, partial similarity or dissimilarity between the instructional leader's take-away point and another teacher's take-away point is in the content delivered in the declarative statement regarding the correct reasoning and/or answer. I do so by analyzing the declarative statement made by the teachers. My criterion for similarity of content delivered in the take-away point is whether a teacher conveys the same procedure or mathematical reasoning for determining the answer and whether the teacher states the same answer as the instructional leader. My criterion for partial similarity is that a teacher provides the same answer but does not attend to the mathematical reasoning that enabled a student to come to the correct answer. My criterion for dissimilarity in the content delivered category is if a teacher solely refers to different mathematical reasoning and a different answer without any mention of the reasoning or answer provided by the instructional leader.

Take-Away Point
Joanne
Chloe: Okay. You would find out how many squares are in that since there's 100 squares. And you take how many squares are in and put that over 100. [Joanne pointed to the squares in a given room. Her gesturing is what made it a kind of Take-Away moment.]

***

Veronica
Jason: Counting the number of squares.
Veronica: Okay. So, the level of the videogame was broken up into 100 squares. And each room-- You can see it better in your book on page 34, actually 33, to see which rooms, the treasure is in each room, and then we counted the number of squares in each room and found the probability that way out of 100.

***

Stacey
Stacey: Did anyone say, "I played eighteenths of a hundred times"?
STUDENT: 18s?
Stacey: No, no, 18 hundredths of a time. Rick, I want you to go home tonight and play 18 hundredths of a time.
STUDENT: 18 times? [Simultaneous conversation]
Stacey: Did anybody say that?
STUDENT: No.
Stacey: So, here's my question on Aces. When I came around and I said, all of you, I circled on your paper, "Your answer doesn't make sense," because if you looked at Ace and you slowed down a little bit-- hint, hint, hint-- and on number five-- I'm getting there in my book. For number five, it asked, C and D, "If level one had [mumble] how many times out of 100--" How many times? None of you said 15 over 100 or 18 hundredths, did you? Okay? You didn't say a fraction, so I don't understand on C and D why you would give me a fraction. Does that make sense?
This is what I worry about when it comes to Monday's quiz is that some of you aren't going to take a minute to slow down. And it says, "How many times--" and you're going to give me a fraction again, and I'll mark it wrong. Yeah, some of you gave me the right fraction, 15 over 100, but how many times is that? 15. Does that make sense, yes or no? Yes?

Content distribution.

The content delivered in the take-away point for both Joanne and Veronica is identical. The content delivered in their take-away point is simply that one counts how many squares are in a given room and divides it by 100 to determine the probability of

the treasure being found inside of it. In Joanne's case the take-away point or concluding point of the instructional interaction comes from Chloe. Chloe says, "Okay. You would find out how many squares are in that since there's 100 squares. And you take how many squares are in and put that over 100." [Joanne looked at Hillary to see if that answer, answered her question. It was in this way that Chloe's answer seemed to indicate a conclusion or take-away point.] In Veronica's case, it was Veronica who provided the take-away point. Veronica states "Okay. So, the level of the videogame was broken up into 100 squares. And each room-- You can see it better in your book on page 34, actually 33, to see which rooms the treasure is in each room, and then we counted the number of squares in each room and found the probability that way out of 100." Given the similar content delivered between Joanne and Veronica's take-away point I see this as demonstrating similar distributed instruction by shared content for this instructional move.

The mathematical content in Stacey's take-away point is that no one can play 18 hundredths of a time, and to make sure the students use whole numbers to communicate their answers. Stacey states, "If level one had [mumble] how many times out of 100--" How many times? None of you said 15 over 100 or 18 hundredths, did you? Okay? You didn't say a fraction, so I don't understand on C and D why you would give me a fraction. Does that make sense? This is what I worry about when it comes to Monday's quiz is that some of you aren't going to take a minute to slow down. And it says, 'How many times—' and you're going to give me a fraction again, and I'll mark it wrong. Yeah, some of you gave me the right fraction, 15 over 100, but how many times is that? 15. Does that make sense, yes or no? Yes?" Due to Stacey and Joanne not covering similar mathematical

content in their take-away point I have determined that they have dissimilar collectively distributed instruction by shared content.

Tool distribution.

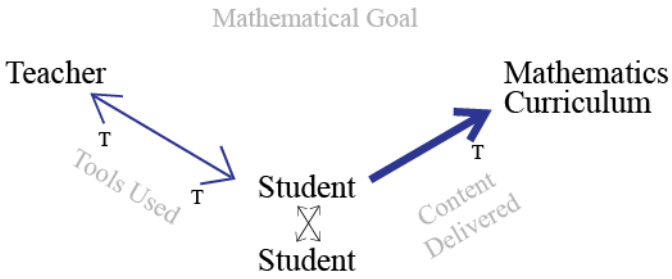
The shared tools between Joanne and Veronica to communicate the take-away point are partially similar for the same reasons they have been partially similar in the previous instructional moves. Namely, Joanne points to the squares in the transparency as Chloe provides the take-away point, whereas Veronica refers students to page 33 in their books. The picture to which both teachers refer students is the same, though it is the same picture in different forms. It is for this reason that this indicates partially similar distributed instruction by shared tools. Joanne and Stacey continue to have dissimilar tool use and therefore an absence of distributed instruction by shared tools. This is largely because Stacey uses no tools in her review of prior work.

Mapping and quantifying similarity and dissimilarity.

The main thing to notice about Composite 4's representation of the instructional move of the take-away point is that it has a bi-directional arrow between Teacher and Student to represent shared tool use and an arrow that goes from Student to Mathematics Curriculum to represent shared content delivered in the declarative statements made to students by a teacher and the instructional leader. The bi-directional arrow between Teacher and Student refers to tool use either occurring by students and/or teacher at the time of the take-away point. The arrow from Student to Mathematics Curriculum illustrates the direct communication regarding the correct mathematical reasoning and answer for a given academic task.

Joanne and Veronica

Since both Joanne and Veronica used the academic task to review a mathematical procedure for determining probability neither discussed a correct answer but both focused on the same mathematical procedure in their take-away point. Consequently, to reflect this similarity in content delivered there is a bold arrow pointing from the Student to Mathematics Curriculum in Joanne's and Veronica's Composite 4 to illustrate similar distributed instruction by shared content between them. Since they have partially similar tool use the bi-directional arrow between the Teacher and Student is present in the following composite.



Composite 4: Take-away Point

Similar = bold arrow; Partially Similar = present arrow; Dissimilar = gray arrow

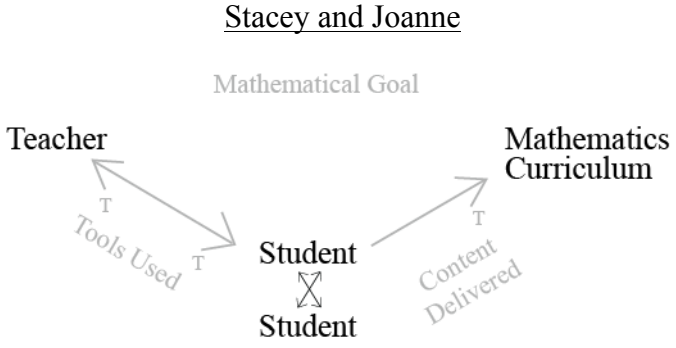
In the following table I represent similar content delivered with a 2 in the Content Delivered category. Last, I represent partially similar tool use with a 1 in the tools used category. The resulting similarity score for the follow-up prompt between Joanne and Veronica is 3 out of 4.

Table 13: Instructional Leader and Veronica Take-away Point 1

Take-Away Point Instructional Leader compared to Veronica Similar = 2; Partially Similar = 1; Dissimilar = 0			
	Content Delivered	Tools Used	Total
Similarity Scale	2	1	3 Out of 4

Joanne and Stacey

Stacey's content remains very different from that of Joanne. Hence, there is a grayed arrow pointing from Student to Mathematics Curriculum, in the below Composite 4 to illustrate dissimilar distributed instruction by shared content between Stacey and Joanne. For Stacey there were no additional tools used to provide an opportunity for pooled interdependence distributed by shared tool use between her and the other teachers. As a result, the bi-directional arrow is grayed between Teacher and Student. As a result, in the accompanying table Stacey's similarity score is likewise a 0 out of 4.



Composite 4: Take-away Point

Similar = bold arrow; Partially Similar = present arrow; Dissimilar = gray arrow

Table 14: Instructional Leader and Stacey Take-away Point 1

Take-Away Point Instructional Leader compared to Stacey Similar = 2; Partially Similar = 1; Dissimilar = 0			
	Content Delivered	Tools Used	Total
Similarity Scale	0	0	0 Out of 4

Cohesiveness of Patterned Shared Adjustment to Student Thinking

Cohesiveness of a pattern of shared adjustment to student thinking between the instructional leader and teachers with whom she works with closely addresses the second research question. Recall the second research question regards whether an analysis of *collaboratively* distributed instruction identifies the spread of the instructional leader's adjustments to student thinking across the instructional practices of teachers with whom she works closely. I labeled the overall shared adjustment to student thinking, "cohesiveness" since it combines all four instructional moves in an attempt to signify the state of shared instructional moves between the instructional leader and another teacher cohering or uniting to match the instructional leader's pedagogical pattern of interacting with students around the content. That is, cohesiveness refers to the degree to which teachers share content and tool use *across* instructional moves as a whole. In the cohesiveness of shared adjustment sub-section there is an identifiable pattern of teachers' interactions with student thinking, but only at an aggregate level at which all instructional moves are seen as a coherent whole. As a result, cohesiveness combines all four instructional moves to represent an overall shared pattern of IRFT adjustments to student thinking shared between the instructional leader and another teacher.

I will illustrate cohesiveness with the use of a 2x2 grid of the four composites of the instructional triangle that show the previous four composites illustrating levels of similar content and tool use within each of the instructional leader's instructional moves. I then tabulate the similarity scores within each instructional move to provide a scoring of similarity across instructional moves to give a value to the cohesiveness across instructional moves between the instructional leader and a teacher. What is important to note in the matter of cohesiveness is that it is not so concerned with the specifics of content and tool use within each instructional move as much as it is concerned with where the patterns of similarity lie across the instructional moves. I provide descriptions of the sorts of analysis this perspective on instruction provides in the following sections comparing similar instructional moves between Joanne and Veronica, and then Joanne and Stacey.

Joanne and Veronica

The visual tool for illustrating cohesiveness of collaboratively distributed instruction by shared adjustment to student thinking is the 2x2. What the 2x2 allows one to see is the striking similarity of mathematical content across Joanne and Veronica within their interactions with students around the content. What is likewise noticeable is that where they differ is in the partial similarity of tool use between them. Veronica has a cohesiveness score of 12/16 or 3/4 with Joanne. In summary they share similar instructional moves covering similar content with slight differences in tool use.

Joanne and Veronica

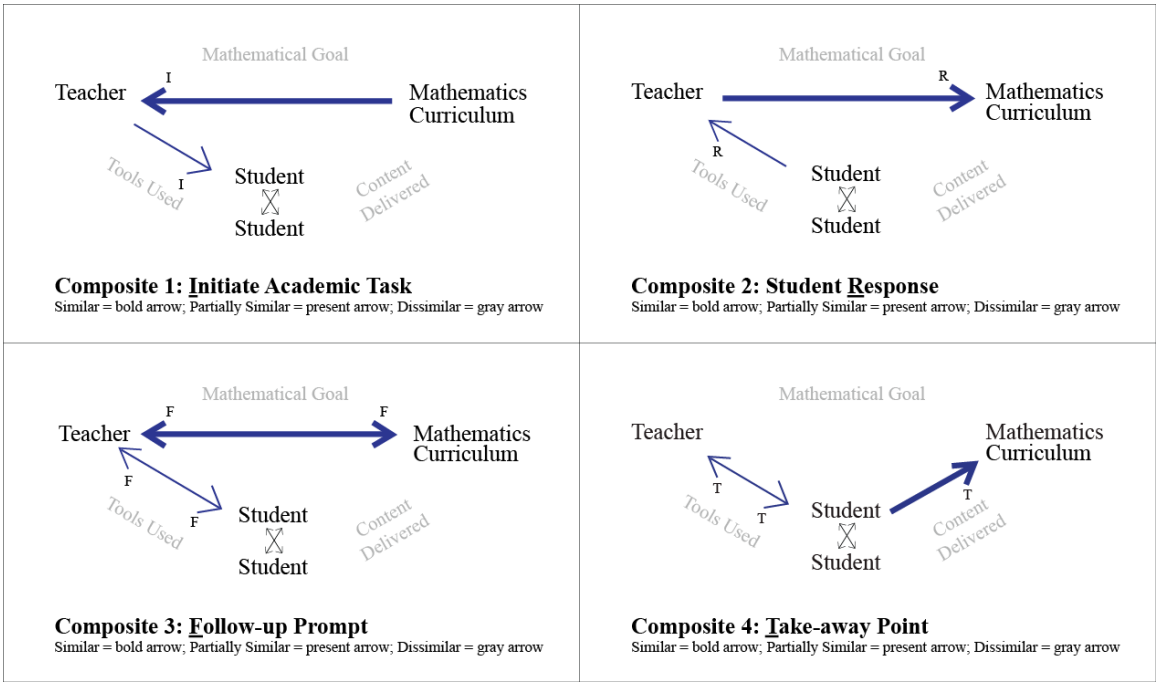


Table 15: Instructional Leader and Veronica Cohesiveness 1

Cohesiveness of Overall Shared Pattern of Adjustment to Student Thinking Instructional Leader and Veronica				
Tripartite Scale of Similarity Similar = 2; Partially Similar = 1; Dissimilar = 0				
	Math Goal	Tools Used	Content Delivered	Total
Initiate Academic Task	2	1	NA	3 Out of 4
Student Response	2	1	NA	3 Out of 4
Follow-up Prompt	2 NA	1	NA	3 Out of 4
Take-away Point	NA	1	2	3 Out of 4
Cohesiveness Score Across Instructional Moves				12 Out of 16

Joanne and Stacey

What the visual tool of the 2x2 allows one to see is that Joanne and Stacey have neither mathematical content nor tool use in common in their review of prior work. Namely, they review entirely different aspects of the prior work they did with students, even though they taught the same lesson and are about to teach the same lesson. The absence of cohesiveness or collaboratively distributed instruction by shared adjustments to student thinking between them may not be a problem given that they chose to review different aspects of the previous lesson. I take up the matter of whether they will still be remarkably different when teaching the same exact lesson and if so in what ways in Vignette 2.

Stacey and Joanne

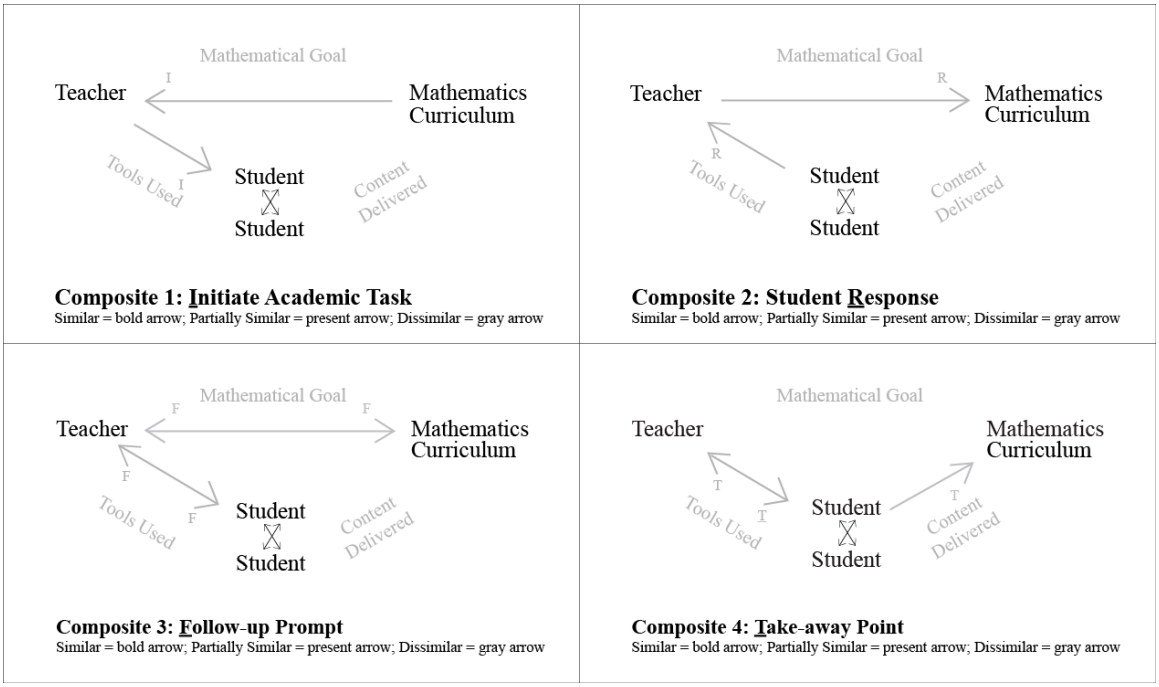


Table 16: Instructional Leader and Stacey Cohesiveness 1

Cohesiveness of Overall Shared Pattern of Adjustment to Student Thinking Instructional Leader and Stacey				
Tripartite Scale of Similarity Similar = 2; Partially Similar = 1; Dissimilar = 0				
	Math Goal	Tools Used	Content Delivered	Total
Initiate Academic Task	0	0	NA	0 Out of 4
Student Response	0	0	NA	0 Out of 4
Follow-up Prompt	0	0	NA	0 Out of 4
Take-away Point	NA	0	0	0 Out of 4
Cohesiveness Score Across Instructional Moves				0 Out of 16

Summary

The above analyses have addressed both research questions as they pertain to the teachers' review of prior work.

1. Does an analysis of *collectively* distributed instruction offer a framework for examining a teacher's shared content and instructional materials (also known as tool use) with the instructional leader within each instructional move?
    a. If so, does this analysis illuminate whether, and to what extent shared content and instructional materials or tool use within each instructional move varies between an instructional leader and two teachers she works with closely?
2. Does the analysis of *collaboratively* distributed instruction offer an analytic framework that identifies the instructional leader's adjustments to student

thinking and its spread across two or more teachers with whom the leader works with closely?

a. If so, does the analysis illuminate whether and to what extent the spread of the instructional leader's adjustments to student thinking varies across two teachers with whom she works with closely?

The first research question was addressed as I performed the analysis of collectively distributed instruction within each instructional move. I addressed the second part of the first research question when I compared collectively distributed instruction between Joanne and Veronica with the lack of collectively distributed instruction between Joanne and Stacey for each instructional move. It was clear within each instructional move how much collectively distributed instruction varied between the pairings of Joanne and Veronica and Joanne and Stacey.

The second research question was addressed in my analysis of cohesiveness of collaboratively distributed instruction by adjustment to student thinking between Joanne and Veronica and then Joanne and Stacey. We learned that across all instructional moves Joanne and Veronica had much higher levels of collaboratively distributed instruction than did Joanne and Stacey. We also learned that Joanne and Veronica had the strongest level of collaboratively distributed instruction by adjustment to student thinking as it pertained to the mathematical content they covered with students relative to their shared tool use. Joanne and Veronica still had collaboratively distributed instruction with respect to the tools they used though the similarity of tool use was only partial and less so when compared to the similarity they shared in mathematical content across instructional moves.

This is the first time in the analysis that differences emerge between the Reader's Digest of CMP and the district-desired CMP pedagogical routines of how to adjust to student thinking within instruction. However, further analysis is necessary to determine whether this difference persists when all three teachers are covering the same academic task. Hence, the analysis moves to the second vignette in which all three teachers are introducing the same lesson, Lesson 3.2.

Review of Prior Work Annotated Transcription

Joanne

Joanne: So please open your book to page 34 so we can start by discussing that. And then we're going to go right into 3.2 today.

…

Joanne: So how would you answer Hillary's question? She's saying how would you find the probability for the great hall? How would you find the probability for the servant's chamber if all the rooms have a different probability? [Academic task.] So what would you say to Hillary? [Used Sticks in a jar to randomly pick a student.] I'll pick somebody else here for a second. Chloe? Whoops, Chloe's up here, she's not paying attention, she's focused. Did you find it? All right, so what would you say to her, Chloe?

Chloe: I was kind of, you know.

Joanne: I know, but I'm going to reread it for you. So she's saying-- try it again, Chloe? How would you find the probability of-- are you listening?

Chloe: Yeah, I'm listening.

Joanne: How would you find the probability of the treasure being in the great hall? [Re-stated Academic task]

Chloe: You would find out how much squares are in there and which was the [mummble]. You would take that and put it over 10.

Joanne: We're just looking at general probability. [Follow-up Prompt]

Chloe: Okay. You would find out how many squares are in that since there's 100 squares. And you take how many squares are in and put that over 100. [Joanne pointed to the squares in a given room. Her gesturing is what made it a kind of Take-Away moment.]

***

Veronica

Veronica: Make sure you have your 3.1 classwork out, along with your lab sheet. And we're on page 34. Okay. So, Landon wasn't here yesterday, so can somebody tell him what we did? What did we do? Let's summarize what we did yesterday quickly. Jason, thanks. [Review of Prior Work Prompt]

Jason: There was a whole bunch of different rooms in this mansion, and we had to find what would be the probability of the treasure chest being in each room. [Student Response]
Veronica: Okay. And how? How did we find the probability of the treasure chest being hidden in each room? [Follow-up Prompt]
Jason: Counting the number of squares.
Veronica: Okay. So, the level of the videogame was broken up into 100 squares. And each room-- You can see it better in your book on page 34, actually 33, to see which rooms, the treasure in each room, and then we counted the number of squares in each room and found the probability that way out of 100. Alright, Landon. [Take-Away]

***

Stacey

Stacey: Alright. Go ahead and put your warm-ups away. Make sure you're putting them in a neat, organized fashion. Here comes Ace. Wait, before I show Ace, real quick. So, what do you play? I'm hearing you play games. I'm hearing Call of Duty out there a few times. So, here is my question. Rick, since you can play Call of Duty quite often from what I'm hearing, Rick, if I asked you how many times you played, let's say, the whole game. I don't understand Call of Duty, so you have to ignore my ignorance on this. [Academic task] So, how many times did you play last night? Or, in the weekend? Put it that way.
STUDENT: Like how long?
Stacey: How many times did you play?
STUDENT: How many games? How many matches?
STUDENT: Maybe like 10.
Stacey: 10, okay. Anybody else play anything?
STUDENT: I played the same thing.
Stacey: How many times did you play?
STUDENT: Nine.
Stacey: What do you play?
STUDENT: I play Grand Theft.
Stacey: Alright, and how many times did you play?
STUDENT: Only about seven in this last week.
Stacey: Seven, okay. What do you play?
STUDENT: I play Black Ops and I played it like 10 times.
Stacey: What do you play?
STUDENT: Black Ops, 14.
Stacey: 14? How many times do you play?
STUDENT: 28.
Stacey: 28. Now, here's my thing. All of you heard the same answer, right?
STUDENT: Yeah.
Stacey: Did anyone say, "I played eighteenths of a hundred times"?
STUDENT: 18s?
Stacey: No, no, 18 hundredths of a time. Rick, I want you to go home tonight and play 18 hundredths of a time.
STUDENT: 18 times? [Simultaneous conversation]
Stacey: Did anybody say that?
STUDENT: No.

> **Stacey:** So, here's my question on Aces. When I came around and I said, all of you, I circled on your paper, "Your answer doesn't make sense," because if you looked at Ace and you slowed down a little bit-- hint, hint, hint-- and on number five-- I'm getting there in my book. For number five, it asked, C and D, "If level one had [00:10:45] how many times out of 100--" How many times? None of you said 15 over 100 or 18 hundredths, did you? Okay? You didn't say a fraction, so I don't understand on C and D why you would give me a fraction. Does that make sense?
> This is what I worry about when it comes to Monday's quiz is that some of you aren't going to take a minute to slow down. And it says, "How many times--" and you're going to give me a fraction again, and I'll mark it wrong. Yeah, some of you gave me the right fraction, 15 over 100, but how many times is that? 15. Does that make sense, yes or no? Yes? Okay, Meagan.

Vignette 2: Class Discussion Post Group Work

Given the nature of leading a class discussion much of the interaction between teachers and students concerns the students' answers to the group work academic tasks. Hence, this section returns to an analysis of both collectively distributed instruction by shared content and tools, and collaboratively distributed instruction by shared adjustments to student thinking across four instructional moves: 1) initiate academic task (posing a question from the curriculum), 2) student response, 3) follow-up prompt (clarifying question regarding student thinking), and 4) take-away point (declarative statement regarding mathematical reasoning to obtain the correct answer and the correct answer). The main point of convergence across all three teachers is that the teachers use the same academic task from the Mathematics Curriculum. The main point of divergence, however, is that only Joanne and Veronica make moves to follow-up on a student response and tie the follow-up to a take-away point. It is in this way that Joanne and Veronica performed all of the instructional moves that constitute the IRFT pedagogical routine.

Conversely, Stacey asks students for their answers, evaluates the correctness, and then moves on to the next academic task. Hence, Stacey performs an adherence to the IRE pedagogical routine of attending to the correctness of the answer rather than to the student thinking that derived the answer. It is in this way that Stacey clearly does not converge to a pattern of shared adjustments to student thinking supported by distributed leadership vis-à-vis the instructional leader's instructional coaching. Below, I provide an analysis of teacher-student interactions around a single academic task to exemplify the pattern I found across multiple academic tasks in which Joanne and Veronica's pedagogical routine converge, while Stacey's pedagogical routine continued to diverge from Joanne's pedagogical routine.

Academic task for group discussion.

In this section I describe the content and tool distribution that constitute my claim that Joanne and Veronica have comparatively greater levels of collectively distributed instruction by shared content and tool use than Stacey has with Joanne. The descriptive specifics of content distribution and tool distribution in the following sections are intended to allow the reader to see whether and to what extent collectively distributed instruction by shared content and tool use exists in a given pairing of teachers. The sections on content and tool distribution are likewise intended to allow the reader to compare *varying* levels of collectively distributed instruction between Joanne and Veronica and then Joanne and Stacey.

> **Academic Task**
>
> **Joanne**
> **Joanne:** …Let us talk about problem 3.2, okay? So it says you just advanced to level two of the treasure hunt. [Puts up projection of the second level of the mansion displaying Queen and King's halves of floor. Unlike the level 1

transparency there are no pen marks of different colors, it is simply the floor transparency for Level 2 that is in the book, and on a separate sheet she gave the students for marking on.] What is the probability that the treasure is hidden in one of the queen's servants' rooms? What do you think, Gary? [Picked a stick as the means of choosing this student.]

***

Veronica

Veronica: Let's take a look at the problem. Alright, here we go. Part A. You advance to the second level treasure hunt. What is the probability that the treasure will be hidden in one of the Queen's servants' rooms? Maggie?

***

Stacey

Stacey: …First one is going to ask you about, "You just advanced to level two in the treasure hunt. What is the probability that the treasure is hidden in one of the Queen's servants'?" Rick what did you get? [Pulling sticks for random call.]

Content distribution.

All three teachers state the same exact academic task, "What is the probability that the treasure is hidden in one of the Queen's servants' rooms?" Consequently, the mathematical content across all three teachers' academic task is identical. All three teachers ask, "What is the probability that the treasure is hidden in one of the Queen's servants rooms? It is for this reason that I determine that Joanne, Veronica and Stacey all have similar mathematical content in the initiation of the academic task. For this instructional move I see this similarity as demonstrating collectively distributed instruction by shared content.

Tool distribution.

All three teachers provide students with a separate photocopy of Level 2's floor plan for students to be able to write on as they work on the problem. The photocopy of Level 2 is a photocopy of Transparency 3.2, which I provide below. However, both Joanne and Veronica hand out the photocopy of the transparency and project the transparency of the second level of the mansion onto a screen that enables the whole class

to simultaneously refer to specific aspects of Level 2 of the mansion. What the photocopy and transparency depicts is that the rooms for the Queen and King's servants are pictured without the use of a grid to show how many equal size squares there are in each room, unlike Level 1's floor plan. I determine that Joanne and Veronica have similar tool use since Joanne and Veronica share both the photocopy and the transparency of Level 2 as instructional materials or tools used to initiate the academic task. This similarity indicates a strong level of collectively distributed instruction by shared tool use.

Conversely, Stacey provides students with a separate photocopy of Level 2's floor plan, but does not use a transparency of Level 2 of the mansion to communicate the academic task other than her stating it as so. This indicates partial similarity in collectively distributed instruction by shared tool use between Joanne and Stacey. When compared with the similar collectively distributed instruction by shared tool use between Joanne and Veronica, this analysis allows the reader to see how distributed instruction by shared tool use can *vary* across two teachers who work closely with an instructional leader.

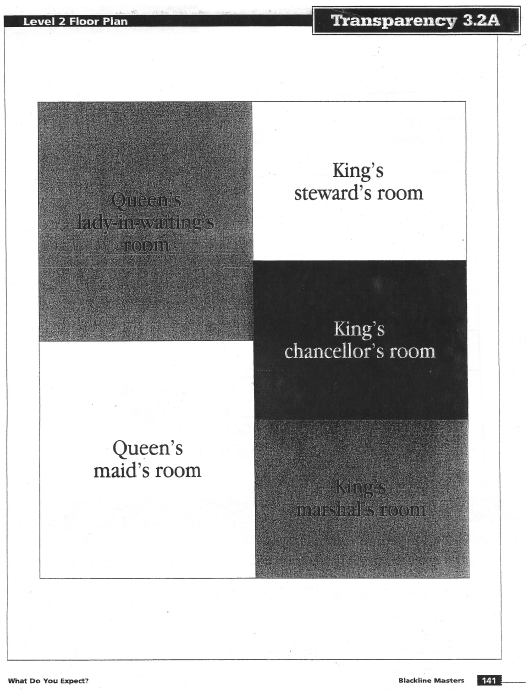


Figure 3: Transparency of Level 2 of Mansion

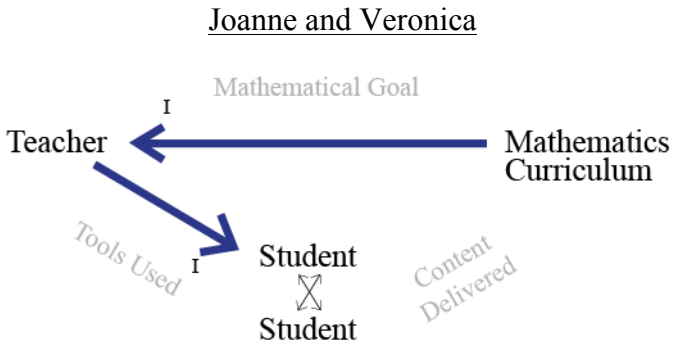
Mapping and quantifying similarity and dissimilarity.

In this section I provide illustrations and a table that quantifies levels of similarity within collectively distributed instruction by shared content and tool use between Joanne and two teachers with whom she works closely.

Joanne and Veronica

I illustrate the similar content and tool use in the way Joanne and Veronica initiate the academic task in Composite 1 below. The bold arrow from Mathematics Curriculum to Teacher indicates similar mathematical content in the initiation of the academic task between Joanne and Veronica. The bold arrow from Teacher to Student indicates similar tool use in the way Joanne and Veronica initiate the academic task. Below the composite, I provide a table that scores the level of similarity for the instructional move

of initiate the academic task between Joanne and Veronica. The similarity score Joanne and Veronica receive in their initiation of the academic task is 4/4.



Composite 1: Initiate Academic Task

Similar = bold arrow; Partially Similar = present arrow; Dissimilar = gray arrow

Table 17: Instructional Leader and Veronica Academic Task 2

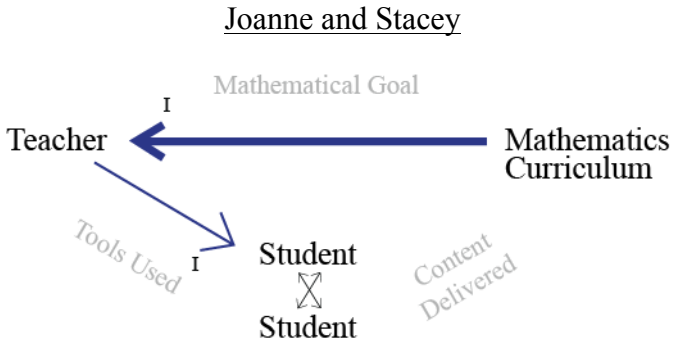
Initiate Academic Task Instructional Leader compared to Veronica Similar = 2; Partially Similar = 1; Dissimilar = 0			
	Mathematical Goal	Tools Used	Total
Similarity Scale	2	2	4 Out of 4

Joanne and Stacey

I illustrate the similar content and partially similar tool use in the way Joanne and Stacey initiate the academic task in Composite 1 below. The bold arrow from Mathematics Curriculum to Teacher indicates similar mathematical content in the instructional move of initiate the academic task between Joanne and Stacey. The present arrow from Teacher to Student indicates partially similar tool use in the way Joanne and Stacey initiate the academic task. Below the composite I provide a table that scores the

level of similarity for initiate the academic task between Joanne and Stacey. The similarity score Joanne and Stacey receive in their initiation of the academic task is 3/4.

The first thing to notice about Joanne and Stacey is that when they are covering the same academic task they do initiate that academic task with a level of collectively distributed instruction by shared content and tool use. This was not the case in their review of prior work since they covered very different content. Likewise by comparing similarities between Joanne and Stacey with similarities between Joanne and Veronica the reader can still see that Veronica and Joanne have more similar collectively distributed instruction by shared content and tool use than do Joanne and Stacey. However, unlike the case in the review of prior work, both pairings of teachers do perform collectively distributed instruction by shared content and tool use.



Composite 1: Initiate Academic Task

Similar = bold arrow; Partially Similar = present arrow; Dissimilar = gray arrow

Table 18: Instructional Leader and Stacey Academic Task 2

Initiate Academic Task Instructional Leader compared to Stacey Similar = 2; Partially Similar = 1; Dissimilar = 0			
	Mathematical Goal	Tools Used	Total
Similarity Scale	2	1	3 Out of 4

Student Response.

In the following sections, on content distribution and tool distribution, I describe the specifics of shared content and shared tool distribution between each pairing of teachers that constitute my claim that Joanne and Veronica have comparatively greater levels of distributed content and tool use than Joanne and Stacey in the instructional move of the student response. These descriptive specifics are intended to allow the reader to see whether and to what extent collectively distributed instruction by shared content and tool use exists within the instructional move, student response. Below, I provide the student response in each teacher's class discussion concerning the first academic task. I provide practice-based specifics of what constitutes shared content and shared tool use across teachers in subsections called content distribution and tool distribution. After which, I provide a visualization of the comparative levels of distribution both through the use of the instructional triangle composites and tables in the subsection "Mapping and quantifying similarity and dissimilarity."

Student Response

Joanne

Joanne: …Let us talk about problem 3.2, okay? So it says you just advanced to level two of the treasure hunt. [Puts up projection of the second level of the mansion displaying Queen and King's halves of the floor. Unlike the level 1 transparency there are no pen marks of different colors, it is simply the floor transparency for Level 2 that is in the book, and on a separate photocopy she gave the students for marking on.] What is the probability that the treasure is hidden in one of the queen's servants' rooms? What's the probability that it's hidden in one of these queen's servants room? [She is pointing to the half of the projection that belongs to the Queen's servants.] What do you think, Gary?

Gary : One half.

***

Veronica

Veronica: Maggie, take a look at the board. How much of the board is the Queen's servants' quarters? [Pointing to the entire half of the floor on the projector.] I shouldn't say quarters; that

is confusing. Here's level two. How much of the board belongs to the Queen's?
STUDENT: Half.

***

Stacey
Stacey: …First one is going to ask you about, "You just advanced to level two in the treasure hunt. What is the probability that the treasure is hidden in one of the Queen's servants?" Rick what did you get? [Pulling sticks for random call.]
Rick: I got 50 out of 100.

Content distribution.

The mathematical content of the student response is nearly identical across all three teachers. Joanne's student says, "One half." Veronica's student says, "Half." Stacey's student says, "I got 50 out of 100." It is for this reason that I see the mathematical content across all three teachers' student response as at least partially similar. However, part of the listening to a student's response is listening to what one can use in the follow-up prompt. As a result, based on how the teacher responds I have a clearer sense of what the teacher is attending to. Based on the follow-up prompt I see that both Joanne and Veronica are attending to the correct answer and are listening for a student's reasoning. On the other hand, Stacey is attending to the correct answer and is not listening for the correct reasoning. It is for this reason that I identify Joanne and Veronica's listening to the student response as similar while I identify Joanne and Stacey's listening to the student response as partially similar.

Tool distribution.

The tool use between Joanne and Veronica is again similar because they use both the photocopy of Level 2 and the transparency of Level 2, and they both point to the portion of the transparency that is related to the Queen's servants' rooms. It is for this reason that Joanne and Veronica perform similar collectively distributed instruction by

tool use. Stacey, on the other hand, has partially similar tool use to Joanne since she uses the photocopy of Level 2 for students to refer to at their desks, and not the transparency of Level 2. It is for this reason that Joanne and Stacey perform partially similar distributed instruction by shared instructional materials or tool use.

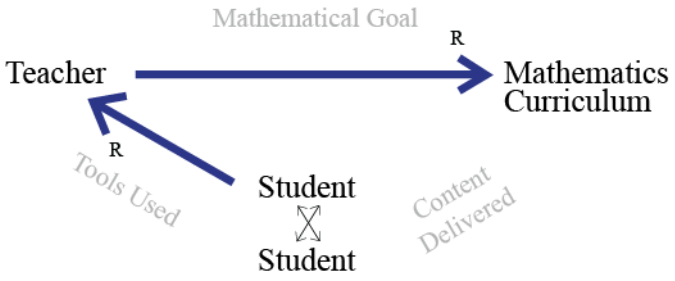
Mapping and quantifying similarity and dissimilarity.

In this section I provide illustrations and a table that quantifies levels of similarity within collectively distributed instruction by shared content and tool use between Joanne and two teachers with whom she works closely.

Joanne and Veronica

I illustrate the similar content and tool use in the student response between Joanne and Veronica in Composite 2 below. The bold arrow from Teacher to Mathematics Curriculum indicates similar mathematical content for the initiate academic task instructional move between Joanne and Veronica. The bold arrow from Student to Teacher indicates similar tool use in the way Joanne and Veronica initiate the academic task. The subsequent table quantifies the similarity between Joanne and Veronica with a similarity score of 4/4 for the student response.

Joanne and Veronica



Composite 2: Student Response

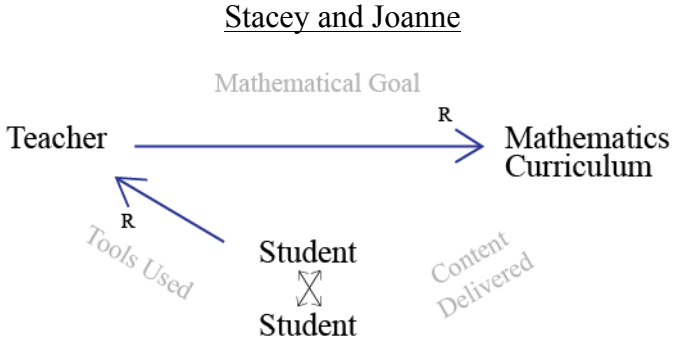
Similar = bold arrow; Partially Similar = present arrow; Dissimilar = gray arrow

Table 19: Instructional Leader and Veronica Student Response 2

Student Response Instructional Leader compared to Veronica Similar = 2; Partially Similar = 1; Dissimilar = 0			
	Mathematical Goal	Tools Used	Total
Similarity Scale	2	2	4 Out of 4

Joanne and Stacey

As stated in the content distribution section, Joanne and Stacey have partially similar shared mathematical content in that they are both listening for the student's answer in the student response. I illustrate partial similarity of content for the student response between Joanne and Stacey with an arrow from Teacher to Mathematics Curriculum. As stated in the tool distribution section, Joanne and Stacey have performed partially similar tool use and have a partial level of collectively distributed instruction by shared tool use. I illustrate partially similar tool use between Joanne and Stacey with a present arrow from Student to Teacher. In the subsequent table Joanne and Stacey receive a similarity sore of 2/4 within the instructional move of student response.



Composite 2: Student Response

Similar = bold arrow; Partially Similar = present arrow; Dissimilar = gray arrow

Table 20: Instructional Leader and Stacey Student Response 2

Student Response Instructional Leader compared to Stacey Similar = 2; Partially Similar = 1; Dissimilar = 0			
	Mathematical Goal	Tools Used	Total
Similarity Scale	1	1	2 Out of 4

Student Response Excerpt
Joanne
Joanne: …Let us talk about problem 3.2, okay? So it says you just advanced to level two of the treasure hunt. [Puts up projection of the second level of the mansion displaying Queen and King's halves of the floor. Unlike the level 1 transparency there are no pen marks of different colors, it is simply the floor transparency for Level 2 that is in the book, and on a separate sheet she gave the students for marking on.] What is the probability that the treasure is hidden in one of the queen's servant's rooms? What's the probability that it's hidden in one of these queen's servants room? What do you think, Gary?
Gary : One half.

***

Veronica
Veronica: Maggie, take a look at the board. How much of the board is the Queen's servants' quarters? [Pointing to the entire half of the floor on the projector.] I shouldn't say quarters; that is confusing. Here's level two. How much of the board belongs to the Queen's?
Maggie: Half.

***

Stacey
Stacey: …First one is going to ask you about, "You just advanced to level two in the treasure hunt. What is the probability that the treasure is hidden in one of the Queen's servant's?" Rick what did you get? [Pulling sticks for random call.]
Rick: I got 50 out of 100.

Follow-up Prompt

In the following sections, on content distribution and tool distribution, I describe the specifics of shared content and shared tool distribution between each pairing of teachers that constitute my claim that Joanne and Veronica have comparatively greater levels of distributed content and tool use than Joanne and Stacey. Recall that the Follow-

up prompt is the 'F' in the IRFT pedagogical routine that I determined is desired by the district and diverges from the IRE pedagogical routine based on my observations of the instructional leader's teaching. As I observed the instructional leader's follow-up prompt I noticed that her follow-up prompt typically began with clarifying questions in an indirect attempt to re-direct a student to a specific mathematical goal that the instructional leader wanted the student to attend to based on the student's response to the academic task. As a result, there could be many back and forth exchanges between the teacher and a student or students in an attempt to clarify the answer and the reasoning behind the answer that was initially given by a student.

The focus of my analysis in the these exchanges is to provide descriptive specifics that allow the reader to see whether and to what extent collectively distributed instruction by shared content and tool use exists within the exchanges that constitute the follow-up prompt between Joanne and a teacher she works with closely. Below, I provide the follow-up prompt in each teacher's class discussion concerning the academic task. I provide practice-based specifics of what constitutes shared content and shared tool use across teachers in subsections content distribution and tool distribution. After which, I provide a visualization of the comparative levels of distribution both through the use of the instructional triangle composites and tables in the subsection, "Mapping and quantifying similarity and dissimilarity."

Follow-Up Prompt Excerpt

Joanne
Joanne: Why? Why one half?
Gary: Because there's two on one side and it's exactly halfway through. So one half--
Joanne: So you're saying this line right here divides the floor in half? [Joanne takes a purple pen and marks on the transparency the line that divides the Queen's side of the floor from the King's side of the floor.]

Gary: Yeah, and then the queens are on one side and the other one's on the other side. [She points to the queen side and the king's "other" side as he says this.]
Joanne: And on the other side. Craig?
Craig : It only asks for what's the probability for one, one of the queen's servant's rooms, not all of the queen's servants' rooms. [Craig states how he read the problem and if read that way there would be a different answer.]
Gary: Oh, my gosh.
Craig: So it's one fourth.
Joanne: Interesting way of interpreting the question. I understand what you're saying, but it was saying one of these rooms. So, it could mean-- what it meant is what's the probability of it being in a queen's servants' room? Instead of one, put the word 'a' there, okay? Do you understand why it would be one half? I understand your thinking. Shh. Do you understand? Leah?
Leah: I had a weird way of doing it. I don't know if it actually worked. Since the two queen's rooms overlapped like where the king's rooms were, I put the king's [00:04:30] however you pronounce that, I put them over there, the two-- [Joanne draws what she understands the student to be saying on the transparency to confirm that her understanding of how the student came about determining the problem occurred.]
Joanne: Just a moment, Leah. Listen. I'm sorry, okay. So just because it overlapped, you did what?
Leah: I took the top lines of those two with that one room and put them over on the other side and made three rooms for the queen. [Joanne points to the line that she thinks the student is referring to.]
Joanne: You did this? [Joanne draws a dotted line connecting the dividing lines of the King's half so that they cut across the Queen's side of the floor as well.]
Leah: Yes.
Joanne: So now the queen has three rooms? This is Leah's room right here, right? [laughter]
Leah: I wish.
Joanne: It's not designated. [laughter] All right. So, you were looking at it and saying that you could have three rooms on each side, but it still would be one half here, right?
Leah: Yeah
Joanne: Okay. Sally, were you talking the same way she was thinking?
Sally: Sort of and sort of not. I couldn't decide whether it was half or a quarter.
Joanne: Well, the queen's rooms constitute half the floor, right? So the probability that treasure would be in a queen's servants' room would be one out of two, or 50 percent of the floor. [Take-Away point.]

***

Veronica
Veronica: Half. The Queen's part of the board is a half, [Drew an outline of the Queen's area with a marker on the projector, and wrote the fraction ½ at the top of the outlined border.] so

the probability of landing in the Queen's-- what do they call it exactly, servants' rooms-- landing in the Queen's servant's room is a half.
Mark: Well it says for one of the rooms, so it'd be a fourth.
Veronica: Okay, so you want to go a step further and say that this is a quarter? And this is a quarter? [Draws an outline of the individual Queen's rooms, making the quarter clearer to the whole class.] Yeah, except for the fact that it says, "What's the probability that it's going to land in one of them?" So, the probability that it's going to land in the Queen's servants' room is really a half, because it's half the board, but if you have it the other way I would be fine with that. Okay. Tell me how you got a quarter though.
Mark: Because the Queen's side of the board could just [mumble, maybe he said they could come together.]
Veronica: Okay, but how did you get a quarter?
Maggie: One Queen's room is one quarter of the board.
Veronica: Yeah. If you take a look at this whole board, you can visually see that if you cut this into four pieces, this would be one of the four. [Veronica extends the line from the Queen's side over to the King's side and shows how it cuts the floor into four parts with her hands.] Or, could you say that the Queen's Ladies-in-Waiting's room is a half of a half? And when you say half of a half, that means multiply. Half of a half is a quarter. Good. Questions? Alright. [Presents this as another strategy students could have used, and writes ½ * ½ = ¼ on the projector to the side of the diagram.]

***

Stacey
Stacey: 50 out of 100, 50%, one half. However you want to look at it. [There are no tools being used that I can see. She is not using a transparency, although she did provide a handout of the floor layout for students to write on instead of the diagram in the book during their group work, which was distributed to all 7th grade teachers from their planning meetings.]
Rick: Wait, wait.
Stacey: What? 50 out of 100 is also reduced to one half.
Rick: It's 50/50.
Stacey: 50/50. …[Moved on to next academic task.]

Content distribution.

The mathematical content covered in the follow-up prompt interaction between teacher and student(s) for Joanne and Veronica is similar since Veronica covers all of the mathematical content that Joanne covers. In Joanne's case when the student gives the answer of one half, Joanne follows up with "Why? Why one half?" And as the student named "Gary" describes his answer while pointing to the transparency he says, "Because

there's two on one side and it's exactly halfway through. So one half." Joanne checks that she understands what he is saying, "So you're saying this line right here divides the floor in half?" as she uses an overhead pen marking the line on the transparency that divides the Queen's side from the King's side. Another student named "Craig" states his interpretation of the problem "It only asks for what's the probability for one, one of the Queen's servant's rooms, not all of the Queen's servants' rooms." And then he states that his answer is "one fourth." Joanne responds by telling the student "…what [the problem] meant is what's the probability of it being in *a* Queen's servants' room. Instead of one, put the word '*a*' there, OK? Do you understand why it would be one half? [Craig non-verbally indicates an understanding.] I understand your thinking." In Veronica's case she states "Half. The Queen's part of the board is half." and similar to Joanne she uses an overhead though instead of just drawing on the line separating between the King's half and the Queen's half of the floor like Joanne, she outlines the entirety of the Queen's half of the floor on the transparency. When another student interjects, "Well it says for one of the rooms, so it'd be a fourth." Veronica responds by accepting the student's reasoning stating, "OK, so you want to go a step further and say that this is a quarter? And this is a quarter?" as she draws an outline one of the Queen's rooms, making a visual representation of why the answer ¼ would make sense given the student's reading of the problem. Then she states, "Yeah, except for the fact that it says, "What's the probability it is going to land in one of them? So the probability that it's going to land in the Queen's servants' room is really a half, because it's half the board, but if you have it the other way I would fine with that, OK? Tell me how you got a quarter, though." What is similar in both Joanne and Veronica's follow-up prompt is that

they are both asking students how they came to the answer they stated. They both cover that the answer is one half, and why the answer is really one half. They both cover that students may have misinterpreted what the question was asking and they both state that they understand how a student could come to the answer of ¼. In this way, Veronica covers the exact same content that Joanne covers with students in her follow-up prompt, and as a result I determined that the mathematical goal in their follow-up prompt is similar.

On the other hand, Stacey's interaction with students in her follow-up simply states the answer is 50-50, she does not ask a follow-up prompt of how a student came to that answer. In this way the mathematical content in the follow-up prompt between Joanne and Stacey is dissimilar. Looked at through another lens, one might say that Stacey didn't provide a follow-up prompt at all, but merely evaluated the answer of 50 out of 100 as correct. For example, unlike Joanne, at no point does Stacey ask a student how they came to the answer he/she provided. It is in this way that Stacey can be seen as adhering to the IRE pedagogical routine, rather than to the IRFT pedagogical routine. Stacey's divergence in pedagogical routine from Joanne is most noticeable in the instructional move of the follow-up prompt, which is where IRE and IRFT most noticeably diverge from one another. Due to this dissimilarity of mathematical content or even the lack of demonstrating the instructional move of a follow-up prompt by Stacey, I do not see evidence of collectively distributed instruction by shared content between Joanne and Stacey within the follow-up prompt.

Tool distribution.

Joanne and Veronica have similar tool use that indicates collectively distributed instruction by tool use. Namely, Veronica uses all the same tools Joanne uses with students. They both use a transparency of Level 2 of the Mansion and overhead pens during the follow-up prompt. In particular, both Joanne and Veronica use the transparency of Level 2 of the Mansion, and mark the area they believe the student to be referring to in his/her answer on the transparency with an overhead pen. In Joanne's case, when the student says half, Joanne draws a line on the transparency down the middle in a way that divides the Queen's half of the transparency and the King's half of the transparency. Veronica uses an overhead pen to outline the entire rectangle that is the half of Level 2 belonging to the Queen on the transparency. Additionally, Veronica writes the fraction ½ at the top of the Queen's rectangle. Both Joanne and Veronica have several volleys with students around specific differences in how students perceived the problem and then use the transparency to represent those perceptions. Conversely, Stacey doesn't use tools in her exchange with students around the content, and there is no volley between Stacey and the student(s) other than Stacey restating the student's answer. As a result, the dissimilarity in tool use between Joanne and Stacey indicates the absence of collectively distributed instruction by shared tools.

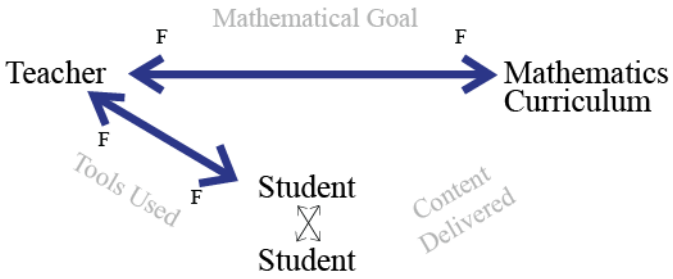
Mapping and quantifying similarity and dissimilarity.

In this section I provide illustrations and a table that quantifies levels of similarity within collectively distributed instruction by shared content and tool use between Joanne and the two teachers with whom she works closely.

Joanne and Veronica

The similarity of tools used between Joanne and Veronica as they volleyed back and forth with students to clarify students' thinking regarding what the academic task was asking of them is illustrated with a bold bi-directional arrow between Teacher and Student in Composite 3 below. Given the similarity of mathematical content that was clarified in the exchanges involved to re-direct students to an intended mathematical goal perceived by the teacher the bi-directional arrow between Teacher and Mathematics Curriculum is likewise in bold. The level of similarity in the follow-up between Joanne and Veronica is quantified in the subsequent table and given a similarity score of 4/4.

Joanne and Veronica



Composite 3: Follow-up Prompt

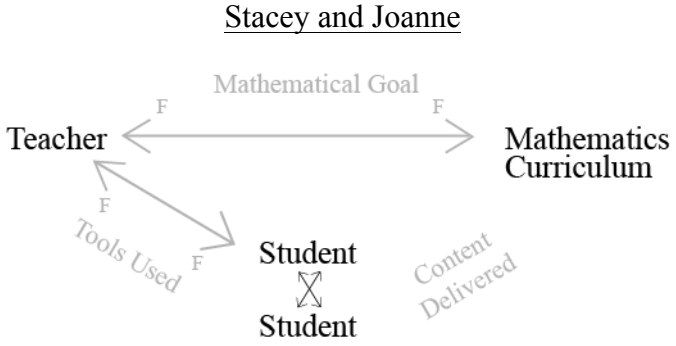
Similar = bold arrow; Partially Similar = present arrow; Dissimilar = gray arrow

Table 21: Instructional Leader and Veronica Follow-up Prompt 2

Follow-up Prompt Instructional Leader compared to Veronica Similar = 2; Partially Similar = 1; Dissimilar = 0			
	Mathematical Goal	Tools Used	Total
Similarity Scale	2	2	4 Out of 4

Joanne and Stacey

The dissimilarity of tools used between Joanne and Stacey indicates a lack of distributed instruction by shared tool use and is illustrated with the gray bi-directional arrow between Teacher and Student in Composite 3. There is dissimilarity of mathematical content between Joanne and Stacey, given Stacey's lack of a follow-up prompt to clarify student thinking. I illustrate this with a gray bi-directional arrow between Teacher and Mathematics Curriculum. The level of similarity in the follow-up between Joanne and Stacey is quantified in the subsequent table and given a similarity score of 0/4. This represents the absence of a follow-up prompt to clarify student thinking by Stacey, and the absence of collectively distributed instruction between Joanne and Stacey for the follow-up prompt.



Composite 3: Follow-up Prompt

Similar = bold arrow; Partially Similar = present arrow; Dissimilar = gray arrow

Table 22: Instructional Leader and Stacey Follow-up Prompt 2

Follow-up Prompt Instructional Leader compared to Stacey Similar = 2; Partially Similar = 1; Dissimilar = 0			
	Mathematical Goal	Tools Used	Total
Similarity Scale	0	0	0 Out of 4

Take-away point.

The take-away point is a declarative statement made by the teacher that summarizes the math reasoning and correct answer the teacher wants to be sure students know before moving onto the next problem. Below, I provide an analysis of similarity of mathematical content and tool use between Joanne and the two teachers with whom she works with closely as they provide the take-away point. Joanne's take-away points typically involve the overview of two aspects of the mathematical content: 1) a procedure or mathematical reasoning for getting the answer, and 2) the answer. As a result, I look for the extent that the other teachers do this, or the way in which a teacher chooses to transition to the next academic task.

Take-away point
Joanne
Sally: Sort of and sort of not. I couldn't decide whether it was half or a quarter.
Joanne: Well, the queen's rooms constitute half the floor, right? [Motioning towards the transparency on which she drew lines that indicate half of the floor belongs to the Queen's servants' rooms.] So the probability that treasure would be in a queen's servants' room would be one out of two, or 50 percent of the floor. [Take-Away point.]

***

Veronica
Veronica: Yeah. If you take a look at this whole board, you can visually see that if you cut this into four pieces, this would be one of the four. Or, could you say that the Queen's Ladies-in-Waiting's room is a half of a half? And when you say half of a half, that means multiply. Half of a half is a quarter. Good. Questions? Alright. [Presents this as another strategy students could have used, and writes ½ * ½ = ¼ on the projector to the side of the diagram.]

***

Stacey
Stacey: What? 50 out of 100 is also reduced to one half.

Content distribution.

Recall the two aspects of the mathematical content Joanne overviews in her take-away point. One is the mathematical reasoning or strategy that derived the right answer, and second is the actual answer. The mathematical reasoning that both Veronica and Joanne use is having students make sense of the amount of space the Queen's servants' rooms take up on Level 2 or the amount of space a specific Queen's servant's room takes up on Level 2. For this reason I see the mathematical reasoning and strategy that Joanne and Veronica use as similar. And in this way I see Joanne and Veronica demonstrating collectively distributed instruction by shared content. However, they both refer to different answers in their take-away point. In particular, Joanne refers to ½ as the answer, "Well, the Queen's rooms constitute half the floor, right? So the probability that treasure would be in a Queen's servants' room would be one out of two, or 50 percent of the floor." Whereas Veronica refers to ¼ as the answer, "Yeah. If you take a look at this whole board, you can visually see that if you cut this into four pieces, this would be one of the four. Or, could you say that the Queen's Ladies-in-Waiting's room is a half of a half? And when you say half of a half, that means multiply. Half of a half is a quarter. Good. Questions? Alright." As a result, I see the content delivered regarding the correct answer as being partially similar for the take-away point. However, it is the case that Veronica had already said that ½ was a correct answer in the follow-up prompt, but as a matter of the take-away point the answer she focuses on ¼ as being just as correct as ½ provided students explained their reasoning.

Conversely, Stacey (consistent with IRE pedagogy) only emphasizes the correctness of the answer as ½, "What? 50 out of 100 is also reduced to one half." She

shares the content delivered regarding the correctness of the answer with Joanne but doesn't explain the mathematical reasoning in a way that is similar to Joanne. As a result, I see the content delivered regarding the correct answer as ½ as partially similar.

Tool distribution.

As mentioned earlier, Veronica and Joanne both use the strategy of looking at and referring to the transparency of Level 2 of the Mansion and pointing out that the Queen's servants' rooms constitute half of the floor. For both Joanne and Veronica the tools referred to are the same as those that were used in the follow-up prompt: transparency of Level 2, overhead pens, the pointing to and drawing of edges of specific rooms to illustrate student thinking. All of these tools were in whole-class view and were pointed to by Joanne and Veronica when they made the summary or take-away points. In this way, Veronica performs similar tool use to Joanne. Veronica again goes an additional step and adds the writing of fractions as they were communicated in the students' reasoning. Since Veronica uses all the tools that Joanne uses she performs similar collectively distributed instruction by shared tool use with Joanne.

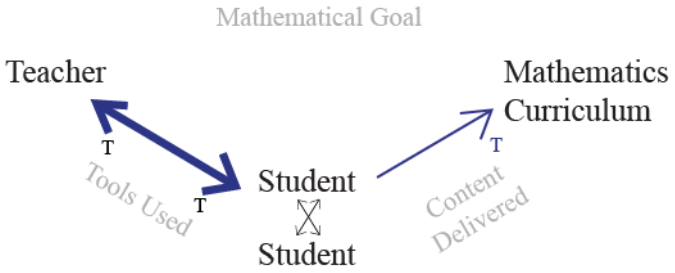
Conversely, Stacey makes no use of tools in her re-statement of the correct answer. As a result, she has dissimilar tool use with Joanne in her take-away point. For this reason, Stacey indicates the absence of collectively distributed instruction by shared tool use.

Mapping and quantifying similarity and dissimilarity.

Joanne and Veronica

My conceptual mapping of the take-away point's mathematical content has an arrow that begins at Student and points to the Mathematics Curriculum to represent the mathematical content delivered in the declarative statements. Since I view the content delivered between Joanne and Veronica as partially similar the arrow from Student to Mathematics Curriculum is present to indicate similar mathematical reasoning covered while also indicating a difference in the answers they accepted. Recall that Joanne emphasizes ½ as the correct answer while Veronica states that she will accept both ½ and ¼ as a correct answer. Since both Joanne and Veronica use the floor plan to explain the special relationship between the room(s) and the whole of the floor to explain the answer I represent similar tool use with a bold bi-directional arrow between Teacher and Student. The subsequent quantitative level of similarity between Joanne and Veronica's take-away point is represented in the table and given a similarity score of 3/4.

Joanne and Veronica



Composite 4: Take-away Point

Similar = bold arrow; Partially Similar = present arrow; Dissimilar = gray arrow

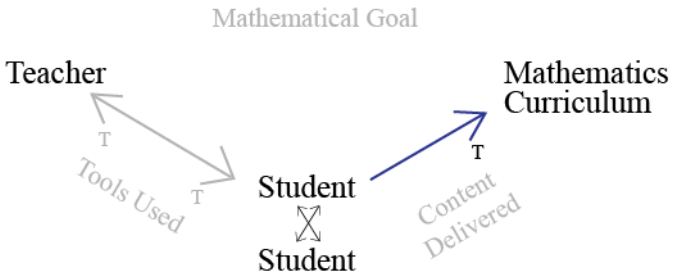
Table 23: Instructional Leader and Veronica Take-away Point 2

Take-Away Point Instructional Leader compared to Veronica Similar = 2; Partially Similar = 1; Dissimilar = 0			
	Content Delivered	Tools Used	Total
Similarity Scale	1	2	3 Out of 4

Joanne and Stacey

In the case of Stacey's instructional practice, she does state that ½ is the answer, which is illustrated by the one-directional arrow from Student to Mathematics Curriculum. However since Stacey does not include any mention of mathematical reasoning to obtain the answer of ½ I consider the similarity of content delivered between Joanne and Stacey to be partially similar. I illustrate the partially similar content delivered with a arrow from Student to Mathematics Curriculum. It is in this way that I illustrate the partial similarity in providing the same answer. Since Stacey uses no tools to communicate the answer I illustrate dissimilar tool use with a gray bi-directional arrow between Teacher and Student. The quantified similarity score for Stacey and Joanne for the instructional move of the take-away point is 1/4 and is represented in the subsequent table.

Stacey and Joanne



Composite 4: Take-away Point

Similar = bold arrow; Partially Similar = present arrow; Dissimilar = gray arrow

Table 24: Instructional Leader and Stacey Take-away Point 2

Take-Away Point Instructional Leader compared to Stacey Similar = 2; Partially Similar = 1; Dissimilar = 0			
	Content Delivered	Tools Used	Total
Similarity Scale	1	0	1 Out of 4

Joanne

Joanne: Well, the queen's rooms constitute half the floor, right? So the probability that treasure would be in a queen's servant's room would be one out of two, or 50 percent of the floor. [Take-Away point.]

***

Veronica

Veronica: Yeah. If you take a look at this whole board, you can visually see that if you cut this into four pieces, this would be one of the four. Or, could you say that the Queen's Ladies-in-Waiting's room is a half of a half? And when you say half of a half, that means multiply. Half of a half is a quarter. Good. Questions? Alright. [Presents this as another strategy students could have used, and writes ½ * ½ = ¼ on the projector to the side of the diagram.]

***

Stacey

Stacey: What? 50 out of 100 is also reduced to one half.

Cohesiveness of Patterned Shared Adjustment

Recall that cohesiveness across instructional moves is considered related to the presence of reciprocal collaboration between the instructional leader and a teacher during classroom observations according to my conceptual framework. Given the various aspects of similarity between Joanne and Veronica it is fairly clear that Veronica has greater cohesiveness with Joanne across all four instructional moves than Stacey has with Joanne. Specifically, Joanne and Veronica have instances of similarity of content and tool use across all four instructional moves. Consequently, it can be said that Veronica shares the patterned adjustment to student thinking that the instructional leader performs and therefore practices the IRFT pedagogical routine with striking similarity to the instructional leader. It is notable that since Veronica's take-away point emphasizes a different answer than Joanne's take-away point she has a similarity score of 15/16 across all four instructional moves.

Joanne and Veronica

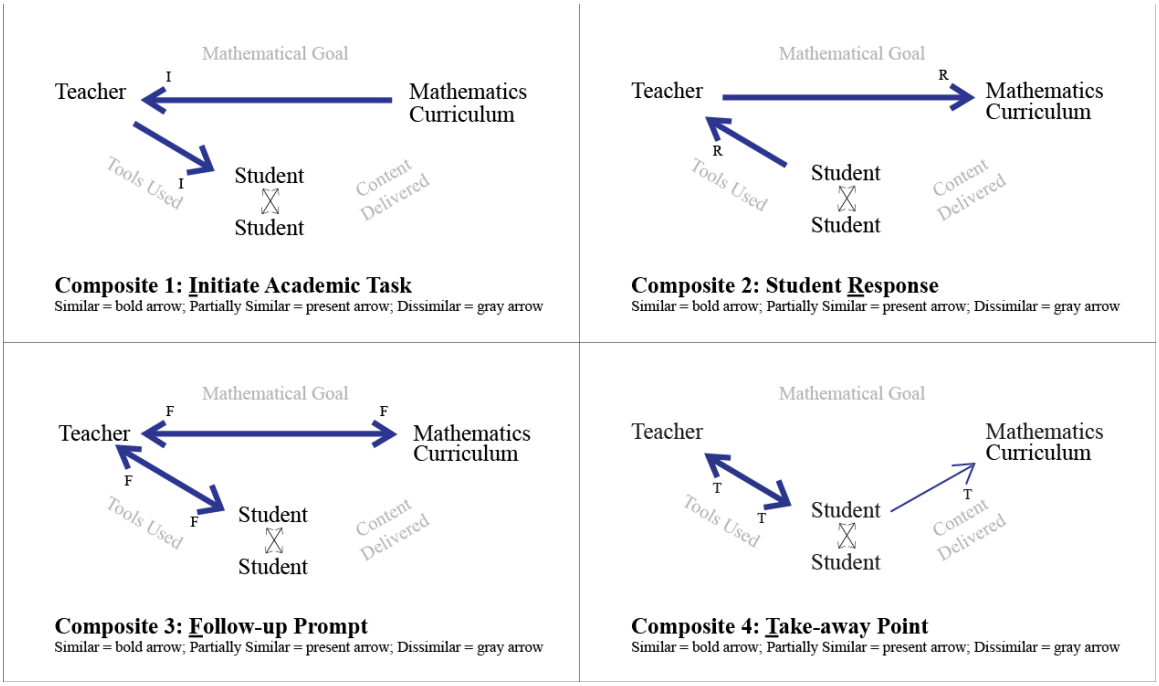


Table 25: Instructional Leader and Veronica Cohesiveness 2

Cohesiveness of Overall Shared Pattern of Adjustment to Student Thinking Instructional Leader and Veronica				
Tripartite Scale of Similarity Similar = 2; Partially Similar = 1; Dissimilar = 0				
	Math Goal	Tools Used	Content Delivered	Total
Initiate Academic Task	2	2	NA	4 Out of 4
Student Response	2	2	NA	4 Out of 4
Follow-up Prompt	2	2	NA	4 Out of 4
Take-away Point	NA	2	1	3 Out of 4
Cohesiveness Score Across Instructional Moves				15 Out of 16

Conversely, looking at an analysis of similarity across instructional moves between Joanne and Stacey with the 2x2 below we can see that instances of similarity are strongest in the initiation of the academic task and begin to diminish when listening to the student response begins. There is a significant drop off in similarity that is even more striking in the follow-up prompt. In fact, Stacey doesn't provide a follow-up prompt, which is significant since that is when the IRFT pedagogical routine begins to diverge from the IRE pedagogical routine. Stacey's pattern of similarity ends with her emphasis on the correct answer in the take-away point. This pattern of similarity indicates that Stacey more strongly adheres to the IRE pedagogical routine than to the IRFT pedagogical routine. Stacey's resulting cohesiveness score across all instructional moves with Joanne is 6/16.

Stacey and Joanne

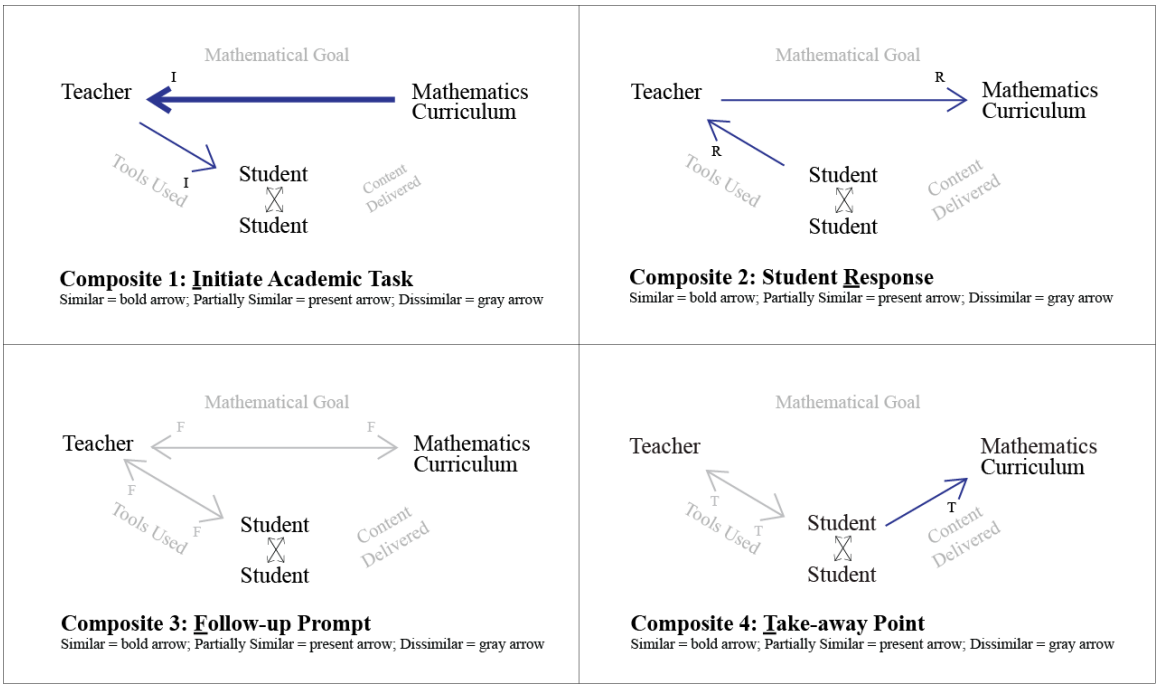


Table 26: Instructional Leader and Stacey Cohesiveness 2

Cohesiveness of Overall Shared Pattern of Adjustment to Student Thinking Instructional Leader and Stacey				
Tripartite Scale of Similarity Similar = 2; Partially Similar = 1; Dissimilar = 0				
	Math Goal	Tools Used	Content Delivered	Total
Initiate Academic Task	2	1	NA	3 Out of 4
Student Response	1	1	NA	2 Out of 4
Follow-up Prompt	0	0	NA	0 Out of 4
Take-away Point	NA	0	1	1 Out of 4
Cohesiveness Score Across Instructional Moves				6 Out of 16

As a result, what is left unanswered is why is it that Veronica is able to use and uses the IRFT pedagogical routine, and Stacey does not? From a similarity score perspective Veronica has a cohesiveness score of 15/16 for collaboratively distributed instruction. Meanwhile, Stacey has a cohesiveness score 6/16 for collaboratively distributed instruction. What is most notable is that nearly 2/3 of Joanne's instructional interaction is missing from Stacey's interactions with students around the academic task. I conclude with some thoughts regarding the comparative difference of both collectively and collaboratively distributed instruction and its variance across both Stacey and Veronica's instructional practice. Recall, that according to the conceptual framework, cohesiveness across instructional moves is directly related to levels of reciprocal collaboration during classroom observations between the instructional leader and a given teacher.

Summary of vignette 2: class discussion post group work

In this last vignette of teaching Lesson 3.2, Class Discussion Post Group Work, Veronica continues to perform high levels of both *similarity* of content and tool distribution and *cohesiveness* across a pattern of shared instructional moves or adjustment to student thinking with Joanne than does Stacey. The instructional dynamic shared by Joanne and Veronica is clearly divergent from the dominant IRE pedagogical routine found in most American mathematics classrooms (Stigler & Hiebert, 1999; 2009). Instead, and as evidenced in each vignette, Veronica's instructional dynamics converge with the IRFT pedagogical routine detected in Joanne's instruction.

Conversely, even when Stacey uses the same academic task as Joanne and Veronica, we see that after the initial academic task, the similarity between Stacey and

Joanne's instructional practice becomes increasingly less similar. What is likewise clear about Stacey's pedagogical routine is its remarkable convergence with the IRE pedagogical routine. Hence, Stacey has minimal, if any level of cohesiveness across instructional moves that indicates shared adjustments to student thinking with Joanne.

Vignette 2: Full transcript

Joanne

Joanne: …Let us talk about problem 3.2, okay? So it says you just advanced to level two of the treasure hunt. [Puts up projection of the second level of the mansion displaying Queen and King's halves of floor. Unlike the level 1 transparency there are no pen marks of different colors, it is simply the floor transparency for Level 2 that is in the book, and on a separate sheet she gave the students for marking on.] What is the probability that the treasure is hidden in one of the queen's servants' rooms? What do you think, Gary? [Picked a stick as the means of choosing this student.]
Gary : One half.
Joanne: Why? Why one half?
Gary: Because there's two on one side and it's exactly halfway through. So one half--
Joanne: So you're saying this line right here divides the floor in half? [Joanne takes a purple pen and marks on the transparency the line that divides the Queen's side of the floor from the King's side of the floor.]
Gary: Yeah, and then the queens are on one side and the other one's on the other side. [She points to the queen side and the king's "other" side as he says this.]
Joanne: And on the other side. Craig?
Craig : It only asks for what's the probability for one [00:03:34] one of the queen's servant's rooms, not all of the queen's servant's rooms. [Craig states how he read the problem and if read that way there would be a different answer.]
Gary: Oh, my gosh.
Craig: So it's one fourth.
Joanne: Interesting way of interpreting the question. I understand what you're saying, but it was saying one of these rooms. So, it could mean-- what it meant is what's the probability of it being in a queen's servants room? Instead of one, put the word 'a' there, okay? Do you understand why it would be one half? I understand your thinking. Shh. Do you understand? Leah?
Leah: I had a weird way of doing it. I don't know if it actually worked. Since the two queen's rooms overlapped like where the king's rooms were, I put the king's [00:04:30] however you pronounce that, I put them over there, the two-- [Joanne draws what she understands the student to be saying on the

transparency to confirm that her understanding of how the student came about determining the problem occurred.]
Joanne: Just a moment, Leah. Listen. I'm sorry, okay. So just because it overlapped, you did what?
Leah: I took the top lines of those two with that one room and put them over on the other side and made three rooms for the queen. [Joanne points to the line that she thinks the student is referring to.]
Joanne: You did this? [Joanne draws a dotted line connecting the dividing lines of the King's half so that they cut across the Queen's side of the floor as well.]
Leah: Yes.
Joanne: So now the queen has three rooms? This is Chloe's room right here, right? [laughter]
Chloe: I wish.
Joanne: It's not designated. [laughter] All right. So, you were looking at it saying that you could have three rooms on each side, but it still would be one half here, right?
Leah: Yeah
Joanne: Okay. Sally, were you talking the same way she was thinking?
Sally: Sort of and sort of not. I couldn't decide whether it was half or a quarter.

***

Veronica
Veronica: Let's take a look at the problem. Alright, here we go. Part A. You advance to the second level treasure hunt. What is the probability that the treasure will be hidden in one of the Queen's servant's rooms? Maggie?
Veronica
Veronica: Maggie, take a look at the board. How much of the board is the Queen's servant's quarters? [Pointing to the entire half of the floor on the projector.] I shouldn't say quarters; that is confusing. Here's level two. How much of the board belongs to the Queen's?
STUDENT: Half.
Veronica: Half. The Queen's part of the board is a half, [Drew an outline of the Queen's area with a marker on the projector, and wrote the fraction ½ at the top of the outlined border.] so the probability of landing in the Queen's-- what do they call it, servant's rooms-- landing in the Queen's servant's room is a half.
STUDENT: Well it says for one of the rooms, so it'd be a fourth.
Veronica: Okay, so you want to go a step further and say that this is a quarter? And this is a quarter? [Draws an outline of the individual Queen's rooms, making the quarter clearer to the whole class.] Yeah, except for the fact that it says, "What's the probability that it's going to land in one of them?" So, the probability that it's going to land in the Queen's servant's room is really a half, because it's half the board, but if you have it the other way I would be fine with that. Okay. Tell me how you got a quarter though.
STUDENT: Because the Queen's side of the board they're trying to come out with it.

Veronica: Okay, but how did you get a quarter?
STUDENT: One Queen's room is one quarter of the board.
Veronica: Yeah. If you take a look at this whole board, you can visually see that if you cut this into four pieces, this would be one of the four. Or, could you say that the Queen's Ladies-in-Waiting's room is a half of a half? And when you say half of a half, that means multiply. Half of a half is a quarter. Good. Questions? Alright. [Presents this as another strategy students could have used, and writes ½ * ½ = ¼ on the projector to the side of the diagram.]

***

Stacey

Stacey: …First one is going to ask you about, "You just advanced to level two in the treasure hunt. What is the probability that the treasure is hidden in one of the Queen's servant's?" Rick what did you get? [Pulling sticks for random call.]
Rick: I got 50 out of 100.
Stacey: 50 out of 100, 50%, one half. However you want to look at it. [There are no tools being used that I can see. She is not using a transparency, although she did provide a handout of the floor layout for students to write on instead of the diagram in the book during their group work, which was distributed to all 7th grade teachers from their planning meetings.]
Rick: Wait, wait.
Stacey: What? 50 out of 100 is also reduced to one half.
Rick: It's 50-50.
Stacey: 50-50. What about the Queen's room? Frank, the Queen's room. Or, the King's, I'm sorry. Second part of A.

Conclusion

In this chapter, I addressed the following research questions:

1. Does the construct of collectively distributed instruction offer a framework for analyzing teachers' use of common academic tasks and instructional materials?
   a. If so, does this framework illuminate whether, and to what extent different academic tasks and instructional materials occur across teachers?

2. Does the construct of collaboratively distributed instruction offer an analytic framework that identifies the instructional leader's adjustments to student thinking and its spread across teachers with whom the leader works with closely?
    a. If so, does the analytic framework illuminate whether and to what extent the spread of the instructional leader's adjustments to student thinking varies between two teachers with whom she works with closely?

Looking at the analysis of instructional interactions across both vignettes has allowed the reader to see collectively distributed instruction by shared content and tool use between Joanne and Veronica, as well as Joanne and Stacey. This analysis has also allowed the reader to see how and when collectively distributed instruction can vary between the instructional leader and two teachers with whom she works closely. Likewise the analysis in this chapter allows the reader to see collaboratively distributed instruction by shared adjustment to student thinking between Joanne and a teacher with whom she works closely. Analyses in both vignettes have also identified what it looks like for collaboratively distributed instruction by adjustments to student thinking to vary between the instructional leader and two teachers with whom she works closely.

Vignette 2: Class Discussion Post Group Work is the vignette that most directly addresses the research question of whether a conceptual model of distributed instruction enables the reader to see distribution by shared adjustment to student thinking that both diverges from the IRE pedagogical routine and converges with a pattern of adjustment to student thinking supported by distributed leadership. It is in the Class Discussion Post Group Work vignette that all three teachers share the same academic task and have an

opportunity to either exhibit instructional dynamics that either converge with the IRE pedagogical routine or diverge from the IRE pedagogical routine and converge with the IRFT pedagogical routine that I detected in Joanne's instruction.

In particular, Vignette 2 makes visible the sort of patterned convergence of adjustments to student thinking between Joanne and Veronica through the use of composites. The added visibility provided by composites allows one to see more clearly whether, how and to what extent teachers' adjustments to student thinking diverge from the IRE pedagogical routine and converge to the instructional leader's pattern of teacher-student interaction. Conversely, the added visibility provided by an analysis of collectively distributed instruction by content and tools, and an analysis of collaboratively distributed instruction by shared adjustment to student thinking illustrated in Composites 1 through 4 make visible Stacey's pattern of adherence to the IRE pedagogical routine found in most American math classrooms (Stigler & Hiebert, 1999/2009).

Consequently, this chapter sheds light on the overarching research questions: 1) What is a construct of distributed instruction and what does it look like in teachers' instructional practices? 2) How might further visibility garnered by a conceptual model and analysis of distributed instruction support further alignment between instructional policy and practice in the iterative process of instructional improvement in schools? With respect to the first overarching research question the analysis in this chapter addresses the question of what a construct of distributed instruction is and what it looks like across teachers' instructional practices. The second overarching research question is addressed when one begins to envision how the conceptual mapping of instructional moves onto composites can be helpful to instructional leaders who can be met with

resistance when working on instructional change with teachers. Some researchers (e.g. Lampert, 2001) have mentioned that teachers can rebuff an instructional leader's call that they need to shift instructional patterns by attributing their pedagogical routine to "personality" or "personal style." However, when a researcher or practitioner is able to illustrate how a teacher's "style" maps onto a culturally dominant pedagogical practice in mathematics classrooms, it can help to diminish teachers' self identification with the often subconscious pedagogical choices a teacher may make. In particular, it could support well-meaning teachers to better see how their "style" does not belong to them, but rather is indicative of how they themselves were taught (Shulman, 1987). Likewise, when coupled with research pointing to how the IRE pedagogical routine diminishes students' opportunities to learn content at the proficiency levels desired by the Common Core, it can further support teachers' sensemaking of the need for a collective shift in pursuit of collective goals. Namely, findings on IRE's negative impact on student learning are not personal, and they belong to a much larger context of schooling and teaching for which no individual teacher is solely responsible. However, equipped with this dissertation's mapping technique, a hypothetical district could identify its desired pedagogical practice for the same academic task to further support teacher learning (without blaming).

In Stacey's case, what is clear from this analysis is that while Stacey, Joanne, and Veronica share instructional moves constituting roughly 1/3 of the instructional dynamic analyzed, sharing academic tasks alone, leaves a lack of cohesiveness to the overall desired adjustments to student thinking around the content across the group of teachers. Once the initial academic task has been provided, nearly 2/3 of instructional dynamics

responsible for adjustments to student thinking supported by distributed leadership are left undone by Stacey's pedagogical practice. Juxtaposing a teacher's pedagogy with that of the desired pedagogy could be used as a learning aid that helps to support teacher learning and skill development within specific aspects of the desired adjustment to student thinking. It could also hypothetically support Stacey to understand how and why for student learning purposes, cutting out nearly 2/3 of the instructional interaction across each academic task could clearly limit her students' opportunities to learn the content. This is especially the case in Title I school contexts, such as the one Stacey works in, in which students' learning opportunities are far more dependent on classroom interactions than these students' wealthier counterparts in non-Title I school contexts.

The purpose of mapping the distribution of desired instructional dynamics across teachers is to make previously underspecified and unseen aspects of instruction visible to teachers, leaders, and researchers who support or strive to support their learning. A critical component of a student's opportunity to learn content is in a teacher's efforts to create a bridge between what the student does not know and what the student needs to know (Cohen, 2011). Consequently, aspects of pedagogical skill that do not explicitly bridge student thinking to content undermine students' opportunity to learn. The lack of a bridge between content and student thinking in some teachers' instructional practice is not surprising, and should be expected (Cohen, 2011). It is for this reason that conceptual and analytic tools developed to support instructional moves that better bridge student thinking to content should be the standard bearer of work contributing to instructional quality and its distribution within and across schools in diverse settings.

More specifically, whether distributed leadership is a useful construct in shaping and shifting instructional dynamics rests with the utility of the conceptual and practical tools it provides to bridge student thinking with the desired content. Without evidence that distributed leadership can influence teachers' explicit and visible bridging between student thinking and the desired content, there is an insufficient theoretical basis to support claims that distributed leadership will or can increase student achievement. For these reasons, the mapping of how, whether, and to what extent such bridging between the desired content and student thinking occurs supports both visibility of desired instructional dynamics and its relationship to efforts by distributed leadership to shape it. To this end, I deploy constructs of similarity of content and tools within an instructional move and cohesiveness of shared adjustments to student thinking across instructional moves to support the conceptual and analytical work necessary to further develop connections between distributed leadership and instruction might look like.

In Chapter 6, I return to the hypothetical connections stated in my conceptual model between distributed instruction and the policy mechanisms within distributed leadership. In particular, I turn to understanding the capabilities and limitations of the mechanisms within distributed leadership that influence teachers' adjustments to student thinking. I use teacher narratives from post-observational interviews that provide a descriptive characterization of how teacher learning has either been bolstered or impeded by the particulars of circumstance. I do so with the intention of learning whether and to what extent teachers' attribute mechanisms within distributed leadership to similarities within and across their instructional moves or lack thereof.

CHAPTER 6

TEACHER NARRATIVES OF FACTORS THAT INFLUENCE DISTRIBUTED INSTRUCTION

This chapter is structured to answer the third research question, "Does a conceptual model of distributed instruction enable researchers to connect mechanisms within distributed leadership to factors teachers say influence varying levels of distributed instruction between the instructional leader and two teachers with whom she works closely?" To this end, this chapter provides narratives from Stacey, Joanne and Veronica regarding the factors that have influenced similarities and differences in their instruction. In Chapter 5, Veronica and Joanne perform more cohesive collaboratively distributed instruction Stacey and Joanne. For this reason, after I observed them teach Lesson 3.2, I asked each teacher, "What contributes to the similarity or dissimilarity in the steps you and the other teachers take to communicate the math concepts either in the given problem or in student thinking?" I did so with attention to whether the factors described could be attributed to one of distributed leadership's three policy mechanisms: standardization by shared content and tools, schedule, and classroom observations. I begin with an overview of the teachers' narratives.

According to Joanne, the instructional leader, there are three central determinants for how teachers came to teach the way they do: i) initial training, ii) first year of teaching the curriculum, and iii) frequency of observing the pedagogical inquiry method espoused by CMP curriculum developers. All three of these factors represent some variant on the policy mechanisms of providing opportunities to observe someone with pedagogical expertise and having the same person observe a given teacher's teaching. In the initial training, for instance, Joanne and Veronica both received in-depth training from CMP curriculum developers during a week-long retreat in which CMP pedagogy was modeled for them and they then attempted to enact what was modeled and were provided feedback from the developers themselves. Moreover, Joanne and Veronica have worked with one another at Walter Johnson Middle School on their implementation of the CMP pedagogical practices they learned in that training over 9 years of observing one another teach, prior to this study. In contrast, Stacey did not receive the initial in-depth training since she was hired after the initial training of teachers was provided and came to the district only 4 years prior to this study. Additionally, in Stacey's first year teaching CMP she taught at Gateway middle school. According to Joanne, Gateway's Math Department Head didn't think CMP pedagogy was critical and used the *Reader's Digest* approach to CMP, even though she went to the same initial in-depth trainings as Joanne and Veronica. Last, Joanne and Veronica share a classroom and observe each other teaching daily and borrow instructional moves from one another. In contrast, Stacey seldom has the opportunity to observe Joanne or Veronica teach a 7^{th} grade CMP lesson.

What is interesting to note is that initially Stacey stated that similarities and differences across teachers' instruction were due to differences in teachers' personality.

This line of reasoning is of interest since previous work on shifting teachers' instruction has documented teachers' attributing differences in instructional skill or professional practice to personality (e.g. Lampert, 2001). According to this work, attributing instructional differences to personality is a common deflector used by teachers whose teaching is not aligned to instructional policies espoused by district and school leadership. One reason this can be effective at deflecting efforts of leadership to change teachers' instruction is that one cannot be expected to change one's personality.

> Stacey: Similarity I guess would be that we all use the same book, the same paper, the same stuff…
> I would say our goal was the same, but how we got there… all three of us have a different style. I don't know how they teach. We ask same questions, I know Joanne is more serious and I am more funny. Veronica likes her class more quiet. We all get there though.
>
> Me: Where do you think dissimilarity comes from with respect to communicating a math concept in a problem that's in the book?
>
> Stacey: I would say just how it's portrayed in terms of our personal text, our personal quirks, our personal, how we teach in general, our personal… that's what I would say would differ.
>
> Like how I am more humorous, Joanne is more – this is what I assume I don't know – I know their personality, so I assume I know, Veronica is on the quieter side, and I don't mind crazy chaos or organized chaos. Joanne is kind of like in between the two of us. So, I think that's where dissimilarity comes in is our personalities. That's what I think it would come from.
>
> Stacey Post Lesson 3.2

What is equally noteworthy, however, is that with further probing Stacey describes how: i) training differences, ii) her first year teaching the curriculum and iii) her opportunities to observe CMP pedagogy contributes to differences in her instruction as compared to Joanne and Veronica. Again, all three factors relate to differences in teachers' exposure to observations of the desired adjustment to student thinking through in-action communication routes, i.e. classroom observations. As a result, below I have organized teachers' narratives with respect to curriculum training, first year of teaching

the curriculum, and opportunities to observe CMP pedagogy in practice. I have done so with an emphasis on narratives for how these factors interact to create divergence in Stacey's instructional practice.

Curriculum Training

What emerged from my interviews with Stacey was a narrative of how the training Stacey had received hadn't taught her how to ask questions. I found this especially interesting since Joanne and Veronica use questions to unpack student thinking to inform follow-up prompts and direct students to the take-away point of the instructional prompt. What this revealed was that Stacey was sufficiently aware of instructional differences to know that the differences were due to more than just matters of personality that she had initially described. By her own admission, the differences were due to varying levels of skillfulness with questioning students to evoke their thinking. In particular, she mentioned that her training had not sufficiently prepared her to be able to adjust to student thinking within instructional dynamics the way that Joanne and Veronica were able to do.

> Me: What is your training with the CMP curriculum?
>
> Stacey: None. None by them. None by the CMP. When the school district bought the program 8, 9 years ago everyone who was a math teacher got a full week of training, like, in depth how to do it, so you were in 6th grade, you got the whole 6th grade. After that when you are hired in they would just do these two hour brief trainings at another school. For example Joanne did a 7th grade math and John did a 6th grade and it was basically this is how I do it, here are some examples, now go. Anyone hired new never got the full week.
>
> …
>
> I think Joanne got to see the full thing, and how, cause Michigan State came up with Connected Mathematics, and she got to see how MSU wants to portray it. She got it straight from the horse's mouth, so to speak, and I feel like everyone else got the Reader's Digest version of what we were willing at [this district] to give you. We never got the

> full, and I feel like sometimes I struggle with CMP especially in the beginning because I was always the kid where it was like this is how you do it, this is the answer, why don't you understand?
>
> *So it was really hard for me to start asking questions, and feel comfortable to know what question to ask.* Cause you can ask questions the book says, but then even like, I would be like, I wouldn't ask that, so *I'd ask questions that are direct answers*. Do you think X? Yes or No. Yes or No. And then I think I had a great discussion. And now having gone through it a couple of times I realize I am personally learning myself…
>
> Me: What would it look like [how does training show up in teaching]? I get that they got the training and they are really going to get what MSU did.
>
> Stacey: They have the *skills and tools* to know how to ask proper questions. And the *tools* like they know how they went through examples, from what I understand what they went through, they went through how this was designed, the background, the thought process of where this came from. We never have, so when I get a lesson that I am not comfortable teaching I don't have… I am just relying on what I know and I am kind of pushing through it and doing what I think. But I feel like they, the people who were trained by them, have *more of an idea of how the book is set up and how the program is set up, and they can use those techniques to ask those deeper questions*, and we never got that stuff.
>
> Stacey Post Team Meeting 1-24-11 [italics mine]

Joanne attributed Stacey's lack of "official in depth training" to differences in her pedagogical style when compared to both Joanne and Veronica as well.

> Joanne: I think Veronica and I both were working here at Walter Johnson when the district adopted Connected Math and both of us went up to MSU for 5 days of training. So [Veronica and I] had the real official in depth training. So there's that. In addition Stacey hasn't had as much training that's in depth.
>
> Joanne Post Lesson 3.2

Given comparative differences between new teachers' more limited formal training on the CMP curriculum compared to veteran teachers that were in the district when the district adopted CMP, I asked Joanne what this training for new teachers provided.

> Joanne: Every new teacher to the district is expected to do pd on each book that they teach for each level, and if you teach at a new level you are expected to do it for the different level for each book. Even if you get CMP you are expected for every level you teach it to get more pd. We are all required to do 6 hours of pd a year.
>
> Me: When within a month or year?
>
> Joanne: Within the year so its equivalent to a day of pay and that is evolving as I say it because they change it up every couple years. Last year it was new and the development building decided what they wanted and they did it after school in two-hour blocks and because last year got messed up due to snow day and trying to reschedule that.
>
> Joanne Instructional Leadership Interview

However, according to an interview with Stacey these "mini-trainings" provide insufficient opportunities to observe how a lesson or a whole unit is taught for each book. When I asked Stacey where she could learn CMP pedagogy she mentioned a different type of training that Joanne hadn't mentioned.

> Me: Where can you go to learn those things?
>
> Stacey: They always offer every year, a week program, MSU offers it Arkansas, Texas, California, and it cost like $600/person. And the district won't pay it, and you know, even if they paid for us to go I would go and pay my own room, but they won't pay for it. They think… and the deal that they got this is the deal they got, they never thought about the future – maybe they did and didn't have the money and crapped it out, but you know, it's available they just won't pay for it.
>
> Me: What other options do you have?
>
> Stacey: Colleagues. We constantly see each other and use each other and being able to communicate that and…
>
> Stacey Post Team Meeting 1-24

As a result, we see that teachers who didn't receive the initial training from curriculum developers are much more dependent on opportunities to observe teachers who teach using the CMP pedagogy, in order for them to learn it themselves. I describe Stacey and Veronica's opportunities to observe and be observed by Joanne in more depth in the section on classroom observations.

First Year of Teaching CMP

Based on interviews with all three teachers, Joanne and Veronica had both first implemented the CMP pedagogy at Walter Johnson Middle School, nine years prior to this study. Stacey, first taught CMP at Gateway Middle School four years prior to this study. According to Joanne, the instructional leader at Gateway did not fully believe in CMP pedagogy, although she had been to the same initial training Joanne and Veronica attended. Consequently, the math department head at Gateway taught the Reader's Digest version of CMP and supported her teachers doing the same.

> Joanne: I think Veronica and I both were working here at Walter Johnson when the district adopted Connected Math and both of us went up to MSU for 5 days of training. So we had the real official in depth training. So there's that. In addition Stacey hasn't had as much training that's in depth. [Veronica and I] also obviously share a room, and we have grown through the process, we worked together at the beginning and we have continued off and on. We work together and we both obviously see each other teach, because we are in the room doing other things, which facilitates a lot of learning I think.
>
> Stacey has come from a building in this district with a completely different student population, and the building math leader has a different philosophy than I do, and while that person says she's not all about [short cuts] she's got all the short cut terminology: plug and chug, give it to them and do it, she often uses those methods. She doesn't teach, even though she was in on the ground floor she does not teach as true to the CMP philosophy as I am. I believe in it really strongly, and I say that because Stacey just said that she does the Reader's Digest version of the book. And that was Stacey's first year with the book and it has been very hard to move her out of that mindset. And I have been working with her on that for a while and I don't think she trusts not doing that yet. But she is growing.
>
> Joanne Post 3.2 Lesson Interview

From interviews with Stacey, I learned that Gateway Middle School -- unlike Walter Johnson Middle School – was not a Title I school, and was one of the schools that had more affluent families than other schools in the district. As a result, according to Stacey, the students effortlessly learned the content on their own with very little needed from her personally.

> Stacey: I didn't realize until I got [to Walter Johnson] that the kids are different. I mean over [at Gateway] it was like an essential just, I don't want to say dream job, that's not what I am saying, I want to say it was easier. We called home when something was wrong and majority of them time the problem was corrected. You have your few that are your pain in your side but for the majority the parents back you up and you call them in for parent teacher conference it wouldn't be a problem but here I make a call 4 or 5 times to the same house and still nothing.
>
> We have to go slower here. We have to go a lot slower. We have to show different types of representation. I didn't have to get as many of manipulatives. We just have to show different types of representations – kids here too – I call them apartment hoppers. They are here for a year and then they are gone. This is their 5th school, 6th school, 7th school - they haven't been in the District the whole time, so they are just getting bits and pieces of education it is never spiraling or concurring. And some of the kids are like, I will only be here a couple of days, a couple of months, a year, so their attitude is a lot harder and you have a lot more gaps and holes. A lot of kids at Gateway, if they are in 8th grade, most likely they've been in our District since Kindergarten and you know exactly what they've had and [at Walter Johnson] it is a gamble. They tell you I've been in this school district, this school and you're like ok, and everyone teaches different things in different areas.
>
> Stacey Post Team Meeting 1-24-11

According to Veronica, Stacey's teaching at Gateway has shaped the way she plans with the team as well.

> Veronica: So, before Stacey taught here she taught at another school where they just kind of made lab sheets and kind of didn't teach and use the book and do the discussions, its just kind of here's the information so now let's just go with it.
> …
> So Stacey calls it her Readers Digest version of teaching it so she kind of lumps it all together and kind of introduces all the information at once, instead of treating it like 1.1, 1.2, 1.3, she's just kind of like this what they need to get out of it lets' just do this and move on. Where I like to let the kids to really investigate it and really discover it and self discovery. So I think we are going to do 1.3 just a little differently than what it is in the book. She is going to do her version of it, which is not good for collaboration. Right? <laugh>
> …
> And I don't know how because I don't really know how the Reader's Digest goes because I've never seen it and I don't know how its taught because I've never taught it that's just how they call it. It's just kind of shortening things up and condensing them and not going through it thoroughly, I think…
>
> Veronica Post Team Meeting Interview 1-24-11

As a result, based on all three teachers' narratives we can see that Stacey had a very different experience teaching CMP in her first year of teaching the curriculum. For starters her math department head didn't think her student population needed teachers to use the CMP pedagogy that she received training on in order to attain their student achievement goals. In contrast, given the population at Walter Johnson Middle School, Joanne places a strong emphasis on her teachers using the CMP pedagogy that she was trained to use with students out of a belief that without doing so the school will not meet their student achievement goals.

Observation

Given the context of a professional learning community in which Stacey taught and observed other teachers' teaching lessons, I asked Stacey about her current learning opportunities to learn how to question students. What emerged was a narrative of the limitations of her learning opportunities to enable her to shift from IRE pedagogical practice of initiating an academic task, receive a student response, and evaluate whether it was correct. The limitations included financial restrictions to getting the same training, but more importantly is Stacey's perception of insufficient time and opportunity to observe other teachers who teach with the desired pedagogical expertise.

> Me: What other options do you have [for learning how to teach CMP the way Joanne teaches it]?
>
> Stacey: Colleagues. We constantly see each other and use each other and being able to communicate that and…
>
> Me: So, have you seen them teach?
>
> Stacey: Bits and pieces.
>
> Me: What do you mean by bits and pieces?
>
> Stacey: I mean Joanne in the past up until this year, Joanne says I will cover you and go and watch so and so and look for this and look for that. It hasn't been, I would personally like them to come in and if I am

> going to learn, the same person for a week or two weeks to see a whole unit or a whole investigation. Not a whole unit that's unrealistic but at least an investigation where I can see someone that has been trained where I can see how they progressed through an investigation. Just seeing one lesson one time, I feel like you are not getting the basics.
>
> Stacey Post Lesson 3.2

In contrast, Joanne and Veronica see each other teaching on a daily basis.

> Veronica: Fortunately, for Joanne and I, we are in and out of each other's room all of the time, because we share the same room, so I can see sometimes how she shares the information and how she summarizes, and then I can steal some of her ideas and vice versa. And sometimes she'll say that's not how I teach it, this is how I am teaching, but I am not in Stacey's room so much, so I don't see her delivery as much.
>
> Veronica Post Lesson 3.2

> Joanne: [Veronica and I] also obviously share a room, and we have grown through the process, we worked together at the beginning and we have continued off and on we work together and we both obviously see each other teach, because we are in the room doing other things which facilitates a lot of learning I think.
>
> Joanne Post Lesson 3.2

According to both Joanne and Veronica, the main reason for similarity in the way that they teach is that they observe each other teaching students on a daily basis, and have done so on and off for nearly 9 years at the time of this study. This again, relates to Veronica's opportunity to learn the desired pedagogical practice via classroom observations as compared to Stacey. These observations are not formal classroom observation but rather due to the fact that Veronica and Joanne share a room and observe each other teach daily. In particular, Veronica mentions she is able to "steal" instructional moves and gets ideas for how to manage instructional dynamics within the lesson in a similar manner to Joanne.

While it is the case that Joanne and Veronica share a room it is also the case that Joanne and Stacey co-teach a class. Although the class they co-teach is a low 8th grade math class that needs review of 7th grade math concepts, Stacey does observe Joanne's

instruction daily. This is a matter that I realized later, and in hindsight, I would have interviewed Stacey regarding what makes that time useful or not useful for learning how to teach using CMP pedagogy. Due to the structure of the study's focus on 7th grade math instruction, I didn't ask specific interview questions regarding the 8th grade math class Joanne and Stacey taught together, although I did observe them teaching it.

From my observations of Joanne and Stacey co-teaching, one matter that may influence the usefulness of co-teaching to influence Stacey's instruction is that Stacey functions as an assistant with the low-level learners. As a result, Stacey is often working with an individual student or passing out work, more than she is focused on observing Joanne. Second, when Joanne and Veronica observe one another teaching, neither of them has responsibility for the learning of the students or to the other teacher. Last, both Veronica and Joanne have half-time teaching appointments, which means they teach for two instructional blocks a day. As a result they have the opportunity to observe one another teach the same lesson they are currently teaching students that day. In contrast, Stacey has a full-time teaching appointment and teaches four instructional blocks. So while Stacey may be exposed to Joanne's teaching she isn't afforded the same frequency of opportunity to reflect on teaching and Joanne's feedback on Stacey's teaching, compared to Veronica.

Conclusion

I analyzed teacher narratives to detect whether there was a relationship between the factors teachers said supported them to teach in ways that were similar to the instructional leader and the coordinating mechanisms Thompson (1967) mentioned. The teachers' narratives did not contradict one another but rather triangulated or provided

confirmation of the factors mentioned by other teachers for what contributed to similar or dissimilar instructional practices among them. The theme of the role of classroom observations (or Thompson's in-action communication routes) seemed to be a common thread through the factors of curriculum training, first year of teaching and opportunities to observe and be observed by the instructional leader that teachers mention were supportive of learning to teach in similar ways as the instructional leader. Interestingly, the teachers do not mention co-teaching with the instructional leader as a helpful way to learn how to teach similarly to the instructional leader. This sheds light on teachers' views of whether and when Thompson's coordinating mechanism of in-action communication routes supports them to have similar instructional practices with the instructional leader. In particular, the teachers viewed classroom observations as useful, and did not mention co-teaching as useful for learning to teach similarly to the instructional leader. It is in this way that these interviews informed my conceptual model so that the third mechanism now solely refers to reciprocal classroom observations. In particular, I came to view teachers' classroom observations as a coordinating mechanism that supports distributed instruction and not co-teaching, while in theory according to my reading of Thompson they should both be effective.

In summary, teachers attribute the reason behind varying levels of distributed instruction between Veronica and Stacey to three factors: 1) in-depth training, 2) first year experience of teaching CMP, and 3) frequency of ongoing organizational routines that allow a teacher to observe CMP pedagogical expertise on a day-to-day basis. Each of these three factors map onto the policy mechanism of classroom observations that is more present in distributed leadership than traditional leadership. As a result, I attribute

differences in exposure to observing the desired pedagogical routine between Veronica and Stacey to varying levels of collaboratively distributed instruction between them in Chapter 5.

I have surmised that the primary barriers to providing Stacey with access to classroom observations in which she is observed and observes one with pedagogical expertise are financial, unlearning and logistical. I cite a financial barrier to her being able to gain access to classroom observations since the district is not going to pay $600 for her to receive in depth training using the curriculum that has been stated by Stacey as an opportunity to have access to observations of teachers with CMP pedagogical expertise. I mention Stacey's unique need to unlearn what she learned about how to teach Connected Mathematics her first year of teaching. I mention this since the other two teachers were able to use one another to further the pedagogical skills they learned from the initial training in their first year of teaching Connected Mathematics. As a result, Stacey did not have access to observing or being observed teaching with the pedagogical routine desired by the district her first year of teaching. Last, I state logistical difficulties to Stacey being able to observe a teacher with the desired pedagogical expertise on account of Stacey's full-time teaching appointment influencing her opportunities to observe CMP pedagogy. Another factor involving logistics is that Veronica and Joanne share a classroom. Joanne and Veronica inevitably get to the classroom before they teach or stay a bit after they teach and observe one another's adjustments to student thinking on a daily basis. In the next and last chapter I conclude with thoughts regarding what the conceptual and analytic framework of distributed

instruction allows the research community in further advancing distributed leadership as a means for aligning instructional practice to instructional policy.

CHAPTER 7

CONCLUSION

This dissertation set out to make a conceptual and analytical contribution to the field's understanding of how distributed leadership influences instruction; and if so, under what circumstances. I began this work with a claim posited by Barnard (1968) that the comparative advantage of cooperative/mutually-constructed leadership structure (i.e., distributed leadership) to top-consolidated power is that it provides greater adaptability of the organization to the client-facing environment to whom services are rendered. Consequently, organizations that need to adapt to changing environments to attain organizational goals are better served by mutually constructed leadership structures than top-consolidated power structures. Barnard points out that top-consolidated power structures can be quite good at influencing the tools practitioners' use (i.e. commodities or standardized instructional materials or academic tasks) and the schedules practitioners adhere to in order to design plans of work (content coverage or sequencing). However, what top-consolidated power structures are not as good at is providing practitioners with the capacity to adapt in collaboration with other practitioners to meet the dynamic needs faced in the environment. Jim Spillane (2001) reasoned that for this very reason elaborating a theoretical model of distributed leadership in schooling was necessary for

those engaged in instructional leadership work to meet the changing teaching and learning demands of the 21st century.

Consequently, I posit that research on distributed leadership's comparative advantage to top-consolidated forms of power should focus on whether Barnard's (1968) hypothesis holds true in the context of schooling. Namely, "Does distributed leadership better enable teachers to collaboratively adjust to the demands of student thinking in interactions with the content as compared to traditional leadership?" If research on distributed leadership overlooks the study of this comparative advantage, I suggest it undermines distributed leadership's legitimacy as a means of achieving the needed alignment between instructional policy and practice to attain schools' goal of increased student achievement (Harris et al., 2007, 2009; Camburn and Rowan, 2003).

In order to contribute to the field's understanding of the relationship between distributed leadership and instruction, I faced a conceptual and analytical challenge to track on whether and to what extent distributed leadership might influence multiple dimensions of instruction inclusive of: content, academic tasks, classroom discourse norms, teaching strategies and instructional materials (Spillane and Burch, 2006). In response to this challenge, in my conceptual framework in Chapter 2, I relied heavily on Thompson's "Organizations in Action" (1967) to articulate a conceptual model of distributed instruction in which three policy mechanisms of distributed leadership correspond to three nested tiers of instructional practice: 1) standardization or shared content and tools correspond to collectively distributed instruction by (i.e. instructional materials, groupings of students and academic tasks; where Camburn and Han (2009) stop), 2) teachers' formalized joint schedules correspond to coordinated distributed

instruction by plan (e.g. pacing content coverage and sequence), 3) classroom observations corresponds to collaboratively distributed instruction by shared adjustment to student thinking (e.g. classroom discourse and teaching strategies). However, this merely provides a conceptual model and not a method to detect whether and to what extent these forms of distributed instruction occur in teaching.

I used a grounded theory approach in order to develop a method for tracking on collectively and collaboratively distributed instruction in Chapter 5. In particular, I used instructional moves made by the instructional leader as distinct units of analysis for detecting similarity and difference between the instructional leader and a teacher with whom she works closely. Levels of similarity between the instructional leader and other teachers are then used to detect varying levels of collectively and collaboratively distributed instruction. I argue that the existence of collectively and collaboratively distributed instruction can serve as an indicator of instructional policy and practice alignment.

I now turn more directly to the secondary overarching research question I stated I would conclude with:

How might further visibility garnered by a conceptual model and analysis of distributed instruction support further alignment between instructional policy and practice in the iterative process of instructional improvement in schools?

The contribution of this conceptual and analytical investment is multi-fold, especially as it relates to representations of shared adjustment to student thinking, the

standard bearer of distributed leadership's comparative advantage to other forms of leadership. In particular, distribution of shared adjustment to student thinking offers insight into the emergent construct of distributed instruction as a potential means of: 1) making district instructional policies more explicit and visible (Jackson, 1968), 2) gauging small wins in teachers' instructional shifts toward a district's instructional policies (Weick, 1984), and 3) supporting more comprehensive instructional plans that do more than simply denote shared academic tasks (indicative of the IRE pedagogical routine), while increasing capacity to communicate plausible instructional adjustments to student thinking. The visual models and tables displayed an analysis of distributed instruction that could lead to a potential metric of collective and collaborative instructional practice that could be used to support the iterative cycle of shifting teachers' culturally engrained practices that might otherwise stay out of view due to perception familiarity (Lewis, 2006). To this end, the construct of distributed instruction contributes a grounded theory approach to the context-specific work of teaching and organizational designs for its improvement.

The benefit of this approach is that it offers insight into how to track distributed leadership's influence on instruction in a manner that would enable distributed leadership to be more specific than vague regarding what is or is not shifting inside instruction across teachers. This kind of feedback could potentially allow schools to be smarter organizations for teacher learning, and thereby student learning. Based on teacher reports of what has supported a specific shift in their instructional practices the distributed leadership team could be equipped with more useable data to inform their next steps for supporting teachers' instructional shifts. Perhaps more importantly it could contribute to

context specific designs for teachers' work that bring into clearer view for the teachers both what the instructional policy provides students, and how teachers own practices match up to instructional policy. It could likewise contribute to a richer description of permissible variation from the pedagogical approach espoused as well.

However, some factors that play a role in teachers' learning may prove immutable for a given schooling organization. For instance, Stacey's request for in-depth training may be a financial impossibility. An added benefit of using concept maps of instructional moves in the form of composites of the instructional triangle is that it can provide feedback that can serve as a form of on-site, in-depth training regarding how one's instructional practice differs from that of the instruction espoused by the district. Conversely, such mapping of how teachers instruction differs from what is espoused can provide the evidence needed to support a bid for grant money to meet teachers' instructional development needs. What is clear is that the conceptual mapping of shared adjustment to student thinking may provide increased visibility to both novice and expert teacher. This increased visibility can enable shared experience around which shared language may emerge to further influence the development of instructional practice in both follower and leader. It is in this way that mapping the construct of distributed instruction both supports the detection of distributed leadership's influence on instruction and may contribute to it when used by leadership in schooling contexts.

Last, in this dissertation's study teachers' narratives of what contributes to varying levels of distributed instruction point to differences in access to observing the instructional leader's instruction between Veronica and Stacey. The driving force between differences between Veronica and Stacey's access to Joanne's instruction in the

day to day of teaching is a byproduct of the district's tenure policy. Namely, because Stacey is the newest hire she has the greatest teaching load. This is fairly typical in most school districts across the country. The teacher with the least tenure or experience teaches the most students and has less opportunity to observe the instructional leader's instruction. The example of this in the dissertation study is demonstrative of how a well-meaning tenure policy can actually impede the instructional quality of teachers who teach the most students. As a result, this dissertation leaves an open question as to how to structure tenure policies to reward experienced teachers without likewise impeding newly hired teachers capacity to learn the district's desired pedagogical routine which is connected to the attainment of the school's goal of increased student achievement. In order to learn how tenure policies could support instructional policy and practice alignment we need conceptual and analytical tools to support our detection of whether those policies actually influence instruction. Further research is necessary to support any causal claims for what directly relates to the variance of distributed instruction, but what this dissertation does help to provide are the conceptual and analytical tools to investigate connections between policy mechanisms and teachers' capacity to bridge student thinking to the desired content.

APPENDICES

Appendix A: Interview and Observation Protocols

District Instructional Leader Protocol

I will begin by informing the subject of the study by stating what is in bold.

Introductory script: **I am interested in understanding more about how schools support teachers to work with others on their mathematics teaching. I will be asking you questions about the district level supports that are provided to schools for supporting teachers' work with others on mathematics teaching. Last, I am interested in learning from you which schools you feel are especially good at providing opportunities for teachers to work with others on their mathematics teaching.**

Eight Core Issues that need to be covered:

1) **What are the district level instructional supports available to schools to support mathematics teaching?**

   This question is intended to get at how those supports are intended to work? How they actually work, and what tools and material resources are used in the delivery of the instructional support.

   Probe: How are specific tools created/developed/supported/used; i.e. pacing guides, lessons or lesson plans, rubrics, Unit Tests, High School Placement Tests developed?

2) **Who is responsible for delivering instructional supports for how mathematics teachers should use the various tools intended for Mathematics teaching to schools, and the teachers in those schools?**

3) **What is the training of those deliverers?**

4) **What does ongoing support for those instructional supporters look like?**

   Probe: for examples.. What sorts of things? Regarding what sorts of tools? What has gone well? What has gone less well? How did you know? How did you respond?

5) **What are things teacher-facing instructional supporters have done that have gone well with the provision of support for tool use in mathematics teaching?**

   Probe: What sorts of things? With what sorts of tools? How do you know they went well? What was the response?

6) **What are things that you are aware of that have not gone so well with the provision of those instructional supports?**

Probe: What are some examples of things that haven't gone as well? How did you know? What was the response?

7) **Who from the district observes mathematics instruction in the classroom?**

This question is intended to get at whom else I might interview. Prompts will regard the tools and guidelines for observing classrooms they use, and what types of things those observers are trained to attend to in those observations? [A separate interview with those individuals will be conducted. That protocol is the same as other instructional leaders at the school level captured in School Level Instructional/Administrative Leader Protocol.]

8) **Can you name schools that are especially engaged in supporting mathematics instruction?**

9) **Why do you think those schools are more engaged in supporting mathematics instruction as compared to others?**

This question is intended to get at what about those schools makes them different?

Identified Instructional Support Provider - Interview Protocol

1) Tell me about the instructional leadership team here. Who is considered part of this? What do they do?

2) What is your role as part of that team?

3) What are the different forms of instructional support provided to the math teachers (especially 7th grade)?

4) How are different forms of instructional support planned? How is the content of these events planned? Who plans them?

5) How do you plan for the instructional support days for others, such as the X? What materials help guide your planning?

6) How did X come to be?

7) What are the tools you use to participate in X? Where did those tools come from?

8) Tell me about a workshop/seminar/site of joint work that you attended lately that made a big impression on you? What was it that impressed you?

9) Tell me about a workshop/meeting that you attended lately that you thought was a waste of time? What was it that made it a waste of time in your opinion?

10) Apart from people who work in this school and committees in this school, are there individuals or agencies that are especially important to your work of supporting mathematics instruction?

11) Who or what are especially important influences on your work to support mathematics teaching in this school?

12) How is [ask separately about 3 important influences mentioned] important to your work?

Classroom Observation Protocol

[Collaboration through tools.]

Teacher stated instructional goal:

Instructional task(s) posed:

What tools are used to pose instructional task?

e.g. worksheets, talk, walk-through examples

What tools are provided for students' use?

e.g. calculators, manipulatives, different colored pencils

Where did tools come from (post observation)?

What steps are taken to understand student thinking?

What tools are used to understand student thinking?

e.g. projector, talk, walk-arounds

Relative frequency of student thinking managed as a whole class, small group, or one-on-one?

Post Classroom Observation Interview

So I just finished observing all three of you teaching the same lesson.

1) Can you briefly tell me what the goal of the lesson was?

2) Can you briefly tell me what tools you had available for supporting students learning of [name concept in above question mentioned]?

3) Which of those tools did you use? Why? What made you choose those tools?

4) What steps did you take to pose the instructional task(s)? What tools did you use to illustrate the concept that was in the task?

5) What steps did you take to understand student thinking about [the math concept stated above]? What tools did you use to understand student thinking?

6) How similar do you think the steps you took and the tools you used to pose the instructional task were to the steps that the other teachers teaching the same lesson were? [Evidence of awareness of others' practice]

7) How similar do you think the steps you took and the tools you used to understand student thinking are to the other teachers teaching the same lesson? [Evidence of awareness of others' practice]

8) What contributes to the similarity or dissimilarity in the steps that are taken to pose the instructional task?

9) What contributes to the similarity or dissimilarity in the tools that are used to pose the instructional task?

10) What contributes to the similarity or dissimilarity in the steps that are taken to understand student thinking?

11) What contributes to the similarity or dissimilarity in the tools that are used to understand student thinking?

Appendix B: Joanne's Lesson 3.2

MODERATOR: So please open your book to page 34 so we can start by discussing that. And then we're going to go right into 3.2 today. Do you have something to do? Do you know what to do? Good. Did you give me one?

__: Yes.

MOD: Need your name on it, please. And then I want to make sure you understand what [00:02:45]. I don't want you out of your seat at all. Sit there. You want to sharpen that?

__: Yeah.

MOD: Great. All right, I think I'm settled. Paul, I need you to go to the hall. I need you to write a new [00:04:12]. All right, I'm ready. Let's go. We've got some learning to do. Yes, Hillary?

__: Are we supposed to [00:04:35]?

REVIEW OF PRIOR WORK

MOD: Thank you so much, all right. Let me just find the sheet from yesterday. Here we go. Okay, so let me put this back up here and then you can ask your question and then we'll do one and two and then we'll move on to today. Okay, so I Leah you're all listening. You're on page 34, Hillary has a question.

[00:05:00]

MOD: And to make sure you're all listening, I'm going to be asking one of you to answer it because she was the only one with a question, so I'm assuming all the rest of you know the answer, all right? So go ahead, your question for me?

__: I didn't see how you figured out the probability if all the rooms had [00:05:25].

MOD: I'm sorry, Hillary?

__: I just didn't know how you figured out the probability if all the rooms had a different one [00:05:34] .

INITIATE ACADEMIC TASK

MOD: All right, so you're not sure how to find the probability if all the rooms have a different probability?

__: Yeah.

MOD: So how would you answer Hillary's question? She's saying how would you find the probability for the great hall? How would you find the probability for the servant's chamber if all the rooms have a different probability? So what would you say to Hillary? I'll pick somebody out here for a second. Chloe? Whoops, Chloe's up here, she's not paying attention, she's focused. Did you find it? All right, so what would you say to her, Chloe?

__: I was kind of--

MOD: I know, but I'm going to reread it for you. So she's saying-- try it again, Hillary? How would you find the probability of-- are you listening?

__: Yeah, I'm listening.

MOD: How would you find the probability of the treasure being in the great hall?

STUDENT RESPONSE

__: You would find out how much [00:06:30] are in there and which was the [00:06:34].

MOD: You would take that and--

__: It'd be on the [00:06:39].

FOLLOW-UP PROMPT

MOD: We're just looking at general probability.

TAKE-AWAY POINT

__: Okay. You would find out how many squares are in essence there's permanent squares. And you take how many squares are in [00:06:48].

NEXT ACADEMIC TASK

__: I got, I think-- sorry. I think I had a problem with C. If you played it ten times, how many would you expect?

__: How many times would you expect it to be hidden in the great hall.

MOD: Okay. And that's a good question, and I'm going to go back because I think I didn't give a great answer yesterday, and I want you to have a great answer before you do homework tonight. All right, so the great hall, the probability of the treasure being in the great hall would be 30 out of 100, correct? All right, so if you have 30 out of 100, let me see if I can get somebody to say. So now we know that the probability is 30 out of 100 for this great hall. Is that right? Yes. And if we play this game ten times-- Isabella, I Leah you're thinking up here-- if we play this game ten times, how many times would you expect the treasure to be hidden in the great hall and why? That's what you're asking, right? Because she's not understanding that.

MOD: Ronald, what would you say? How would you answer?

__: Three times.

MOD: Three times you're saying. Why, she wants to know? How do you get three?

__: Because if you could count from zero to thirty and take the zero from ten, then you have 100. And it leaves it ten.

MOD: So if I take off those zeroes, I have three tens?

__: Yes.

MOD: But you didn't say three tens, you said three.

__: Three tens [00:08:23].

MOD: Pardon?

__: Three times you find it [00:08:27].

MOD: Three times what?

__: Three times you'll find it in the great hall.

MOD: Well, this is just saying the probability of finding it is three out of ten, right? So, help her to understand how we find that for ten times. Do you want to try helping, Sally?

__: I did three tens times ten, I had three tenths.

MOD: So the probability is three tens, or three out of ten, or 30 percent. And you multiply that by ten?

__: Yes.

MOD: So then you end up with 30 over 10, which is three. Okay?

__: Yeah.

MOD: What Ronald was trying to say, I believe, and you can stop me any time and say, "No, Mrs. Foss, that's not what I was trying to say," all right? He's saying that if you look at this as instead of 30 out of 10, you divide both by ten, then this becomes three out of ten. So the answer would be three for every ten times you play, okay? Now, is that what you were thinking? So did you understand how I explained your thinking so that when I asked you to explain and I'm saying sometimes give me a little more, it's because you weren't thinking, you jumped in places which I understand, but not everybody in here.

[00:10:00]

MOD: And so when you're responding to me, you're the teacher. And you have to be not making sure that you're explaining it for me, but for 30 some other people and that all of them understand. Do you see the difference? Okay.

__: I don't understand two in follow-up.

MOD: We didn't do the follow-up yet, right? So let's do the follow-up right now, and as we go through two, if you have further questions after we go through it, then certainly ask. All right? All right, number one. The first time you play level one, the treasure is hidden in the library. What is the-- you just need your book right now. Just look in your book and think about it, all right? Great. What is the probability that the treasure will be hidden in the library the second time you play level one? And not only give me the answer, but explain why you think that way. So Christina wasn't here yesterday, so she probably hasn't thought about this yet. Craig was, though.

__: What [00:11:10] ?

MOD: I'm on question one in the follow-up, 3.1, page 34.

__: Thirty-four? Oh, okay.

MOD: I know, we did this yesterday, right? We just didn't talk about it. First time you play level one, the treasure's hidden in the library. What is the probability that the treasure will be hidden in the library the second time you play level one?

__: Twelve out of a hundred?

MOD: Twelve out of a hundred the second time? Why?

__: It's a [00:11:48].

MOD: But I've already played it once. Second time, still 12 out of 100?

__: Twenty-one out of 200.

MOD: Twenty-four out of 200 the second time?

__: [00:12:05]

MOD: Two out of fourteen the second time. Why would it be--

__: [00:12:20]

MOD: Shh. So now, you don't know what it would be. First, you said 12 out of 100. Then I questioned you, now you're saying you don't know. I want you to think a little harder. I'm trying to make sure your thinking is good and I want you to explain to them. If you think it's 12 out of 100 the second time, why? Justify your answer, defend your answer.

__: Because each time the same thing.

MOD: Each time it's the same thing? Why?

__: Here in the same group [00:13:05].

MOD: All right. You're really, really close to being complete. Can anybody add a little bit to his answer to make it more complete? Ron?

__: Well, if you play a second time, it'll just be the same. You already know where it is, so be like what-- at first, I didn't think about [00:13:27]. Because when you play one more time, it doubles. Because I said 12 plus 12 equals 24, so it would be 24 out of 100.

MOD: So you thought it would be doubled. Now, do you still think it's 24 out of 100 the second time, or 12 out of 100?

__: I'd say 24.

MOD: Twenty-four out because you're doubling it? Because you're playing it twice? So the probability of the treasure being hidden here is now 24 out of 100 because we're playing it a second time?

__: I thought it was the whole game.

MOD: We're talking about-- look at the question. The question is what is the probability that the treasure will be hidden in the library the second time you play level one?

__: [00:14:16]

MOD: Why would it be 12 out of 100? You're really close, but not completely there, Craig.

__: You're looking in the same room you look in, so it would still be the same probability [00:14:31].

MOD: Each time you play, it's going to be the same probability, right. So if there's anyone that doesn't understand why 12 out of 100, ask me now because I have a different way to explain it. But your explanation was fine. Every time you play, slate's wiped clean, the probability starts all over. Anybody have any questions about that? No? All right, great. Moving on to the next question then.

[00:15:01]

MOD: Monty says that since the computer randomly picks the location of the treasure, the treasure is just as likely to be hidden in the entrance corridor as in the great hall. Is Monty correct, and explain your answer. That person was absent yesterday. I Leah they're taking good notes today. Divina? Pull your chair all the way up to the table. Monty says that the treasure is just as likely to be hidden in the entrance corridor, right here, as in the great hall. Is he correct, and explain your answer. Would you please open your book?

__: I don't know what we're doing.

__: I don't think so because the great hall is like five times bigger than the entrance corridor. So I think that the great hall has a better chance of being hidden than the corridor.

MOD: Okay, great. So we can tell by the area of this that this has how many, 30 squares in it? So there's 30 places that the treasure could be hidden in the great hall. And the entrance corridor has--

__: Six.

MOD: Six squares. So there's only six squares that it could be hidden there. So that's obviously not the same probability as that. Leah, do you have a question or do you understand it now?

__: I get it now.

MOD: You get it now. Luke?

__: What page are we on?

MOD: We were on page 34, we were finishing up the follow-up from yesterday. All right, so today, taking a look at level two, we figured out where the treasure was in level one. We're now moving up to level two, all right? Page 34, they have a picture of level two. For the second level of the treasure on game, a player has to find hidden treasure on the second floor of the palace. Now, the second floor of the palace is for the king and queen's servants, all right? So take a look, let me put this up here real quick. King's and queen's servants. We've got different rooms, queen has a room for the ladies in waiting-- focus-- and a room for the maids. And the king, however, he's got three rooms; a room for the steward, a room for the chancellor and a room for the marshal, completely different kinds of servants there, huh?

All right. Your job, then, is to figure out the probability of things being hidden on this floor. Now, this floor is not a square like the first floor, so it's not a 10x10 grid. And you don't have any squares on it, so you're going to have to look at how you figured that probability without thinking that there's this many squares out of 100, all right? And I'm really not going to give you too many more clues than that. I want you to think about how you'd answer these questions. A is asking what is the probability that the treasure would be hidden in one of the queen's servants rooms? Now, this is a queen's servants room, and this is a queen's servants room. And then it's saying what's the probability that the treasure would have been hidden in one of the king's servants room. And this is a king's servants room, this is a king's servants room, and this is a king's servants room.

And then it's going to get more specific and ask about specific rooms. You're working with a person at the table next to you. If you have a question, you have to ask them first. Those of you that were absent, I will get your papers in a minute. They're up in the purple folder. Sean, you had a question? This paper is basically for you to draw on today. Lexie, question?

__: So are we getting the sheet for that?

MOD: You got it yesterday. You were here yesterday, it was on the back of what you had yesterday. All right, I am going to plan on discussing this in 15 minutes at the most. If you have questions in the meantime, ask the person sitting next to you. And then if they can't answer, then you can raise your hand. You don't get to get out of your seat and ask someone else. You don't get to cross the room and ask someone else. And then I'll get these papers for those that were absent.

__: Do you want us to put in any [00:19:54]?

MOD: Yes. Do all parts-- I think it's A, B, C, D and the follow-up.

[GROUP DOING EXERCISE]

[00:20:00]

MOD: Joanna, you know what? You could be working without this sheet. I don't even usually give the sheets. The conversation you have with the other person next to you needs to be about this problem and only this problem.

[GROUP CONTINUING EXERCISE]

MOD: Are you serious? Gosh, I am so old and I just don't have a good memory anymore.

[GROUP CONTINUING EXERCISE]

[00:30:04]

[GROUP CONTINUING EXERCISE]

MOD: All right. Stand up if you are not done with A, B, C and D.

END OF PART 1
BEGIN PART 2

MOD: Okay, everyone.

__: I forgot.

MOD: No forgetting. That's exactly why I said that.

__: I'm just showing you because everybody else is standing up. I can't get out of my seat. I'm serious.

MOD: I'm waiting. Still waiting.

__: She's waiting.

MOD: I don't want your help.

__: Excuse me.

GROUP DISCUSSION ACADEMIC TASK

MOD: Never asked for it, I'm good. I know what I mean. Shh. Let us talk about problem 3.2, okay?

INITIATE ACADEMIC TASK

So it says you just advanced to level two of the treasure hunt. What is the probability that the treasure is hidden in one of the queen's servants rooms? What's the probability that it's hidden in one of these queen's servants room? What do you think, Gary?

STUDENT RESPONSE

__: One half.

FOLLOW-UP PROMPT

MOD: Why? Why one half?

__: Because there's two on one side and it's exactly halfway through. So one half--

MOD: So you're saying this line right here divides the floor in half?

__: Yeah, and then the queens are on one side and the other one's on the other side.

MOD: On the other side? Craig?

__: It only asks for one [00:03:34] one of the queens rooms, not all of [00:03:39].

__: Oh, my gosh.

__: So it's one fourth.

MOD: Interesting way of interpreting the question. I understand what you're saying, but it was saying one of these rooms. So, it could mean-- what it meant is what's the probability of it being in a queen's servants room? Instead of one, put the word 'of' there, okay? Do you understand why it would be one half? I understand your thinking. Shh. Do you understand? Leah?

__: I had a weird way of doing it. I don't know if it actually worked. Since the two queen's rooms overlapped like where the king's rooms were, I put the king's [00:04:30] however you pronounce that, I put them over there, the two--

MOD: Just a moment, Leah. Listen. I'm sorry, okay. So just because it overlapped, you did what?

__: I took the top lines of those two with that one room and put them over on the other side and made three rooms for the queen.

MOD: You did this?

__: Yes.

MOD: So now the queen has three rooms? This is Chloe's room right here, right? [laughter]

__: I wish.

[00:04:58]

MOD: It's not designated. [laughter] All right. So, you were looking at it saying that you could have three rooms on each side, but it still would be one half here, right? Okay. Sally, were you talking the same way she was thinking?

__: Sort of. I was [00:05:19] in half or [00:05:24].

TAKE-AWAY POINT

MOD: Well, the queen's rooms constitute half the floor, right? So the probability that treasure would be in a queen's servants room would be one out of two, or 50 percent of the floor.

__: And I put the same answer for the king's rooms.

MOD: Oh, she's jumping ahead. So you're saying that the king's rooms, the king's servants, that would also be one out of two, or one half?

__: Yeah.

MOD: Because that makes up-- the area of it is half the floor, is that right? Okay, great. Moving on then to the next question, the next question says what is the probability that the treasure is hidden in the maid's room. Aya, we want to know, what's the probability that the treasure is hidden in the maid's room? And here's the maid's room down here. What's the probability that the treasure is hidden there?

__: Well, for the first part, I just took a line where the queen's laid in the waiting room and the queen's maid room and I split that line in half. And then put that line down, the one that Gary did. So, I said one fourth.

MOD: Would you explain what you said before the one fourth? I got the one fourth, but why don't you come up here and point-- because I'm lost. When you say that line and that line, and I'm like, "Which line is she talking about?" So just if you would explain it, then that would be a little easier for all of us to see. So go ahead.

__: I took right here and I split that in half. And then half, so about where the queen's maid's room would be, the one fourth.

MOD: So like I sort of did with the purple?

__: Yeah.

MOD: Splitting it in half? Okay. So you said one fourth, one out of four? All right. Anybody have a different answer for that that they want to discuss or talk about? Okay, how about what is the probability that the treasure is hidden in the steward's room? Lexie, now here's the steward's room right here.

__: I said one sixth, and I said that I found it two ways. But, the first way I did is kind of like Aya did. I split it up so there's six rooms. And so I said that's why I got one sixth.

MOD: Kind of like you had for-- I mean, more like what Leah had me do, draw these lines over here?

__: And then another way, I just did-- I knew that the king's was a half of it, and then-- yeah, I know that the queen's was a half of it. And then I knew that the king's was one third of the half, so I multiplied those two.

MOD: Oh, so what you were saying is that the king-- this steward's room was one third of the half of the floor?

__: And I multiplied that by half, so a sixth.

MOD: So you did one third times one half and you had one sixth? So you got it two different ways? Great. Anybody else think of it a different way? Ron? Anybody else think of it a different way? And I'll come back, because you had your hand up.

__: I'm not really sure if this is what she explained, but I kind of split it up by [00:08:51] there and these six pieces. And I saw that the steward's room had only-- it has only-- it was only one room, so one in six. So I [00:09:07].

MOD: Yeah. So she was saying so if we took this half of the second floor and we divided it up so that we had six rooms of the same size, then this is one of the six rooms, right?

__: Yeah.

MOD: All right. Your hand was up. Did you have a comment, a question? Okay, so we're good. All right, anybody else? Everybody understand this? Where are your answers?

__: Right here.

MOD: Okay, what I need you to do is now you've got your book closed in in front. I need you to take your answers out of your binder, put it on your table. I need you to take your book out and open it up to page 34 and 35. Just in the possibility that I pull your stick. Because there is like a one out of 32 chance that I'll pull your stick here.

[00:10:00]

MOD: And the probability gets higher since I've already pulled some sticks here today and we have some absent people, okay? I want you to be ready. Okay, so C says if you play the second level 100 times, how many times can you expect the treasure to be hidden in one of the queen's servants rooms? What do you think, Rachel? You play this 100 times, what do you think the probability of it being in one of these rooms here will be?

__: I think it would be--

[LOUDSPEAKER ANNOUNCEMENT]

__: I think it will be 25 for the queen.

MOD: Twenty-five that it would be on this side?

__: Yeah.

MOD: Why 25?

__: Because it's--

MOD: She's thinking like you, Craig.

__: Now I know why.

MOD: Pardon?

__: [00:11:18]

MOD: All right, back to question A, Rachel. I want you to think about this. In question A, we said that the probability of it landing in one of these rooms is one out of two, because this is half the floor. So if it's one out of two, that means if we play it two

times, one time we'd expect it to be on the queen's side, right? What if we play it 100 times, how many times would you expect it to be on the queen's side? Twenty-five? Why only 25?

__: Because the queen doesn't [00:12:14] the 16--

MOD: Shh.

__: Because she has two rooms which means it's more.

MOD: So 25 for this room, 25 for this room. How many for this whole side? Fifty. So we play 100 times, we expect it to be in one of these rooms 50 times, all right. How about on the king's side? What would we expect if we play it 100 times? Craig?

__: I said one half.

MOD: One half of?

__: A hundred.

MOD: A hundred, which is?

__: Fifty out of a hundred.

MOD: Fifty out of 100. Whoa, stop. We have homework tonight, all right? So I'm going back to what Craig just said. We'd expected to land there 50 times, not 50 over 100, but 50 times. So when you're writing answers tonight, I don't necessarily think you're going to be writing fractions sometimes. [00:13:22] whether fraction's correct or whole numbers. Chairs up [00:13:25], bye.

__: Bye.

MOD: [00:13:32] for a minute.

END OF RECORDING

Appendix C: Veronica's Lesson 3.2

[Side remarks]

REVIEW OF PRIOR WORK

INITIATE ACADEMIC TASK

Q: Make sure you have your 3.1 class work out, along with your lab sheet. And we're on page 34. Okay. So, Landon wasn't here yesterday, so can somebody tell him what we did? What did we do? Let's summarize what we did yesterday quickly. Jason, thanks.

STUDENT RESPONSE

A: There was a whole bunch of different rooms in this mansion, and we had to find what would be the probability of the treasure chest being in each room.

FOLLOW-UP PROMPT

Q: Okay. And how? How did we find the probability of the treasure chest being hidden in each room?

A: Counting the number of squares [00:07:56]

TAKE-AWAY POINT

Q: Okay. So, the level of the videogame was broken up into 100 squares. And each room-- You can see it better in your book on page 34, actually 33, to see which rooms, the treasure in each room, and then we counted the number of squares in each room and found the probability that way out of 100. Alright, Landon?

And then we also talked a little bit about if we played the game 20 times, how many times we would land in each room. So I think we stopped there. So let's take a look at that. Let's pick it up from right there.

So, let's talk about the servants' chamber. What's the probability that we're going to land in the servants' chamber? Brave?

A: That was four [00:08:57]

Q: Four out of a hundred. So, if we play the game 100 times, you would expect to land in the servants' chambers four times, right? Okay. What if we only play the game 20 times? How many times would we expect to land in the servants' chamber? Meat?

A: One?

Q: Why?

A: Because I put four out of 100, and then I did X over 20, and then I figured-- I did four divided by 100, and I got-- I forgot. 0.8 and then 0.8 times 20, and I got the answer.

Q: Okay. So, you set them up as equivalent ratios, correct?

A: Yeah.

Q: Right. We've been doing this for two units now. You guys know how to solve this. The probability of landing in the servants' chamber is four out of 100. I suggest you guys write this down.

We want to know how many times it would land in the servants' chamber if we played this game 20 times. So, set as your equivalent ratios and solve. Remember the little diagram that I made for you guys? Divide the two numbers that you know and then multiply it by the other piece. Divide and then multiply.

So, four divided by 100 is 40 hundredths, right? I don't know where you got eight from. [Side remarks] So we get four hundredths, and then you're going to multiply that by the piece that we know is 20. And .04, four hundredths times 20 is .8, but you can't land in a room .8 out of a time, right? So let's round this to one time. Not a lot, right? You played the game 20 times. Would you predict that it's going to be in the servants' chamber?

A: No.

Q: I probably wouldn't either. I probably wouldn't either. Let's talk about the Great Hall. Does anyone have any questions on how to solve this? Last time we had lots of questions on this. No? I know we went over it yesterday, but I went over it yesterday with first hour too, and they still seemed to have questions.

A: They weren't listening.

Q: Alright. How about the Great Hall? What is the probability of landing in the Great Hall? Really?

A: [00:11:40]

Q: 30 out of 100. There are 30 squares that are in the Great Room out of the 100 squares that are on the board. Good. Most of you should be writing this down, so you have this data, okay. So if we were to play this game 20 times, who can help me figure out how many times that I would land in the Great Hall? Kevin, what do you think?

A: You'd land in the Great Hall [00:12:24]

Q: So landing in the Great Hall is 30 out of 100. What if I play 20 times? How many times would you expect to land in the Great Hall?

A: Well, I want to say--

Q: Don't guess. Let's mathematically figure this out. What did I do up here to figure it out from the servants' chambers? I set up two equivalent--

A: Ratios?

Q: Good. So, what ratio should I set up here? This was the probability, and this is just X over 20 because we're playing the game 20 times. The X represents how many times we're going to land there, that treasure chest is going to be in that room is we play 20 times. So, how do you think I would set up my equivalent ratios for the Great Hall?

A: [00:13:39] and then you inverse the nominator.

Q: A little bit louder. I can't hear you. Follow the steps that I did up here. Four out of 100 was my probability for landing in the servants' chamber. What's my probability for landing in the Great Hall?

A: 30 out of 100?

Q: 30 out of 100. [Side remarks] I'm going to set that equivalent to what?

A: 4.2

Q: What did I do up here? Ask me to help you really quick, so that you can tell everybody. [Side remarks] Alright, Kevin, you were saved by the phone.

A: Isn't it six out of 20?

Q: First let's solve it. I don't know what it's going to be out of 20, but let's start with X out of 20, because this is the number we're looking for, right? We want to set

these equal to one another because if the probability of landing in the Great Hall is 30 out of 100, and I play the game 20 times, I'm going to set this equal to some number over 20. These two numbers, these two fractions or ratios need to be equivalent to one another, right, so that we can figure out what X is. Got it?

Questions? Andrew, do you have a question? You have this written down? Do you need to leave? Okay, head up then. Write this down. Here we go.

Alright. Andy, how do I solve for X?

A: I don't really get ratios.

Q: So you do scale factor, fine. How would I solve this?

A: Well, what I kind of did is I divided the 30 and the 100 both by two.

Q: Okay.

A: And I got 15 fiftieths.

Q: Okay.

A: And then, I was--

Q: Then what?

A: And then, after that I figured out that fifteen goes into fifty three times.

Q: Okay.

A: And then, I don't really know where I'm going with this.

Q: Alright. How would you solve this if you don't set up ratios? Because there are lots of ways to solve this, right? You don't always have to do it using ratios. You can do it however you want. So how would you figure it out? What did you get for your answer?

A: I got six.

Q: How?

A: Well, what I did yesterday was I thought the Great Hall had twenty-five squares, but it didn't.

Q: Oh, I see. So you thought it was a quarter.

A: Yeah.

Q: Okay, but that still wouldn't be six.

A: I know, and you said it was six.

Q: And then I said it was six, so you just wrote it down. Alright. Sam?

A: Well, 100 divided by five equals 20, so if you take 30 and divide it by five, it's six.

Q: There's one way, yes. What did you multiply by 100 to get 20 is one-fifth? This is where your scale factor would come in from, Andy. You could do-- What do I multiply by five to get 20 is one-fifth? So if I multiply 30 by one-fifth I would get six, which is the same as doing 100 divided by five gives me 20, so I'm going to divide 30 by five to get six. Anybody else?

A: Okay. So you do 30 divided by 100, and then I don't know what you did, but then you kind of get 20, and then that's it.

Q: This is, I think, one of the easiest ways, because we keep seeing it over and over again, to do it. If you set up the equivalent ratios, you divide the ratio you know, change it into a decimal, and multiply it by how many times we play the game. Okay? Questions on this? Should we do one more room?

A: Sure.

A: Yeah.

Q: Let's do one more room. Ed, pick a room in level one.

A: The conservatory.

Q: Alright. What's the probability that we're going to land, or the treasure is going to be in the conservatory? I'm sorry. I can't hear you because these guys are--

A: 12 out of 100.

Q: Good. So, I play the game 20 times. How many times do I land in the conservatory? Tell me how to set it up. You don't even need to tell me the answer. Just tell me what to do.

A: 12 divided by 100, and the answer times 20.

Q: The answer times 20.

A: Are we having a test on this?

Q: Yes. Somebody figure this out for me. It's 2.4 Can I land 2.4 times in the conservatory when we play a game? No. Should I round up or down?

A: Down.

Q: Good. I spent over a half hour yesterday with my math support class talking about when to round up or down. If it's five or greater, you round your next digit up; four or lower, you leave it the same. So, if we play the game 20 times-- nice job, Sylva-- we will land in the conservator two times. Yes?

A: I thought that [00:21:33]

Q: Typically you round up, but it depends what you're looking at, what you're doing. Any questions on this so far? Alright. Flip your loose sheet of paper over. Label it Investigation 3.2. Flip your lab sheet over and open up your books to page 34.

Alright. You guys are so good at the video game, you guys passed level one and we're going to move on to level two. [Side remarks]

Okay. So you guys did such a great job with level one, we're going to move on to level two. Okay. Cracking level two. Level two is a little bit different than level one. Obviously as you move up into more higher levels in video games, the levels get more difficult; so this level is a little bit more difficult than level one. And it's going to be a little bit more difficult to find the probability of having the treasure chest hidden in certain rooms than it was in level one. Questions or do you want to read? Question?

A: [00:24:08]

Q: Sure, here we go. Cracking level two.

A: From the second level of the treasure hunt games, [00:24:28] on the second floor of the palace. The second floor has [00:24:32]

Q: Alright. So, this is a little bit different than yesterday because level two is not a perfect square, and level two does not have grid marks like we did yesterday. So it was easy to count squares yesterday out of 100 to find the probability of having the treasure chest hidden in that room. Today's level two does not have grid lines, okay? So you need to come up with some type of idea as to how and why you're going to find the probability of landing in these rooms.

Take a look at problem 3.2A It says, "Answer each question and explain your reasoning. You've just advanced to level two of treasure hunt." What is the probability that the treasure is hidden in one of the Queen's servant's room, and in one of the King's servant's room?" So, take a look at your lab sheet and try to decide what is the probability that you're going to land in the Queen's servants' room and what is the probability you're going to land in the King's. And then, B says, "What is the probability that the treasure is hidden in the maid's room? What is the probability of landing in the steward's room?"

So you have to find me the probability of landing in the Queen's part of the floor, the rubble, and then the King's, the King's steward's room and the King's maid's room. After you're done with that, it says, "If you play the game 100 times," tell me how many times you would land in the Queen's servant quarters and the King's. You should be able to get through there in the next eight minutes, and then I'm going to stop you and discuss. You may have small discussions with your neighbors to help problem solve through this, and then be ready; I'm picking sticks. Mikala?

A: [00:26:46]

GROUP DISCUSSION ACADEMIC TASK

INITIATE ACADEMIC TASK

Q: Absolutely. [Side remarks] Alright. Let's take a look at the problem. Alright, here we go. Part A. You advance to the second level treasure hunt. What is the probability that the treasure will be hidden in one of the Queen's servant's rooms? Maggie?

Q: Maggie, take a look at the board. How much of the board is the Queen's servants' quarters? I shouldn't say quarters; that is confusing. Here's level two. How much of the board belongs to the Queen's?

STUDENT RESPONSE

A: Half.

FOLLOW-UP PROMPT

Q: The Queen's part of the board is a half, so the probability of landing in the Queen's-- what do they call it, servant's rooms-- landing in the Queen's servant's room is a half.

A: Well it says for one of the rooms, so it'd be a fourth.

Q: Okay, so you want to go a step further and say that this is a quarter? And this is a quarter? Yeah, except for the fact that it says, "What's the probability that it's going to land in one of them?" So, the probability that it's going to land in the Queen's servant's room is really a half, because it's half the board, but if you have it the other way I would be fine with that. Okay. Tell me how you got a quarter though.

A: Because the King's side of the board they're trying to come out [00:36:21]

Q: Okay, but how did you get a quarter?

A: One King's room is one quarter of the board.

TAKE-AWAY POINT

Q: Yeah. If you take a look at this whole board, you can visually see that if you cut this into four pieces, this would be one of the four. Or, could you say that the Queen's Ladies-in-Waiting's room is a half of a half? And when you say half of a half, that means multiply. Half of a half is a quarter. Good. Questions? Alright.

What is the probability that it's going to be in one of the King's rooms? So I mean the whole King's servant's areas. Andy? I already called on you once today. I'll give you a break

A: But I know the answer.

Q: You do?

A: Yeah.

Q: Go ahead.

A: 50%.

Q: 50%, a half again. So the King's is a half and the Queen's is a half. Okay? Let's move forward then. What is the probability that the treasure is hidden in the maid's room? Mike, what's the probability that it's in the maid's room?

A: 25% or one fourth .

Q: How did you get it?

A: Because it's one fourth of the board.

Q: One fourth of the board, okay. So, some of you could just look at it and see immediately that it's one fourth of the board; some of you needed a little more math. Great. What is the probability that we're going to be in the steward's room?

So this, the King's side of the board is a half, right? Then what happens to the King's side that's a half? It gets broken up into two?

A: Three.

Q: Three. So, while it would be one out of three, yes, but it's one out of three times a half is? One sixth. How many of you said that the King's steward's room is one sixth? The probability of the treasure being in the King's steward's room is one sixth. Greg, what did you get?

A: [00:38:52]

Q: You did it out of 100. How?

A: [00:39:04]

Q: Okay. This level has nothing to do with the last level. Look at how we're breaking this up. This is half the board. This is half the board. Alright, Greg? Half the board. And then Andy and Pat told me that if you take this board and cut it in half, half of a half is a quarter.

A: Oh no, that was me.

Q: Yeah, but he told me too, and Mike.

A: That was me.

Q: And then, Bre said, "Oh, well, if the King's servant's rooms is half of the board, and they cut it up into three pieces, one, two, three, one, two, three, then this side of the board is a third times a half, because it's a third of a half. And when you say the word "of" it's multiply, so I get one sixth. So the King's steward's room is a sixth. The King's chancellor's room is a sixth. And the King's marshal's room is a sixth. Okay?

A: [00:40:47]

Q: Yeah, I'm not on D. I'm still on B.

A: Oh, yeah.

Q: Alright? Questions. We're good? Now let's move on to C. No one has any questions on this?

A: No, it's easy.

A: [00:41:12]

Q: But we can't break it up into 100 even pieces, because we don't know how many are in that. Does this make more sense? Okay. Put that away please. Alright, now let's take a look. If we play this game 100 times, how many times do we expect to land in each room? So, really, we only have two probabilities that we need to worry about, right? Because we have a fourth or a sixth for each of the rooms.

So, if I play this game 100 times, tell me how to set this up, Erin. Let's do the Queen's servant's room. What is the chance that I'm going to land on the Queen's side of the board?

A: 50?

Q: 50%, so if I play it 100 times, how many times am I going to land on the Queen's side of the board? 50 times. That one was easy; no math needed. Okay? What about landing in the King's servant's rooms? Karen?

A: For C or D?

Q: C.

A: I got 50 over 100.

Q: So, 50 times, good. If we played the game 100 times, 50% percent of the time, or 50 times you're going to land on the King's side of the board. Good. Alright, what about how many times would you land in the maid's room? Landon, this is part D. How many times would I land in the maid's room? Why?

A: [00:43:24]

Q: Yeah, good. So, a quarter set up to 100 is X-- equivalent ratios. One divided by four is 25 hundredths. 25 hundredths times 100 is 25. Good. Mentally, most of you could have done this, yes? Right, Andrew? Questions?

How about the steward's room? Matt, how many times am I going to land in the steward's room if I play the game 100 times?

A: [00:44:13]

Q: How'd you get it?

A: 50 divided by three would be around 17.

Q: Three divided by-- What did you divide?

A: One third.

Q: One third of fifty. What a great way to do that. And you rounded. Wonderful. Could you set up equivalent ratios? Yes, we could have said one sixth is equal to X over 100; divide, multiply. You should get like 16.6. Better? Questions on C or D? We're good with that? Jason? Okay.

Let's take a look at the follow up. Read problem number one for me please, Katie who hasn't been here all week.

A: She's sick.

Q: Sally.

A: You've just advanced to level two. What is the probability that the treasure is hidden in one of the rooms on the second floor? Explain how you determined your answer.

Q: What did you say?

A: I asked you, and you didn't answer my question.

Q: Really? When did you ask me?

A: Up there.

A: And you walked away.

A: I went to go do my book to read you the question, and then you walked away.

Q: And you didn't come find me?

A: No, because then you started speaking.

Q: Oh. Sally, reread the question slowly, and tell me what you think.

A: You have just advanced to level two.

Q: Level two.

A: Okay. What is the probability that the treasure is hidden in one of the rooms on the second floor?

Q: Second floor.

A: Is that going to break?

Q: I know; no wonder this doesn't work by the end of the year, right? What's the probability that it's going to be in one of these rooms if you're playing level two?

A: 100%

Q: So what's the probability? It's going to be-- If we're playing level two, it's absolutely going to be in one of these rooms, right? Okay. Did I answer your question, Sally?

A: Yes.

Q: Great. Allison, will you read number two for me please?

A: Yes. You have just advanced to level two. What is the probability that the treasure is hidden in the cook's room?

Q: Okay, we're playing level two. Here is level two. What is the probability that we're going to land in the cook's room, Allison?

A: Zero.

Q: What? Why?

A: Because there's no cook's room.

Q: There's no cook's room. The probability of landing in the cook's room on level two-- I'll wait for you guys; still waiting-- is zero. It can't happen. On level two, we do not have a cook's room, okay? We do not have a cook's room. It's not going to happen.

A: [00:47:50]

Q: They are one sixth of the board. The other thing that first hour did too, you guys, is they took the board and they drew a few more lines than we have up here. So they cut the room into, they cut the King's steward's room and the King's marshal's room in half, and extended those lines, and realized that then you have 12 equal pieces-- one, two, three, four, five, six, seven, eight, nine, ten, eleven, twelve-- so then you could set up your probabilities to all have the same denominator, so the Queen and Ladies' room would also be three twelfths, and the Queen's maid's room would also be three twelfths, and the King's steward's room would be two twelfths, and the King's chancellor's room would be two twelfths, and the King's marshal's room would be two twelfths. Okay? Nikita?

A: Can you pull that down?

Q: Oh yeah, sorry. I pulled it up for me. Any others? Okay. For those two of you that are showing up today after school to take the test, they're reporting here first. Report here right after the bell with all of your stuff to go home-- your coat, your backpack.

FEMALE: A few minutes before 3:00 if possible, because we're going to take you somewhere else, and then I have to be someplace at 3:00.

Q: So you have a four minute passing time from after sixth hour to get here. Four minutes. Whoa, I'm still talking. I have a few of you that are still missing more than two assignments. I am going to give you a academic lunch slip. Hold tight. I'll wait. I'll wait. If the bell rings, please don't leave. Still waiting.

A: I have to go somewhere else.

A: Yeah, me too.

Q: If I'm giving you one of these, this means that you must report to academic lunch until the end of the quarter unless you've turned in all assignments except one. Now, if you are reporting somewhere else, it is your responsibility to bring me a note from where you were during lunch the next day. Otherwise, if you miss twice, I'm referring you to the office, because we are close to the end of the quarter. I will not accept any late work, any more missing assignments after next Thursday. Next Thursday is the last day of the quarter. I'm closing up my books Thursday afternoon unless you're absent. Questions?

Okay, your homework for tonight, page 36 through 38, one through six, and seven and eight are the extensions. Please don't come without it. Andrew, come grab your slip. Landon, come grab your slip. Right there, Andrew. Marlena, Sylvia, Bre

END OF AUDIO

Appendix D: Stacey's Lesson 3.2

Q: Aces are out, warm-ups are being worked on. I did not pass your quizzes back, because some of you [00:01:06] Alright, if I get to your seat and you don't have it ready I'm moving on; I'm not wasting time. [Simultaneous conversation]

Excuse me. Go over there. I'm not talking about it. [Side remarks]

Okay, quicker reminder if you took a look at the board. We have Ace two through four tonight, and you have warm-ups due tomorrow, so if we're not even eight columns done with warm-ups, then I would be concerned that you have more homework than usual tonight. So, keep that in mind and do your work. Give yourself a goal, maybe two or three problems.

Alright. Go ahead and put your warm-ups away. Make sure you're putting them in a neat, organized fashion. Here comes Ace. Wait, before I show Ace, real quick.

REVIEW OF PRIOR WORK

INITIATE ACADEMIC TASK

So, what do you play? I'm hearing you play games. I'm hearing Call of Duty out there a few times. So, here is my question. Rick, since you can play Call of Duty quite often from what I'm hearing, Rick, if I asked you how many times you played, let's say, the whole game. I don't understand Call of Duty, so you have to ignore my ignorance on this.

So, how many times did you play last night? Or, in the weekend? Put it that way.

STUDENT RESPONSE

A: Like how long?

Q: How many times did you play?

A: How many games? How many matches?

A: Maybe like 10.

Q: 10, okay. Anybody else play anything?

A: I played the same thing.

Q: How many times did you play?

A: Nine.

Q: What do you play?

A: I play Grand Theft.

Q: Alright, and how many times did you play?

A: Only about seven in this last week.

Q: Seven, okay. What do you play?

A: I play Black Ops and I played it like 10 times.

Q: What do you play?

A: Black Ops, 14.

Q: 14? How many times do you play?

A: 28.

Q: 28. Now, here's my thing. All of you heard the same answer, right?

A: Yeah.

FOLLOW-UP PROMPT

Q: Did anyone say, "I played eighteenths of a hundred times"?

A: 18s?

Q: No, no, 18 hundredths of a time. Rick, I want you to go home tonight and play 18 hundredths of a time.

A: 18 times? [Simultaneous conversation]

Q: Did anybody say that?

A: No.

TAKE-AWAY POINT

Q: So, here's my question on Aces. When I came around and I said, all of you, I circled on your paper, "Your answer doesn't make sense," because if you looked at Ace and you slowed down a little bit-- hint, hint, hint-- and on number five-- I'm getting there in my book. For number five, it asked, C and D, "If level one had [00:10:45] how many times out of 100--" How many times? None of you said 15 over 100 or 18 hundredths, did you? Okay? You didn't say a fraction, so I don't understand on C and D why you would give me a fraction. Does that make sense?

This is what I worry about when it comes to Monday's quiz is that some of you aren't going to take a minute to slow down. And it says, "How many times--" and you're going to give me a fraction again, and I'll mark it wrong. Yeah, some of you gave me the right fraction, 15 over 100, but how many times is that? 15. Does that make sense, yes or no? Yes? Okay, Meagan.

A: [00:11:30]

Q: So when you're checking Ace, all of you that I circled that on your paper, I Leah you're taking your correcting pen and you're writing in the right answer and making yourself a mental note, because on the quiz or test I'll mark it wrong. And it's simply slowly down and asking yourself, "Does my answer make sense?" If someone said, "Hey, I'm going to the casino night and I'm going to play one half a hand of blackjack" the dealer might deal me out because he thinks I'm crazy. So you have to consider what you're putting down. Make sure when you're going through Ace and on the problems you're answering the question.

Six and seven is on there. You didn't have that, but two years ago I assigned it, so no big deal. Okay. Questions on Ace? I really feel like with last night's Ace a lot of us are picking this up, they understand the questions; you had no problems giving me a straight answer. So, the only red flag I saw on this was five C and D, which hopefully we all understand.

Alright. I am collecting homework tomorrow, so make sure you're putting your Ace away, and copy investigation two and three Ace together, so organize your stuff, put it where it's supposed to go. Let's not just stuff it in the random, unknown dark hole, and you need to get out-- Yeah, dark hole for sure.

You need to get out yesterday's problems. I'm looking at the back. You can also get out yesterday's problem 3.1. We're going to work on the front of-- You can work on the back of problem 3.2. [Side remarks] And also, on page 34--

So, books open to page 34, problems out. Books open to page 34, problems out.

A: Page 34?

Q: Page 34, right after 35, or 33. 34. You can use yesterday's problem, the back of that sheet, so we're not using double paper, if you like. Okay, I'm still waiting. 34. Dave, Katie, 34.

Alright, level two. Cracking level two. So yesterday we talked about level one. It was a complete perfect square. You guys could break it up into a 10 x 10 grid. Now we're looking at level two. For the second level of the treasure hunt game, a player must find the hidden treasure on the second floor of the palace. As in level one-- Sorry.

The second floor has rooms for the King and Queen's servants. As in level one, the computer thinks of the floor as a grid, and hides the treasure by randomly selecting a grid square. However, notice the floor of level two is not a square. It's a rectangle, right? So, off the top of your head, is this going to pose a problem for us or is this going to make things easier or harder? What do you think? What's your gut say?

A: Easy?

A: Harder.

Q: What made your gut say it's easy?

A: Because the rectangle, they have lines here, so you can just go across like that.

Q: I like your thinking. Alright. Taylor, what do you think?

A: I'd have to say easy, kind of the same thing that Mark said.

Q: Okay, we have two easies. Meagan, what do you think?

A: I think it's going to be somewhat hard but somewhat easy, because they can still divide it into squares.

Q: What kind of squares would I divide it? Because I couldn't put a 10 x 10 grid in there. Excuse me, I'm sorry. I'll wait for you. I asked the question, but Tommy think it's more important, whatever he's talking about, so I'll give him a second. Alright.

A: You could do a 10 x 8 grid.

Q: A 10 x 8 grid. Okay, so a 10 x 8 grid. What if I said the maid's quarters is 39 over eightieth? Would you be able to know that percentage?

A: No.

Q: So that would might be where the difficulty come in? Okay. I like your thinking. I like how Meagan said, "We couldn't use a 10 x 10" but she said, "we could use a 8 x 10." The only hard part about an 8 x 10, it's not as even, so I couldn't say, "Oh that's 20% or that's 33%" like we did yesterday. So, I like how Barry and Taylor saw it, the easiness part of it, but then I also enjoyed how Meagan was like, "Well it could be, but we could do something different." Meagan, you want to answer it?

A: Yeah. I think it would be kind of easy to predict how much they are, because I didn't realize it.

Q: So you think it would be a little easier to just visualize, pull out the grid and just visualize it.

A: What I'm trying to say is I could tell you what percentage the Queen's maid's room is.

A: Me too.

Q: Alright. So, we're going to put it to the test then. So, what you're going to work on today is problem 3.2 A, B, and C. I want to draw your attention to C and D, that if you play the second floor and 100 times. So, if it's 100 times, should I see a fraction on anyone's paper?

A: No.

Q: No, so let's make sure that we are slowing down, making sure we're answering that question. And what, Barry? It makes sense. Good? Then follow-up one and two. Yes, follow-up one and two is that easy. I feel like some of you are going to come up to me and be like, "Really? This is the answer?" And I'm going to look at you like, "Yeah, it is." So, follow your gut on this. Read it. Don't read into it. Just read it. It's that easy. Alright. Any questions for me?

While I have you here, turn to page 37 real quick, because some of you are going to finish this problem and follow-up quickly, and I wanted to look at Ace. Ace homework tonight, do you see where it has three dartboards at the top, two, three, and four, A, B, and C? So you're going to answer two A, B, and C, and when you go to three, you're going to answer those same questions again, three A, B, C, and four A, B, C. Does that make sense?

A: Yes.

Q: So you're using different dartboards but the same questions. So that's Ace. If you get done with problems and Ace, then holy-moley, you're on fire, and we're all going

to do awesome tomorrow, but this should only take us 15 minutes max. It's that easy. You may work with a friend of your choice, and let's do some work. [Side remarks]

If we're already not working, we're not picking good partners. Ladies, let's go. [Side remarks]

Make sure you answer all questions on the follow-up, or the problem. [Side remarks]

Alright, let's move ourselves back to our seat. [Side remarks]

I should see the problem out on your desk, so I don't call on you and you give me this, "Hold on; I'm looking for it; hold on" stuff. You're looking at the problem on your desk, Aces put away.

GROUP DISCUSSION ACADEMIC TASK

INITIATE ACADEMIC TASK

Alright, first one. First one is going to ask you about, "You just advanced to level two in the treasure hunt. What is the probability that the treasure is hidden in one of the Queen's servant's?" What did you get?

STUDENT RESPONSE

A: I got 50 out of 100.

FOLLOW-UP PROMPT

Q: 50 out of 100, 50%, one half. How do I look at it? What? 50 out of 100 is also reduced to one half.

TAKE-AWAY POINT

A: It's 50/50.

Q: 50/50.

NEXT ACADEMIC TASK

What about the Queen's room? Freddy, the Queen's room. Or, the King's, I'm sorry. Second part of A.

A: I'm still looking.

Q: I should throw my stick at you. Alright, I will skip you and you get B, so locate it quickly. Melanie, what's the King's room.

A: A half.

Q: Half or 50%. Fred, are you there yet?

A: No.

Q: I'll move on. Matt, what is the probability that the treasure is hidden in the maid's room?

A: One fourth.

Q: One fourth. It's one fourth of the total. Nice job, Matt. What about the steward's room, Freddy/

A: One sixth.

Q: One sixth. Katie, if you play the second level 100 times, how many times can you expect the treasure to be hidden in the Queen's servant's room?

A: 50?

Q: 50 times, because it's half. Tommy, what about the King's rooms? How many times could I expect it?

A: 50 times.

Q: 50, that is correct. Good job. D. If you play the second level 100 times, how many times can you expect the treasure to be in the maid's room, Taylor?

A: 25.

Q: And how did you get 25? Is that your lucky number?

A: No, I kind of figured you could take one of the Queen's rooms and put it where the King's rooms are.

Q: Yeah, you could look at it that way, how many times 25, 25, 25. Or, some of us did, one fourth of 100, we actually did the multiplications. Ray, I'm sorry, did you want to finish? I can sit down. I love to take breaks. You're talking, so I want to make sure you got enough time.

A: That's okay.

Q: You're sure? Okay. Leslie?

A: So for the maid's room it's 25 times?

Q: 25 times, because we said it's one fourth of the whole, right? So it's one fourth of the whole; if I played it 100 times, one fourth of 100 is 25.

A: Okay.

Q: Makes sense?

A: Yeah.

Q: Matt, what about the steward's room?

A: Steward's room-- I forgot which question were we on.

Q: We're on D.

A: D? I said, the steward's room, 16.

Q: 16. Why not 16.6666 or whatever it was?

A: Because there's three of them, and because you can't get a half of a room.

Q: Right, or a half a turn, so that's why you went lower. I like that. So if you put about 16 or 16. It wouldn't make sense to put 16.3 or 16.8, because I can't play that many times. Nice job.

You have just entered level two. What is the probability that the treasure is hidden in one of the room's?

A: 100%

Q: 100%. No matter what, it's going to be there. So it's 100% legit. Then you've got two. Ms. Wiles, can you show me where the cook's room is? Can you show me where the cook's room is?

A: There is none.

Q: There isn't one. So what's the probability of getting in there?

A: Zero.

Q: Zero. Alright, you have approximately-- wow-- 10 minutes? Wow.

A: Bonus.

Q: Bonus is right. It doesn't happen often. [Side remarks]

Alright, quizzes. Taylor. Okay, 100%s. First one up is Rick. You can clap a little bit. Second one, Kaitlin. Third one, Katie. Leah, 100%. Jeff, 100%. Tommy, you're up. Jake.

A: What'd you get?

A: 18 out of 20. That's actually really good for me.

Q: Taylor, 100%. Matt, 100%. Josh, 100%. Barry, 100%. Melanie, 100%. Ray, 100%. Dave, 100%. Don, Karen. Ryan, 100%. Freddy, 100%. Monty. Ray-Ray, 100%. Meagan, 100%. Carrie. Mitsie, 100%.

Alright, I love the work I'm seeing, but you still have time. There's still plenty of time to get things done. I shouldn't see pencils not moving or I'll start the next thing. I'm ready to work. [Side remarks]

Let's focus. We still have five minutes. [Side remarks] For tomorrow, my expectation is that you have warm-ups and Ace done. [Side remarks]

END OF AUDIO

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