

A Complexity Analysis of Two Teachers' Learning from Professional Development: Toward an Explanatory Theory

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A COMPLEXITY ANALYSIS OF TWO TEACHERS' LEARNING
FROM PROFESSIONAL DEVELOPMENT:
TOWARD AN EXPLANATORY THEORY

Dissertation
by

MEREDITH C. MOORE

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ABSTRACT

A Complexity Analysis of Two Teachers' Learning from Professional Development: Toward an Explanatory Theory

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Chair: Dr. Marilyn Cochran-Smith

Professional development is widely viewed as a key lever for school change. Each year, federal and state governments pour billions of dollars into developing teachers, while researchers seek to identify which professional development programs are most effective. However, even as consensus has been growing in the research and policy communities about what constitutes high-quality professional development, teachers continue to vary greatly in what and how much they learn through such programs. There is no theory of teacher learning that explains this variation. In this dissertation—a comparative case study of two teachers from the same school who were participating in the same professional development initiative—I used complexity theory as a lens to understand teacher learning as a complex system. The intention was to develop causal explanations of teacher learning that accounted for the interactions between a particular teacher, a particular school, and a particular professional development.

Data analysis revealed that whether, what, and how the teachers learned through professional development was contingent upon learning conditions that resulted from three intersecting systems: the teacher, the school, and the professional development. Although they were colleagues, the two teacher participants experienced professional

development under different learning conditions, resulting in different learning outcomes; one teacher changed little, while the other ultimately transformed some of her beliefs and classroom practices. I found seven structural elements, across the three system levels, that shaped the system of teacher learning. Based on my analysis, I propose an analytic framework that can be used to analyze the conditions within and the interactions between the three systems. By offering a new means to analyze professional development through a complexity lens, this study contributes to a broader understanding of teacher learning. There are also important implications for designing and selecting professional development that will meet the needs of individual teachers in specific school contexts.

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CHAPTER ONE

A Linear Model for a Complex Phenomenon: The Problem of Professional Development

For the past two decades, student achievement, as measured on standardized tests, has been the focus of many conversations about education in the United States. The conversation turns to teachers when students fail or do not measure up to global competitors. Administrators, policymakers, researchers, parents, and children alike blame the teachers. The belief that teacher quality is the key driver of student achievement has been bolstered in recent years by research relating variation in student achievement to differences between teachers (e.g. Gordon, Kane, & Staiger, 2006; Hanushek & Rivkin, 2012).

In this high stakes climate, professional development is viewed as a key lever for change. The basic theory of change underlying many professional development efforts is a linear model with three main parts: (1) professional development leads to (2) change in teachers' classroom practice, which leads in turn to (3) improvement in student learning outcomes (Desimone, 2009; Guskey, 2002; Opfer & Pedder, 2011). There is disagreement about how exactly change in teachers' practice comes about. Some models propose that professional development can cause change in teachers' beliefs and attitudes, leading them to alter specific classroom practices (e.g. Desimone, 2009), while other models suggest a change in beliefs and attitudes occurs only after teachers observe improved student outcomes (Guskey, 2002). Regardless of how the change occurs, it is

widely agreed that professional development can bring about positive changes in the classroom, leading to better student outcomes.

Professional development is a regular part of the work lives of teachers in the United States. Many states oblige teachers to participate in professional development to maintain their license. For instance, Massachusetts requires 150 professional development points, or roughly 150 hours of professional development, every five years (MDOESE, 2017). In a major report commissioned by the National Staff Development Council (subsequently renamed Learning Forward), researchers Wei, Darling-Hammond, and Adamson (2010) found that the number of teachers participating in professional development was on the rise; 88% of teachers reported participating in content-focused professional development, 67% in technology-focused professional development, 62% in professional development on reading, and 46% in professional development on discipline and classroom management. Although a more recent comprehensive report is lacking, it is likely that professional development participation has continued to increase in the past eight years, incentivized by the Obama administration's Race to the Top competitive grant program. Premised on linear models of change, Race to the Top provided additional funding to states that met certain criteria, including developing teacher evaluation plans that tied teacher ratings to student achievement data (so-called "value-added" measures), and using these evaluations to inform decisions regarding professional development (USDOE, 2009).

All of this professional development requires a significant investment of monetary and human resources at the federal, state, and district levels. The federal government spends billions of dollars annually on professional development (USDOE, 2017). In

recent years, many school districts have created new professional development coordinator positions. These administrators are tasked with creating a coherent professional development strategy for the district and ensuring the provision of high quality professional development, led both by outside providers and district personnel, at no cost to the teachers.

As researchers and policymakers have focused on rethinking professional development, there has been a growing interest in job-embedded professional development, which refers to teacher learning that is grounded in day-to-day teaching practice and is primarily school- or classroom-based (Croft, Coggshall, Dolan, & Powers, 2010). In particular, many have argued that school-based communities of teachers with common goals of learning from practice and improving instruction should play a central role in professional learning (e.g. Hargreaves & Fullan, 2012; Little, 2006; McLaughlin & Talbert, 2006). In its Standards for Professional Learning (2011), Learning Forward, a major professional association devoted to educator professional development, calls for learning communities, stating, “Professional learning that increases educator effectiveness and results for all students occurs within learning communities committed to continuous improvement, collective responsibility, and goal alignment” (Learning Communities section). The last fifteen years have seen a proliferation of school-based teacher learning communities, taking different forms and serving a variety of purposes, under names such as professional learning communities, critical friends groups, inquiry communities, study groups, and data teams (Cochran-Smith & Lytle, 2009; Croft et al., 2010).

The Problem of Professional Development

In recent years, professional development has also received much research attention. The largest strand of research focuses on program effectiveness. Single program research studies looking at the overall effectiveness of particular professional development programs or approaches are common (Goldsmith, Doerr, & Lewis, 2014; Hill, Beisiegel, & Jacob, 2013). A smaller subset of this research strand compares programs to identify the key characteristics of effective professional development (e.g. Desimone, 2009; Garet, Porter, Desimone, Birman, & Yoon, 2001; Heck, Banilower, Weiss, & Rosenberg, 2008). There is now a general consensus in the research community about what constitutes “high quality” professional development, which has begun to inform policy as well as practice (Darling-Hammond et al., 2009; Desimone, 2009; van Veen, Zwart, & Meirink, 2012).

However, participating in “high quality” professional development is no guarantee that teachers will actually change their classroom practice, let alone that their students will perform better. Researchers who have compared the experiences of multiple teachers participating in the same professional development have found considerable variation in the extent to which they change or “improve” their classroom practice (e.g. Brownell et al., 2014; Spelman & Rohlwing, 2013). Some teachers make dramatic changes to their practice, while others make superficial changes or, in some cases, no changes at all.

Why do some teachers change more through professional development than others, and how does this change take place? A decade ago, Kazemi and Hubbard (2008) noted that little is known about “the mechanisms by which some teachers learn more than others or experiment with practice more than others” (p. 432). They called for research

that examines whether and how teachers' participation in various settings, including their classrooms and formal professional development activities, coevolve over time. In a 2014 review of the literature on mathematics teachers' learning, Goldsmith, Doerr, and Lewis echoed the call to explore how learning occurs, exhorting researchers to stop treating teacher learning as a "black box:"

We should not focus on *whether* a program is effective (as if effectiveness is a global characteristic of the program), but rather on *how* it works in particular settings to promote teachers' learning, and what learning pathways look like for teachers with different belief and knowledge systems, and different pedagogical practices. (p. 21)

Effectiveness studies fail to account for the conceptualization of learning as a process of active construction in which learners make meaning of new ideas and concepts through the lens of their existing knowledge and experiences (Bransford, Brown, & Cocking, 2000; Sawyer, 2014). They miss the importance of individual and contextual differences for teachers who participate in professional development. In sum, the dominant strand of research on professional development, which employs a linear view of change, has not been able to explain the dramatic variations in teacher learning outcomes that occur following professional development.

Rationale and Research Questions

Complexity theory, which I describe at length in Chapter Two, offers researchers a lens for understanding complex phenomena, like teacher learning, that cannot be explained in terms of simple, linear causes and effects (Byrne & Callaghan, 2014). In this dissertation, I take the stance that teacher learning through professional development is a

complex phenomenon and that it needs to be researched as such. Following Opfer and Pedder (2011), I conceptualize teacher learning as a complex system, evolving at the intersection of the teacher-as-system, the school-as-system, and the professional development activity-as system. While some researchers have begun to explore how teachers learn through professional development (e.g. Coenders & Terlouw, 2015; Gallucci, 2008; Raphael, Vasquez, Fortune, Gavelek, & Au, 2014), there is a need for more research in this area, specifically research employing complexity theory, to detect the wide variety of learning pathways that occur for different teachers and in different settings. Ultimately, we need causal explanations that can explain under what conditions, why, and how teachers learn, and which may help us to generate an explanatory theory of teacher learning through professional development (Opfer & Pedder, 2011).

This study was designed to shed light on teachers' learning processes by using complexity theory to explore two teachers' coevolving participation in professional development activities and in their classrooms. The teachers, Kelly and Martina, were participants in a large, curriculum development project on Language Awareness and Dialogic Reasoning (LADR)¹. Over the course of three years, researchers collaborated with teachers at multiple schools to develop an English language curriculum for emergent bilingual students in the upper elementary grades. The curriculum consists of text-based lessons that are designed to foster language awareness and skills, oral language proficiency, and reading comprehension. During the 2016-2017 school year, the teachers implemented the curriculum in their own classrooms while simultaneously participating in a teacher working group, which was a researcher-facilitated, school-based, teacher

¹ The project and all project participants are referred to by pseudonyms for the purposes of confidentiality.

learning community. I was a research assistant for the larger curriculum development project and a co-facilitator for the teacher working group at the Bilingüe School where Kelly taught 4th grade and Martina taught English as a second language (ESL).

This study uses data drawn from the larger Language Awareness and Dialogic Reasoning curriculum study. This study addressed the following research questions:

1. What is the nature of four, complex, nested, and overlapping systems: a professional development initiative that grew out of a university-school research partnership, the school in which the professional development occurred, and two teachers who participated in the professional development?
2. What do two teachers learn about language-focused instruction for emergent bilingual students in the course of participating in the professional development initiative?
3. How do three complex learning systems (the teacher, the professional development, and the school) interact and combine to influence the teachers' learning?
 - a. What are the control parameters and complex, contingent, causal mechanisms that promoted or hindered their learning?
 - b. What role do the actions of the facilitators play in influencing their learning?

Overview and Organization of the Dissertation

The overarching argument of this dissertation is that whether, what, and how a teacher learns through professional development is contingent upon learning conditions that result from the interaction of the teacher, conceptualized as a complex learning

system, the school conceptualized as a complex learning system, and the professional development program conceptualized as a complex learning system. Based upon my findings, I assert that learning conditions can be categorized as: 1) stasis conditions, which permit minimal learning; 2) modification conditions, which promote incremental, additive learning; or 3) transformation conditions, which allow for radical change. This dissertation makes three sub-arguments to support this larger claim. First, I argue that while structures within the school-level and the professional development-level systems can create conditions that support or constrain teacher learning, it is the congruence between these two systems that is a key determinant in shaping teacher learning conditions. My analysis shows that the teacher learning conditions were far from optimal within the Bilingüe school-level learning system and the Language Awareness and Dialogic Reasoning Project professional development system, and that a degree of dissonance between the two systems adversely impacted learning conditions. Second, I argue that school- and professional development-level structures interact with teacher-level structural elements to shape the learning conditions for individual teachers. Altogether, I found that seven structural elements, across the three system levels, shaped the system of teacher learning. I demonstrate that, although they were colleagues at Bilingüe, Kelly and Martina experienced professional development under different learning conditions. My third sub-argument is that different learning conditions allow different complex, contingent, causal learning mechanisms to operate. When teachers experience professional development under stasis conditions, the learning mechanisms that tend to operate are weak, bringing about little change. However, modification conditions permit mechanisms of moderate strength, and transformation conditions allow

for strong mechanisms. Overall, I argue that understanding teacher learning during professional development requires analysis of the conditions within and the interactions among the three systems. Drawing on the data collected for this study, I propose an analytic framework that I utilized to analyze the two cases of teacher learning during professional development. I posit that this tool may also be useful in helping to develop an explanatory theory of teacher learning through professional development.

In Chapter Two, I present the two theoretical frames that informed the study: complexity theory and sociocultural theory. I unpack key concepts from both theories and explain how I anticipated using them together to generate causal explanations of teacher learning through professional development. I then review several bodies of empirical literature related to teacher learning through professional development, including research on professional development effects, facilitation of professional development, individual factors that influence teacher learning, teacher learning processes, and school-level factors that influence teacher learning. In order to both organize and critique the literature, I used as a frame the conceptualization of teacher learning as a complex system, evolving at the intersection of the teacher-as-system, the school-as-system, and the professional development activity-as system (Opfer & Pedder, 2011).

Chapter Three describes the research design of this qualitative multiple case study. I discuss the challenging methodological implications of complexity theory. I lay out my case study design and briefly introduce the Bilingüe school, the Language Awareness and Dialogic Reasoning Project, and the two teacher cases, Kelly and Martina. In this chapter I also discuss my own positionality as a researcher and

professional development facilitator. The chapter then details the methods that I used to collect and analyze data.

Chapter Four is an analytic description of the school-level learning system and the professional development system in which the two teacher cases were nested. This description offers necessary background for my subsequent analysis of what and how the teachers learned. In Chapter Four, I illustrate how the structures of both the professional development system and the school-as-system limited the possibilities of teacher learning. I discuss areas of congruence and dissonance between the two systems that further impacted what teachers could learn.

Chapters Five and Six present the findings from the two teacher cases. Chapter Five begins with an overview of the analytic framework for teacher learning through professional development that I developed through my in-depth analysis of the data. The framework focuses on the control parameters that created professional development learning conditions as well as the complex, contingent mechanisms that allowed learning to emerge. I then use this framework to theorize Kelly's and Martina's learning from the professional development program.

Following the overview of the analytic framework, Chapter Five focuses on Kelly as an illustration of professional development under stasis conditions. I show that school-, professional development -, and teacher-level control parameters combined to create conditions in which it was very difficult to learn much from professional development. I show that Kelly learned very little about language-focused instruction through her participation in the Language Awareness and Dialogic Reasoning professional development, and I analyze how the learning conditions led to this outcome. In Chapter

Six, I present the case of Martina, which is dramatically different from the case of Kelly. I divide Martina's learning process into two stages. During the first seven months of the school year, modification conditions permitted Martina to make incremental changes to her knowledge and practices. Transformation conditions began to develop, and the last two months of the school year saw a radical change in Martina's beliefs and classroom practice.

Finally, Chapter Seven summarizes the main findings of this comparative case study and offers implications for theory, research, practice, and policy. I discuss the limitations of sociocultural theory for analyzing teacher learning, arguing that the more holistic view offered by complexity theory is necessary for understanding teacher learning. This chapter also elaborates on the connections between the findings of this dissertation and the relevant literature on teacher learning and professional development. Ultimately, this dissertation challenges the popular, linear notion that professional development should cause teacher learning, as long as it includes specific features. Instead, it offers an approach for thinking about teacher learning holistically, which can explain the dramatic variations in learning outcomes that follow professional development. I suggest new directions for research using this approach. The chapter concludes with implications for policymakers, administrators, and professional developers to assist in the design and selection of professional development that is congruent with specific schools and specific teachers.

CHAPTER TWO

Complexity Theory, Sociocultural Theory, and Teacher Learning through Professional Development

In this chapter, I present the theory and research that inform this study. I begin by outlining my theoretical framework, which combines complexity and sociocultural theories. I then employ this framework to review and critique the empirical literature on teacher learning through professional development, situating this study in relation to the extant literature on: professional development effects, facilitation of professional development, individual factors that influence teacher learning, teacher learning processes, and school-level factors that influence teacher learning.

Complexity Theory

Since the Enlightenment, natural and social scientists have viewed the universe as rational and deterministic (Davis & Sumara, 2006; Morrison, 2008). Scientific work has been oriented to understanding the universe through studying causes and effects. This is a reductionist model, which assumes that by understanding how smaller sections (or variables) work and adding them together, one can understand the whole (Radford, 2006). However, this model does not suffice to explain all processes. A growing awareness of the limitations of linear explanations has spurred increasing numbers of scholars to embrace complexity theory. Originating in fields such as physics, mathematics, and information science, complexity theory has spread to fields as diverse as economics, health, and education (Davis & Sumara, 2006; Waldrop, 1992).

Complexity theory is a theory of change, evolution, adaptation, and development that challenges the Newtonian view of a rational, deterministic world in which everything functions in predictable ways (Morrison, 2008). Rather, complexity theory is premised on the ontological position that much of the world and most of the social world is made up of complex systems, which cannot be explained in terms of simple causes and linear effects (Byrne & Callaghan, 2014). In complex systems, system elements interact and combine in various ways, so that even small decisions can have multiple causal pathways. Opfer and Pedder (2011) illustrate this idea with the example of the decision to have a cup of tea.

If we think about why someone may choose to have a cup of tea we can identify multiple mechanisms or systems at work including biological (thirst), normative (he or she lives in England), institutional (it is readily available), historical (he or she has always done so when writing), and so on. How these dynamics combine will vary for different people and even for the same person at different times of the day or in different contexts. Furthermore, the ways they combine and the circumstances in which they combine are patterned; there may be a large number of reasons for tea drinking, but the reasons are neither limitless nor tend to be random. (p. 378)

In other words, the decision to have a cup of tea is unpredictable, yet patterned. It is complex.

Complex systems are fundamentally different from both simple and complicated systems, which behave predictably. Simple systems have only a few parts. Consider a ball rolling down a ramp. Given knowledge of conditions such as the shape and mass of

the ball and friction between surfaces, it is possible to predict the ball's trajectory accurately. Complicated systems are those that have many parts, such as a computer or a car engine, where the relationship between parts is fixed and defined. For instance, although a car's engine consists of many components with different forms and functions, when you assemble them, they all operate in predictable ways to make the car run as expected. Complex systems, on the other hand, do not behave in predictable ways; they are more than the sum of their parts. Complexity theory seeks to explain how change occurs in complex systems, which range from anthills to social movements to classroom communities.

Opfer and Pedder (2011) conceptualize teacher learning as a complex system that “evolves as a nested system within systems” (p. 379). They theorize:

Teacher learning tends to be constituted simultaneously in the activity of autonomous entities (teachers), collectives (such as grade level and subject groups), and subsystems within grander unities (schools within school systems within sociopolitical educational contexts). These systems and subsystems associated with teacher learning are interdependent and reciprocally influential.
(p. 379)

Following this logic, explaining teacher learning through professional development necessitates exploring the relationships between: 1) the professional development system that is supposed to promote teacher learning; 2) an individual teacher's learning system, consisting of her knowledge, beliefs, practices, and experiences; and 3) the school-level learning system, including the contexts that support or constrain learning within the

school (Cochran-Smith, Ell, Ludlow, Grudnoff, & Aitken, 2014; Opfer & Pedder, 2011). This study explores these overlapping complex systems.

Features of Complex Systems

Many complexity theorists have described the features of complex systems (e.g. Byrne & Callaghan, 2014; Cilliers, 1998; Davis & Sumara, 2006; Morrison, 2008). Below I describe several features that are relevant to understanding teacher learning through professional development, illustrating each with examples related to teacher learning at various system levels.

The form of a complex system is determined by its control parameters. Control parameters refer to the structural elements of the system that, in interaction with each other, determine the state of the system (Byrne & Callaghan, 2014). They regulate the rate at which information flows through the system, the richness of connectivity between agents in the system, and the level of diversity within and among agents (Stacy, 1996). In an individual teacher learning system, a teacher's habits of mind, those mental processes such as reflection and metacognition, are control parameters which impact how information moves within, informs, and transforms the system. Stacey identifies two additional control parameters that shape complex human systems, such as the school and professional development systems: power differentials and levels of anxiety containment. In schools, the teachers' ability to learn is impacted by the size of the power differentials between administrators and teachers, as well as by the general level of anxiety within the faculty.

Complex systems are nested in and interact with other systems (Byrne & Callaghan, 2014; Davis & Sumara, 2006; Nielsen, Triggs, Clarke, & Collins, 2010).

Davis and Sumara (2006) note that, “complex unities can be (and usually are) simultaneously autonomous unities, collectives of autonomous unities, and subsystems within grander unities” (p 90). The context of this study was the school-based, researcher-facilitated, collective professional development system referred to as a teacher working group. The teacher working group was both nested within the larger school-level learning system of the Bilingüe School, and contained the individual learning systems of its teacher agents. Delineating the boundaries of a system is a challenge, because complex systems are open, constantly exchanging matter and/or information with their environment (Cilliers, 1998; Davis & Sumara, 2006; Hetherington, 2013). The teacher working group consisted of eight teachers and four researchers, but each of us was influenced by countless others, and those influences came into our shared conversations, influencing the collective learning of the group.

Complex systems are characterized by multiple, short-range, nonlinear interactions (Byrne & Callaghan, 2014; Cilliers, 1998; Cochran-Smith et al., 2013; Davis & Sumara, 2006). Information is exchanged most readily between near neighbors within a system (Davis & Sumara, 2006). Within the Bilingüe School, the school-level learning system included 45 teachers, along with paraprofessionals, administrators, and other staff, as well as approximately 700 students. Within this system, each teacher was most likely to share information with those with whom she interacted regularly. This included teacher colleagues with whom she interacted due to proximity of classrooms, joint membership on a grade-level team or committee, or shared responsibility for a student’s educational program. In addition, teachers also exchanged information with the students in their classes, parents, the principal and other school administrators and staff members,

as well as numerous individuals and entities outside of the school. Information could travel through any of these channels, influencing the parts of the system as well as the system as a whole. As Byrne and Callaghan (2014) note:

The character of complex systems is a consequence of interactions: interactions of parts of the system with each other; interactions of parts of the system with the system as a whole; and interactions of the system with other systems with which it intersects, within which it is nested, and with which it may share interpenetrating components. (p. 173)

These multiple interactions are nonlinear; information can change in scale as it travels, carrying more or less consequence for the receiving agent than the sending agent (Cilliers, 1998).

Complex systems have the potential for radical change, although they can be static for long periods of time (Byrne & Callaghan, 2014; Cilliers, 1998). Some complexity theorists (e.g. Cilliers, 2008; Morrison, 2008) have used an idea originated by physicists Bak and Chen (1991) as an analogy to explain how complex systems change. Bak and Chen describe an experiment in which sand is dropped onto a circular disk, one grain at a time, to form a pile. While a pile of sand is not a complex system, the way the pile changes during the experiment shares key characteristics with change in a complex system. At first the sand slowly accumulates in a pile with a gentle slope. When the slope becomes too steep somewhere in the pile, the grains slide down in a small avalanche, and then the pile continues to accumulate. As more sand is added to the pile, the slope steepens, and the size of the avalanches increases. Eventually the pile reaches a point where it is no longer growing. At that point, which Bak and Chen term the “point of

criticality”, an individual grain of sand can start an avalanche of various sizes, including a “catastrophic event,” although the pile as a whole never collapses. It is always the same sand pile, even as the grains of sand that comprise it are replaced or rearranged.

Complex systems also reach a point of criticality, like the sand pile. Complexity theorists refer to the state when order and chaos are in balance, just before the system transforms, as “the edge of chaos.” (Waldrop, 1992). As Waldrop vividly describes, the edge of chaos is where:

The components of a system never quite lock into place, and yet never quite dissolve into turbulence, either... The edge of chaos is where new ideas and innovative genotypes are forever nibbling away at the edges of the status quo, and where even the most entrenched old guard will eventually be overthrown.... The edge of chaos is the constantly shifting battle zone between stagnation and anarchy, the one place where a complex system can be spontaneous, adaptive, and alive. (p. 12)

Radical change happens when something perturbs the system, like that last, individual grain of sand, disrupting the status quo and precipitating a transformation (Davis & Sumara, 2006; McQuillan, 2014). Within a school level learning system, a reform, such as a newly adopted curriculum with accompanying professional development, may perturb the system, precipitating a radical change in school-wide norms for teaching.

Complex systems grow, learn, and change through feedback loops (Cilliers, 1998; Davis & Sumara, 2006). Positive feedback serves to amplify dynamic aspects of the system, while negative feedback can shut down aspects of the system. A viral video on social media is an example of a positive feedback loop at work. One person shares a

video with the members of her social network, who in turn share it with their entire social networks, triggering a rapid-fire spread of information. Through this mechanism, small events can trigger large changes within a system. A complex system is constantly altering its own structure in response to new experiences. Unlike in a simple or complicated system, a virtually identical stimulus may produce a dramatically different response in a complex system a short time later (Davis & Sumara, 2006). Teachers learn from their experience in this way. When a child calls out during a class discussion, a teacher may respond by reminding the child to raise her hand. A few moments later, a different child calls out an answer. This time the teacher reacts by asking the child to move her seat. Having determined that redirection is not sufficient, the teacher explores a different possibility.

Complex systems are self-producing and self-organizing (Cochran-Smith et al., 2013; Davis & Sumara, 2006; Morrison, 2008). This phenomenon of self-organization within a complex system is referred to as emergence. Emergence occurs when agents who may not have much in common or even share a common goal join together in activities that are intertwined and co-dependent (Davis & Sumara, 2006). It is generated internally, rather than imposed by a central authority. Davis and Sumara explain that intelligent, collective action can arise “out of the bottom-up, independent (but co-specified) actions of individual agents who act out of self-interest and who may even be motivated by profound selfishness” (p. 85). The twelve agents in the Language Awareness and Dialogic Reasoning professional development system had varied motivations for participating. Some of the teachers hoped for mental stimulation, others sought pedagogical innovations, while others were motivated by the attached stipend.

The researchers had altogether different motivations. However, when this group came together to discuss teaching language to emergent bilingual students, new ideas about pedagogy emerged. These ideas could not have been predicted, as the system ultimately self-organized.

Complexity and Teacher Learning

Educational scholars who have taken up complexity theory understand learning as complex. Morrison (2008) describes learning as “a process of emergence and co-evolution of the individual, the social group and the wider society” (p. 21). There is a rejection of the commonplace understanding of knowledge as something that exists “out there” to be learned by individuals, who are empty vessels, waiting to be filled with knowledge (Davis & Sumara, 2006; Morrison, 2008). Instead, knowledge is understood to be emergent. Morrison explains, “Our minds are not static; each new event is met and learned by a new mind—it is not the same mind as it was moments before” (p. 21). As the mind meets and makes sense of each new event, both the mind and knowledge are changed. Learning is a recursive and elaborative process; it is decidedly nonlinear (Davis & Sumara, 2006).

Professional development activities can play a role in teacher learning, but this role should be understood in terms of the entire, complex, nested teacher learning system. Radford (2006) offers contrasting analogies to explain complexity theory’s implications for the role of a teacher (or professional developer):

Rather than planning a specific course along which a route is bulldozed by a visionary leader, the practitioner is more in the position of the canoeist shooting the rapids, continuously adapting in the face of unknown and unpredictable

challenges and with sufficient information only to respond to the local and immediate. (pp. 184-185)

The professional developer cannot hope to bulldoze her way to teacher learning by implementing a prescribed program of professional development, as each teacher will interact with the program differently, based on his own orientation to learning and the context in which he teaches. This helps to explain why so much professional development results in little change, as many professional development activities fail to account for the teachers' lived experiences and the contexts in which they work. The professional development activity itself is complex; professional development facilitators cannot control the system, but they can establish the control parameters that are likely to occasion the emergence of new ideas (Morrison, 2008).

As discussed above, complexity theory has broad applicability to physical systems as well as social systems. While it offers a helpful way to make sense of the variation in teacher learning, it has not often been used to study teacher learning. Complexity theory does not (yet) account for the mechanisms through which social systems impact individual cognitive systems, and vice versa (Lantolf, 2008). That has been the domain of sociocultural theory.

Sociocultural Theory

Sociocultural theory explains the relationship between human action and the cultural, institutional, and historical situations in which humans act (Wertsch, 1995). It comes out of Russian psychologist Vygotsky's (1978) work in the 1920s and 1930s on child development, which focuses on the interrelationship between the child and the social world. Vygotsky argued that a child's cognitive development could not be

understood by studying the individual in isolation; it is necessary to examine the external social world, as the child develops through interactions with others who are more knowledgeable.

Sociocultural theorists have applied Vygotsky's ideas about the interrelationship between the learner and the social and cultural worlds to multiple contexts and varied types of learners. Scholars use sociocultural theory to analyze children's learning in schools (e.g. Tharp & Gallimore, 1990) as well as informal learning settings such as Girl Scouts (Rogoff, 1995). Others have extended sociocultural theory to adult learning, to explain how adults learn through apprenticeships (Lave & Wenger, 1991) and in a variety of workplaces (Billett, 2004; Wenger, 1998, 2000).

Similar to complexity theorists who understand learning as a process of co-evolution among the individual, the social group, and society at large (Morrison, 2008), sociocultural theorists also hold individual learning as inseparable from the social context (Larsen-Freeman & Cameron, 2008; Lave, 1996; Wenger, 2000). Sociocultural theorists explain learning by emphasizing interrelationships between individuals and social worlds. According to sociocultural theory, what the individual learns is influenced by, although not irreducible to, interactions with other people, including those who are in positions of authority (e.g. a student learning from a teacher; a younger sibling learning from an older sibling) as well as our peers (Rafael et al., 2014). Vygotsky (1978) theorized that learning takes place when children are drawn into activities that require cognitive and communicative abilities just beyond what the child can do independently. Growth occurs in what he termed the "zone of proximal development," when others nurture and scaffold the child's development, until she is able to complete the activity independently. These

ideas apply to adult learners as well. In groups in which everyone has similar levels of competence, learning can occur as the group collaboratively tackles a shared problem (Tharp & Gallimore, 1990). In addition to face-to-face interactions with others, we learn through participating in socially constructed practices, as we use tools of reasoning, materials, and artifacts that embody the intellectual history of a community (Resnick 1991; Rogoff, 1995). By participating in social practices, whether in person or independently, we develop our higher-order functions.

From a sociocultural perspective, learning is defined as a transformation of participation (Lave, 1996; Rogoff, 1997). For individuals, learning means transforming the ways that they engage in and contribute to social practices, including the ways that they think and act. Rogoff explains that transformation occurs during participation: “Individuals transform their understanding of and responsibility for activities through their own participation in activities, and in the process they become prepared to engage in similar subsequent activities” (p. 272). Wenger (2000) posits that learning takes place in the interplay between socially defined competence and our experience. For instance, a new elementary teacher recognizes that she lacks the experience to teach writers workshop effectively; thus she asks for advice from colleagues who have taught writers workshop in previous years, in order to learn from them. The new teacher transforms her actions to match the competent actions displayed by her more experienced colleagues. This view of learning complements a complexity perspective. In specifying social processes through which learning comes about, sociocultural theory lends itself to the design of learning activities, as well as the analysis of learning within a group. Where sociocultural theory helps us to zoom in on specific social and cultural learning activities,

complexity theory provides the theoretical tools to look holistically at the multiple systems involved in learning, in order to analyze both the similarity and the variation between individuals' learning.

Communities of Practice

The community of practice is a key concept in sociocultural theory, which is of particular relevance to this study, due to my focus on the learning of teachers who participated in collective professional development. A community of practice is a group that shares cultural practices reflecting their collective learning (Lave & Wenger, 1991; Wenger, 1998). Wenger (2000) defines a community of practice using terminology that echoes complexity theory: "Communities of practice are the basic building blocks of a social learning system because they are the social 'containers' of the competences that make up such a system" (p. 229). Communities of practice are everywhere: in homes and workplaces, at religious institutions and community organizations, in physical and virtual spaces. For the purpose of this study, I conceptualized the teacher working group, which was a complex and collective learning system, as a community of practice.

Communities of practice have three dimensions, which are the source of their coherence: 1) a joint enterprise, or collectively developed understanding of what the community is about, for which members hold each other accountable; 2) mutual engagement as partners in the joint enterprise; and 3) a shared repertoire of communal resources (e.g. language, routines, tools, artifacts, styles) to use in their enterprise (Wenger, 1998, 2000). As individuals learn through transforming their participation in the practice of their communities, so too can communities of practice learn and transform. For a community of practice, learning is an exercise in negotiation of

meaning; community members define and tune the enterprise, evolve forms of mutual engagement, and develop, adapt, and abandon tools and representations in their shared repertoire (Wenger, 1998). As with individuals, learning comes about in the gap between socially defined competence and experience. A community of educators may abandon an old approach to teaching vocabulary that was formerly defined as competent when an individual member learns about and shares a new approach that can help the teachers to achieve better results with their students. In this case, a new experience triggers a change in the community's definition of competent practice. This example concretizes the idea, discussed above, that the nature of a complex system is a consequence of interactions (Byrne and Callaghan, 2014); in this instance, learning is triggered by the interaction of a collective learning system with an individual teacher system nested within it. These complex systems co-evolve, iteratively and recursively refining and redefining notions of competent teaching practice.

A Sociocultural Approach to Professional Development

Many scholars have applied sociocultural theory to understand how teacher learning takes place through professional development (e.g. Gallucci, 2008; Kazemi & Franke, 2004; Raphael et al., 2014; Tharp & Gallimore, 1990). Raphael and colleagues elaborated on Harré's (1983) concept of the Vygotsky Space (see Figure 1) to develop a framework to represent the learning process of teachers participating in ongoing professional development. The Vygotsky Space represents two dimensions of learning. The first concerns how learning is displayed: in public or in private. The second is whether learning activities are individual or social. Positioned along intersecting axes, these dimensions form four quadrants that depict a process through which cultural

practices are appropriated collectively, transformed based on individuals' contexts, and made public in ways that can be taken up by others. This process is not linear or cyclical, but iterative. It is a complex process that demonstrates key concepts from complexity theory including nested and intersecting systems, nonlinear interactions, feedback loops, unpredictable but patterned responses, self-organization, and co-evolution.

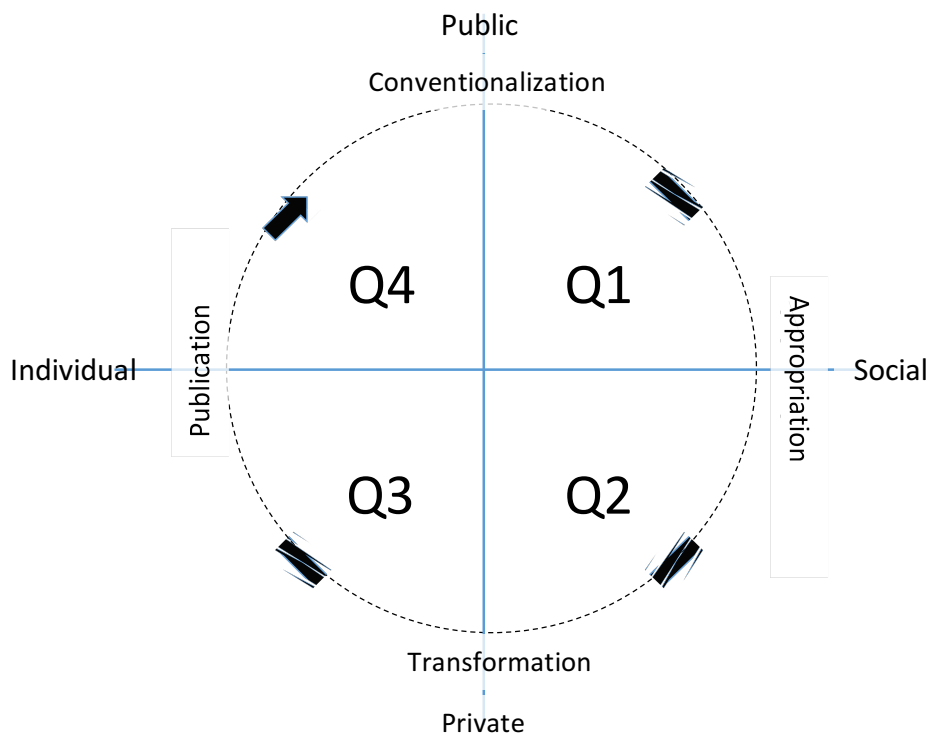


Figure 1. The Vygotsky Space. Adapted from “Sociocultural approaches to professional development: Supporting sustainable school change, by T. E. Raphael, J. M. Vasquez, A. J., Fortune, J. R. Gavelek, & K. H. Au, p. 145. In L. E. Martin, et al. (eds.) *Handbook of Professional Development in Education: Successful Models and Practices, PreK-12*, New York, NY: Guilford Publications.

The quadrants on the right side of the vertical axis (Q1, Q2) are social spaces in which participants collectively make meaning. Q1 is also a public space. In a professional development context with a designated facilitator, Q1 represents the space in which the facilitator introduces a new construct or practice in the role of “more-knowledgeable other” (Raphael et al., 2014; Vygotsky, 1978). Participants try to understand this new information, considering whether to appropriate it in order to deploy it in their own practice. Participants may engage in facilitated conversations, making their developing knowledge public.

Q2 is a space outside of formal professional development, hence a private space, in which teachers continue to work with others to appropriate and transform ideas from Q1 to generate new knowledge for their own context. When professional development occurs offsite or is facilitated by an outsider, Q2 is the space in which teachers plan with others from their own school or department to enact new ideas in such a way as to meet the needs of their particular context.

Q3 is a private and individual space, in which participants continue to transform ideas from Q1 and put them into action. For teachers, this space includes the work of planning, teaching, and reflecting on lessons. As teachers put the ideas appropriated in Q1 into practice, they make new discoveries that are context specific, which require them to further transform their new knowledge.

Finally, in Q4 individuals make public the new learning that has occurred privately in Q2 and Q3. In a professional development context, this may occur when teachers share the ways in which they transformed the ideas originally taught in Q1. As teachers articulate their new ideas, this may lead into a process of conventionalization,

with their ideas becoming part of the learning community's repertoire of practice. However, when discrepancies arise, teachers may return to Q2 or Q3 for further refinement of practice.

Participants may not move through every quadrant in the Vygotsky Space. However, the four quadrants maintain their relationship to one another: public learning informs and is informed by private learning; social learning informs and is informed by individual learning. The process is iterative; teachers can continue to learn individually and collectively as they participate in each of the four quadrants.

Not only is the Vygotsky Space a useful heuristic to conceptualize common patterns of learning, but it can be beneficially combined with ideas from complexity theory. The four quadrants offer a map to likely sites of learning at different levels of the teacher learning system. The intersection of Q4 and Q1 is the likely site of collective learning within a professional development-level system, as the group takes up for consideration new ideas presented by individual teachers. At the individual teacher level, learning is likely to occur in Q3, as teachers privately adapt and transform ideas for their own practice, or in Q4, as teachers articulate their new understandings as a result of their experimentation.

As this discussion makes clear, sociocultural theory offers constructs such as communities of practice and the Vygotsky Space that address the ways in which individuals and social groups learn. By using these constructs as a complement to complexity theory, I hoped to identify specific learning events and learning processes in teachers' professional development experiences, while maintaining a holistic view of the multiple, complex systems involved in teacher learning.

Literature Review

As discussed above, Opfer & Pedder (2011) posit that three overlapping, complex systems are involved with teacher learning through professional development: the professional development activity as a complex system, individual teachers as complex systems, and schools as complex systems. I employ the idea of these three complex systems and their interactions as an organizational frame for this review of the literature related to teachers' professional learning. Few of the studies that I reviewed conceptualize teacher learning in this way; my organization of the literature and my use of terminology from complexity theory reflects my perspective, not the researchers'. The first two sections of the review address, in turn, the professional development system and the individual teacher as a system. This is followed by a discussion of the research on teacher learning processes, which illuminates how the professional development and teacher-level learning systems interact. Next I present the research on school-level learning systems, through the lens of their interactions with professional development systems. I conclude by describing a case study (Gallucci, 2008) that uses sociocultural theory to analyze one teacher's learning process. I utilize ideas from complexity theory to extend Gallucci's analysis.

As Borko (2004) notes, "For teachers, learning occurs in many different aspects of practice, including their classrooms, their school communities, and professional development courses or workshops. It can occur in a brief hallway conversation with a colleague, or after school when counseling a troubled child" (p. 4). While acknowledging that professional learning happens in all these aspects of practice, in this review I focus on professional learning that occurs within contexts explicitly intended to foster

professional development. Little (1987) defines professional development as “any activity that is intended partly or primarily to prepare paid staff members for improved performance in present or future roles in the school district” (p. 491). For the purposes of this literature review, I refine this definition further to include any organized activity that is intended to help teachers do their jobs better, in which multiple teachers participate. This encompasses myriad forms of professional development, including traditional forms such as workshops, courses, and institutes, and newer forms, such as professional learning communities, study groups, and inquiry communities. This definition excludes learning activities in which teachers engage individually, informally, or outside of a professional context.

I employed this definition as a search parameter in my review of the professional development literature. Additionally, I only included studies of: 1) practicing teachers; 2) in K-12 schools; 3) who teach academic subjects. I included research from the United States as well as international contexts, a decision that was informed by my theoretical framework. From a complexity perspective, I understand that the nature of learning depends on the specific context and the individual. Learning varies from teacher to teacher and school to school, regardless of where the teacher or the school is located; using international borders to distinguish learning experiences would be arbitrary. Thus I intentionally sought out studies that would speak to the variation as well as the similarity in teacher learning across contexts.

Professional Development Systems

In this section, I address two distinct strands of the research on professional development, neither of which employs a complex view of teacher learning. First I

summarize the professional development effects literature, an influential strand of research that analyzes professional development activities in terms of features that promote learning. I also discuss the much smaller body of literature on the facilitation of professional development.

Professional Development Effects. During the past twenty years, much attention has been paid to figuring out what makes professional development work. Operating from an epistemology that is decidedly not complex, researchers have analyzed the characteristics of professional development in an effort to isolate the features that result in improved outcomes, including increased teacher knowledge and skills, changes in teachers' attitudes and beliefs, changes in classroom practice, and improved student learning. This research includes small-scale program evaluations (e.g. Driets-Esser & Stark, 2015; Gearhart et al., 1999; Haug & Sands, 2013), as well as large-scale studies using statistical modeling to compare multiple professional development programs and activities based on teachers' self report (e.g. Garet et al., 2001; Heck et al., 2008; Penuel, Fishman, Yamaguchi, & Gallagher, 2001).

Informed by the mounting body of professional development effects research, many researchers and policymakers have come to a consensus regarding some of the critical features of professional development (e.g. Darling-Hammond et al., 2009; Desimone, 2009; van Veen, Zwart, & Meirink, 2012). In a widely cited review, Desimone (2009) claimed that the research community generally agrees on five features of professional development that are associated with improved outcomes: 1) content focus, 2) active learning, 3) coherence, 4) duration, and 5) collective participation. I briefly summarize the research on these five features below, after which I offer a critique

of the consensus view, including discussion of the reasons for some conflicting findings (Kennedy, 2016; Opfer & Pedder, 2011; Spelman & Rohlwing, 2013).

A growing body of research links teacher learning to content-focused professional development activities (e.g. Desimone et al., 2002; Garet et al., 2001; Penuel, et al., 2001). Content-focused professional development is often designed to increase teachers' subject matter knowledge by helping them to understand the central facts and concepts of a discipline, the connections between ideas, and the inquiry processes of the discipline (Borko, 2004). Researchers have also found positive effects for professional development focused on increasing teachers' pedagogical content knowledge (Ball & Cohen, 1999; Desimone et al., 2002; Penuel et al., 2001). However, Kennedy (2016) found that content-focused professional development varied in effectiveness and was no more effective than professional development with other goals.

Growth in teacher learning has also been linked to active learning (Desimone et al., 2002; Garet et al., 2001; Kennedy, 2016). As opposed to passive learning activities, typified by lectures, active learning requires teachers to engage with ideas and practices. A variety of professional development activities involving active learning have been found to lead teachers to gain knowledge and skills and change their classroom practices. These include analyzing student work samples; observing other teachers and being observed, whether by visiting classrooms in person or watching video-taped lessons; designing lessons, assessments, and curriculum; and presenting, leading, and writing (Drits-Esser & Stark, 2015; Garet et al., 2001; Haug & Sands, 2013).

Researchers have found that the coherence of professional development with other school, district, and state initiatives and reforms is associated with changes in

teacher practice (e.g. Cohen & Hill, 2011; Garet et al., 2001; Penuel et al., 2007). Some studies have found greater effectiveness when professional development programs incorporate adopted curriculum materials (Cohen & Hill, 2011) and focus on alignment with state and district standards (Penuel et al., 2007). Teachers are more likely to implement ideas from professional development when administrators provide support, including time, space, and encouragement, as well as instructional leadership (Cohen & Hill, 2001; Dagen & Bean, 2014; van Veen, Zwart, & Meirink, 2013).

Many researchers have identified a relationship between the duration of professional development and changes in teachers' knowledge and practice (e.g. Avalos, 2011; Darling-Hammond et al., 2009; Desimone, 2009; Heck et al., 2008; Supovitz & Turner, 2000). While no clear tipping point has been determined, both professional development programs that last for at least a semester and intensive summer institutes with follow up during the school year have been shown to result in teacher learning (Desimone, 2009). However, some research has turned up contradictory results (Kennedy, 2016; Penuel et al., 2007), suggesting that the quantity of professional development does not necessarily predict better results.

Collective participation is another feature of professional development that many researchers have found to be correlated with teacher learning (e.g. Desimone et al., 2002; Garet et al., 2001; Penuel et al., 2007). Collective participation refers to teachers participating in professional development with other teachers from their grade, department, or school. Penuel et al. (2007) found that changes in teacher knowledge were predicted by collective participation in a program designed to prepare teachers to

implement an international earth-science education program. However, Kennedy (2016) found varying effects of programs that included collective participation.

Despite the growing consensus around best practices in professional development, the literature in this tradition has significant limitations. Most of this research is based on a linear logic in which particular features are expected to directly result in improved outcomes for teachers (Opfer & Pedder, 2011). Despite all the talk about consensus and best practices, a deeper dive into the literature reveals significant variation. Even when professional development activities are designed with the so-called “core features,” researchers have found significant variation in both teacher outcomes and student outcomes (e.g. Kennedy, 2016; Spelman & Rohlwing, 2013). In a recent meta-analysis of 28 experimental research studies on the effects of professional development on student learning, Kennedy (2016) found no correlation between student learning and several of the “core features” of professional development, including content focus, collective participation, and duration.

From a complexity perspective, variation in outcomes is hardly surprising. Research in the professional development effects tradition focuses primarily on the professional learning program itself, paying little attention to interdependence with teacher-level and school-level learning systems. Researchers attend only to inputs, ignoring how the same inputs may interact differently with each individual’s learning system, and with different school-level learning systems, potentially resulting in very different outcomes. Additionally, the research tends to look at the absence or presence of certain features, without regard to their intensity or quality. However, when it comes to teaching and learning, the Goldilocks Principle often applies: too little and learning will

not occur, too much and it may be counterproductive or negative (Opfer & Pedder, 2011). In the search to find out what works, the professional development effects literature has paid too little attention to why it works, for whom, and under what conditions.

Facilitation. Although it has received little attention, there is a small body of research on facilitation, which is relevant to the question of the conditions under which professional development works. A variety of people may find themselves in the role of facilitator, such as school-based teachers and administrators, external professional developers, and university-affiliated personnel. Regardless of their official positions, facilitators have multiple responsibilities, including setting up the professional development, managing the flow and direction of interactions, initiating and sustaining professional learning, and helping to create an environment for learning by addressing interpersonal dynamics (Molle, 2013). Facilitators have a major influence on the professional development system through their enactment of these responsibilities. As I explain below, facilitators help to establish initial conditions and control parameters, foster or limit interactions and feedback loops, and potentially promote radical change and self-organization.

At the most basic level, facilitators create times and spaces for teacher learning. They establish the conditions of the professional development system by selecting a time and place to meet, recruiting teacher participants, determining the topic, and selecting materials and resources to use. Their decisions about how to use the time, including the types of activities and structures they put in place, influence the control parameters within the system. Not surprisingly, these actions have been found to have significant

implications for teacher learning (Drits-Esser & Stark, 2015; Jenlink & Kinnucan-Welsch, 2001; Sztajin, Hackenberg, White, & Alexsaht-Snider, 2007).

Facilitators play an important role in managing the flow and direction of interactions within the professional development system. Many facilitators try to encourage broad and equitable participation during group activities and discussions. Some use conversational protocols to help distribute participation and encourage teachers to listen to each other (Allen, 2016; Krell & Dana, 2012). Others lead conversations about group norms and verbally invite quieter participants into the discussion (Jenlink & Kinnucan-Welsh, 2001). Facilitator positioning also impacts the flow and direction of interaction. Placing a high value on dialogic discourse, many facilitators try to stand back, positioning themselves as co-learners rather than experts (Chan & Clarke, 2014; Peressini & Knuth, 1998; van Es et al., 2014). Through these actions, facilitators may (or may not) establish control parameters that permit teachers to learn through multiple, short-range interactions with one another.

In addition to fostering interactions, facilitators help to determine the content of those interactions through their role in initiating and sustaining professional learning. Facilitators can launch professional inquiry by setting a task and asking questions to focus participants' attention in a particular direction (Kazemi & Franke, 2004; van Es, Tunney, Goldsmith, & Seago, 2014). Once the conversation has begun, facilitators use a variety of discourse moves to sustain it. Van Es and colleagues (2014) propose six facilitation moves for sustaining inquiry: 1) highlighting noteworthy ideas or events for discussion; 2) "lifting up" important ideas raised by participants for further discussion; 3) pressing participants to explain their reasoning or elaborate on their ideas; 4) clarifying a

participant's comment to ensure common understanding; 5) offering an explanation or interpretation of an event, interaction, or idea; and 6) countering a participant's idea with an alternative point of view. Depending on when, whether, and how facilitators use these moves, they can foster or foreclose positive feedback loops through which participants may learn from each other and novel ideas may emerge (Zhang, Lundeberg, & Eberhard, 2011).

The facilitator also plays an important role in fostering and maintaining trust among the participants, which is a necessary condition in a professional learning environment (Little, 1990; Thang et al., 2011). Trust can be threatened when perturbations disrupt the system. However, perturbations can also offer the potential for radical change. When divergent opinions arise in group discussions, the facilitator's response can promote radical change or a reversion to the status quo. Molle (2013) found that the lead facilitator of a professional development program focused on teaching emergent bilingual students used a variety of strategies to resolve tension among teachers without ignoring their differences: she built common ground in divergent opinions, challenged the basis of an argument rather than the argument itself, and promoted the coexistence of divergent views. These strategies enabled the participants to maintain collegial relations, while promoting the development of ideological clarity about their beliefs and practices.

While the research on facilitation sheds some light on the conditions within professional development systems that can promote teacher learning, it does not address the variations in learning that occurs from teacher to teacher and school to school (e.g. Brownell et al., 2014; Spelman & Rohlwing, 2013). Opfer and Pedder (2011) attribute

variation to interactions between the professional development system and other systems. I turn next from professional development systems to teacher-level learning systems.

Teacher-Level Learning Systems

Opfer and Pedder (2011) describe a teacher-level learning system as “the interaction and intersection of knowledge, beliefs, practices, and experiences” (p. 388). Teachers filter their professional development experiences through these lenses, each of which can impact what and how teachers learn. In addition to these lenses, teachers’ habits of mind, or ways of thinking, also play a part in their learning systems. Below, I review the research literature that addresses the influence of teacher-level systems on teacher learning through professional development.

What teachers already know affects how they engage with ideas and concepts during professional development activities and what they learn. Several researchers have found that teachers who start out with more subject matter knowledge and pedagogical content knowledge are more likely to try out practices discussed during professional development in their classrooms than less knowledgeable teachers (Britt, Irwin, & Ritchie, 2001; Brownell et al., 2014; Supovitz & Turner, 2000). Prior knowledge can influence how teachers participate in professional development activities. Among a group of teachers participating collectively in school-based professional development about mathematical learning trajectories, those teachers with more developed mathematical knowledge for teaching participated in discussions in a qualitatively different manner from their less knowledgeable colleagues (Wilson, Sztajn, Edgington, & Confrey, 2014). They were able to move the discussion from issues of pedagogical content knowledge to issues of subject matter knowledge, creating additional opportunities to learn.

Teachers' beliefs about teaching and learning have also been found to interact with learning from professional development. Teachers' beliefs impact their interpretation and appropriation of new reforms. When teachers' existing beliefs are well aligned with those promoted through professional development activities and materials, teachers are more likely to enact ideas from professional development in their classrooms (Grant, Peterson, & Shojgreen-Downer, 1996; Remillard & Bryans, 2004; Supovitz & Turner, 2000). Remillard and Bryans (2004) investigated how eight elementary teachers who were participating in a math study group enacted a new, reform-oriented math curriculum. They found that teachers' implementation was influenced by their beliefs about math and how it is learned, their ideas about the role of a math teacher, and their attitudes toward packaged curricula. Only those teachers who felt that the curriculum fit with their beliefs enacted it as it was intended. Similarly, teachers' beliefs about students' capabilities impact their take up of ideas from professional development; teachers are unlikely to implement ideas that they perceive their students as incapable of handling (Mouza, 2009).

Like all learners, teachers make sense of and evaluate new experiences in relation to their previous experiences and current practices (Dewey, 1938/1998; Bransford, 2000; Kolb, 1984). This includes their experiences as learners. Drake, Spillane, and Hufferd-Ackles (2001) found that teachers' childhood experiences learning math impacted who they were as math teachers as well as their approaches to mathematics reform. Those whose experiences with mathematics had been consistently negative were not interested in reforming their math teaching, and were not open to opportunities to learn.

Researchers have found consistently that teachers engage with new information in professional development in relation to their previous and current teaching experiences (Coburn, 2001; Drits-Esser & Stark, 2015; Fore, Feldhaus, Sorge, Agarwal, & Varahramyan, 2015; Van Duzor, 2011). Rather than adopting ideas wholesale, teachers think about how students they have taught might respond to particular practices, how they have taught similar concepts in the past, and how new ideas fit with their current practice. Based on these experiences, some teachers decide to adapt activities or practices to make them more appropriate for or relevant to their particular students (Fore et al., 2015; Van Duzor, 2011). When their experience suggests that an idea is not appropriate for their students, teachers may decide to reject the idea outright (Coburn, 2001). The ease of integrating new ideas with current approaches is another factor that may influence teachers' appropriation decisions (Coburn, 2001; Fore et al., 2015).

Teacher's participation in and response to professional development may be influenced by how much classroom experience they have. Some novices are eager to participate in any professional learning activity, hoping that they will gain practical strategies and techniques, while more experienced teachers may be more skeptical that they will learn anything useful (Cameron, Mulholland, & Branson, 2013; Grant, Peterson, & Shojgreen-Downer, 1996). This helps to explain Remillard and Bryans' (2004) finding that inexperienced teachers were more likely than experienced teachers to pilot a reform-based math program with fidelity; it offered them a recipe for teaching math. However, when professional development does not offer a simple manual, the results may be different. Luft (2001) found that beginning science teachers who participated in professional development geared toward developing beliefs and practices conducive to

inquiry teaching, changed their beliefs more than their practices, while the experienced teachers changed their practices more than their beliefs. This professional development required them to create their own extended inquiry units, which may have been more than some novices could handle at a time in their careers when they needed to prioritize other tasks, such as enacting a beginning repertoire of practice and creating a classroom learning community (Feiman-Nemser, 2001).

Relatedly, some researchers have found a correlation between self-efficacy and teacher learning through professional development (Guskey, 1988; Smylie, 1988). Many novices experience a decline in self-efficacy as they realize that they are less prepared for the classroom than their pre-service programs led them to believe (Chester & Beaudin, 1996). However, while high self-efficacy may give teachers the confidence to try out new ideas from professional development, it can also result in overconfidence in certain practices, lack of interest in learning, and an unwillingness to utilize ideas that deviate sharply from established practices (Collopy, 2003; Wetzels, Steenbeck, & Van Geert, 2016).

Teachers' habits of mind, or ways of thinking, also appear to play a role in their learning systems. Although little research has been done in this area, two studies merit discussion. In a multiple case study of five special education teachers participating in yearlong professional development focused on word study and fluency, Brownell and colleagues (2014) concluded that differences in the teachers' analytic abilities accounted for much of the variation in how teachers applied ideas and activities from professional development. Teachers who were more analytic about students' needs, curricular resources, and their own instruction were able to purposefully implement strategies from

professional development that matched students' needs. Less analytic teachers also used activities that they learned about in professional development, but failed to take their students' needs into consideration when selecting learning activities. Self-regulation (2015) is another habit of mind that may influence teachers' learning, as teachers who have less self-regulation may need more external regulation to achieve the goals of professional development activities (Van den Bergh, Ros, & Beijaard, 2015).

In addition to the aspects of the teacher learning system outlined above, the teachers' motivation for participating in professional development and orientation to learning influence what and how they learn through professional development. Multiple researchers have found that teachers' motivation to participate in professional development impacts outcomes (Britt et al., 2011; Brownell et al., 2014; Grant et al., 1996; Kennedy, 2016; Wetzels et al., 2016). Unsurprisingly, teachers who choose to participate in professional development and who have an interest in the topic are likely to experience more learning and change than teachers who are mandated to participate (Kennedy, 2016; Wetzels et al., 2016) or who are participating for financial reasons (Brownell et al., 2015). Motivation may be related to a teacher's "orientation to learning." Opfer, Pedder, and Lavicza (2011) use this term to refer to how teachers perceive their own learning. This includes the value that teachers place on various types of learning (internal, external, or collaboration), as well as the types of learning that they engage in. They have found that teachers' orientations influence the extent of their learning through professional development (Opfer, Pedder, & Lavicza, 2011).

Interaction of Professional Development Systems and Teacher Learning Systems

When teachers are conceptualized as complex learning systems, it is clear that they have a strong influence on what and how they learn through professional development, also conceptualized as a complex system. In this section, I address the intersection of these two systems, synthesizing the literature that speaks to the mechanisms and processes through which teachers learn from professional development. The themes of experience, reflection, and dialogue permeate this literature (Rohling & Spelman, 2014). Although these processes are interrelated, and many studies address two or more, in the sub-sections below I tease them apart, in order to explore how each can contribute to or impede teacher learning.

Experience. Many scholars have written about the role of experience in learning. Dewey (1938/1998) theorized that we learn through experience due to the principles of interaction and continuity. Interaction refers to the transaction between an individual and his environment that shapes the experience. The principle of continuity allows an individual to carry the learning from one experience into future experiences.

As an individual passes from one situation to another, his world, his environment, expands or contracts. He does not find himself living in another world but in a different part or aspect of one and the same world.

What he has learned in the way of knowledge and skill in one situation becomes an instrument of understanding and dealing effectively with the situations which follow. (Dewey, 1938/1998, p. 42)

Dewey's ideas have been taken up and elaborated on by constructivist scholars (e.g. Bransford, 2000; Kolb, 1984), who emphasize that individuals come to a learning situation with existing knowledge, skills, beliefs, and attitudes acquired through

experiences. As they encounter new information, they make meaning through the lens of their own schemas. For adults, who have more life experiences to draw on than children, experience is thought to play a particularly important role in learning (Merriam, Caffarella, & Baumgartner, 2012).

Professional development activities that do not explicitly connect to teachers' professional experiences tend to have limited effectiveness at promoting learning. Kennedy (2016) reviewed professional development programs that operated from different theories of action. Those premised on supplying teachers with a body of knowledge, using didactic methods and paying relatively little attention to implications for enactment, tended to have a minimal effect, as measured by changes in student achievement.

Increasingly, recognition of the importance of experience in professional learning undergirds the design of professional development programs, and is embodied as active learning. Learning activities such as analyzing student work samples, observing and being observed by other teachers, and designing curriculum materials foreground teachers' experiences, providing opportunities for teachers to consider new ideas in the context of their practice. The research on teacher learning is replete with examples of teachers learning through active learning experiences in professional development (e.g. Coenders & Terlouw, 2015; Hoban, Butler, & Leslie, 2007; Kazemi & Franke, 2004; Lewis, Fischman, Riggs, & Wasserman, 2013).

These examples make it apparent that learning through experience takes varied forms, depending on what is being learned and by whom. This is consistent with a complex view of teacher learning at the intersection of multiple systems. While

professional development may include an active learning experience intended to promote particular learning objectives, individual teachers experience the activity differently depending on their previous experiences, knowledge, and beliefs (e.g. Coenders & Terlouw, 2015; Nielsen, 2012; Remillard & Bryans, 2004). They are more likely to learn what is being “taught” when the professional development activity introduces them to a skill, idea, or frame of reference that is consistent with their existing practice, than they are in situations that require that they change long-held beliefs. In the former situation, opportunities to connect new information from professional development to their experiences may be sufficient to promote learning (e.g. Dritz-Esser & Stark, 2015; Lewis et al., 2013). However, when teachers encounter new ideas that would entail dramatic changes to beliefs and/or practices, some researchers have found them likely to reject these ideas as inappropriate or irrelevant, even with occasions to try ideas out in practice (Coburn, 2001; Collopy, 2003; Remillard & Bryans, 2004).

Reflection. The research on teacher learning through professional development reveals the essential role of reflection. From a complexity viewpoint on teacher learning, reflection can be understood as a feedback loop between systems, through which information travels between professional development activities and a teacher’s experiences and back again. In his work on reflective practitioners, Schön (1987) addresses the relationship between experience, reflection, and learning. When confronted with a situation that does not meet expectations, the practitioner can either brush aside the discrepancy or reflect on it. Reflection can become a positive feedback loop: the practitioner can begin to question her assumptions, thinking critically about the situation. This may lead to experimentation, as she explores the newly perceived phenomenon, and

tests her tentative understandings. Alternatively, reflection can serve as a negative feedback loop: the practitioner may reflect on the discrepancy she noticed, conclude that it does not correspond with her previous experiences, and reject its implications.

When learning about new practices, teachers must reflect on when, whether, and how to incorporate them into their existing practice (Brownell et al., 2014).

Transformational learning necessitates critical reflection on one's beliefs, assumptions, and values (Mezirow, 2000). It is not surprising that Kennedy (2016) found that professional development programs that operated by prescription, providing teachers with explicit directions about the best way to address a particular teaching problem were limited in effectiveness, compared to those that incorporated reflection.

Many successful professional learning initiatives incorporate activities that prompt reflection by asking teachers to think more about their teaching practices and student learning. Teachers frequently engage in reflective discussions about classroom video footage or other artifacts of practice (e.g. Nielsen, 2012; Santagata & Bray, 2015; Ticha & Hospesova, 2006). Written reflections are also common, such as prompts that ask teachers to analyze their students' work (e.g. Kazemi & Franke, 2004; Sato, Wei, & Darling-Hammond, 2008) or record take-aways that will inform their own teaching (Haug & Sands, 2013; Van Duzor, 2011).

Dialogue. Dialogue features prominently in the literature on teacher learning through professional development. This is consistent with a sociocultural perspective, in which learning is understood as a social process. Research suggests that dialogue is one of the key mechanisms through which individuals learn in face-to-face interactions, and through which communities of practice negotiate meaning. As traditional models of

professional development based on the delivery of information by an expert have slowly given ground to newer models oriented around collective participation in communities of practice, the discourse structures within professional development are shifting. Univocal discourse, which functions to convey information from one person to another, is being supplemented, and in some cases supplanted, by dialogic discourse, in which new meanings are generated through interaction among participants (Peressini & Knuth, 1998). In many collective forms of professional development, dialogic discourse plays an important role in the learning of individuals and the group. Research suggests that both what is discussed and how it is discussed impact learning.

Many professional learning activities include opportunities for teachers to share their practices. For individual teachers, such conversations can be valuable opportunities to hear what is going on in other people's classrooms, exposing them to new ideas which they may want to try out in their own practice (Brady, 2009; Britt et al., 2001; Kazemi & Franke, 2004; Sato et al., 2008). Teachers learn by questioning each other about the specifics of their practice, so that they can try to implement the same practices in their own classrooms (Kazemi & Franke, 2004). Discussing colleagues' experiences allows teachers to anticipate what to expect in their own classrooms and to prepare to respond (Grandau, 2005). From a sociocultural perspective, such conversations can be understood as providing the scaffolding necessary for teachers to appropriate new practices that are in their zone of proximal development. However, even when teachers report that they value hearing about other people's practice, they may not actually implement new ideas (Brownell et al., 2014); this is in keeping with the nonlinearity of teacher learning, as viewed through the lens of complexity.

Dialogue can afford opportunities for collective learning, as teachers explore and refine ideas, negotiating meaning collaboratively. Conversations in which a range of possible actions are explored and debated, and those that are best suited to the situation at hand are selected, are likely sites of emergence (Davis & Sumara, 2006). New ideas can emerge when teachers engage in collaborative tasks such as solving math problems (Crespo, 2006), analyzing student work (Kazemi & Franke, 2004; Popp & Goldman, 2016), designing lessons, assessments, or curriculum (Percy, Martin-Beltrán, Silverman, & Daniel, 2015; Pella, 2015), or planning how to implement reforms in their own school and classroom contexts (Coburn, 2001).

Regardless of the topic of conversation, various dialogic processes may promote or constrain learning. At the most basic level, individuals learn by articulating their unformed and developing understandings as well as their tacit knowledge (Sawyer, 2014). Professional development activities that require teachers to articulate formerly tacit knowledge, creating opportunities for them to reflect aloud on their knowledge and beliefs, can enhance teacher learning (Dritts-Esser & Stark, 2015; Peressini & Knuth, 1998). Some researchers have analyzed the discourse in professional learning communities and other communities of practice in order to understand how conversational moves can hinder or promote learning (Crespo, 2006; Horn, 2005; Horn & Little, 2010; Popp & Goldman, 2016). Popp and Goldman identified specific discourse moves that are associated with opportunities for collective learning, including questioning, proposing, elaborating proposals, negotiating, and explaining thinking. They found that these moves were rare in conversations that revolved around sharing instructional practices. When teachers simply describe classroom events, they are likely

to get emotional support from their colleagues, but little collective or individual learning is likely to occur (Horn, 2005). However, teachers engaged in meaningful shared work are more likely to engage in reflective dialogue (Coburn, 2001; Horn, 2005). For instance, Coburn found that a grade-level team that was collaboratively scoring reading assessments began to question fundamental assumptions about the nature of reading comprehension. Over several meetings, the teachers explored questions about the nature of reading comprehension and the teacher's role in helping students to improve reading comprehension, and they engaged with external sources that helped to shift the community of practice's shared understandings, worldviews, and practices.

Professional development does not take place in a vacuum. Teachers engage in dialogue with colleagues, participate in experiences, and reflect on professional development within a particular context. In the following section, I address the other significant system that interacts with a teacher-level system and a professional development system to influence teacher learning: the school-level learning system.

School-Level Learning Systems

Opfer and Pedder (2001) conceptualize a school-level system as “the contexts of the school that support teaching and learning, the collective orientations and beliefs about learning, the collective practices or norms of practice that exist in the school, and the collective capacity to realize shared learning goals” (p. 384). Research has shed light onto the forces that shape these systems as well as some of the system elements that are particularly important in constraining or enabling learning.

School principals and other school-level and district-level administrators play an important role in shaping the school-level learning system (e.g. Firestone, Mangin,

Martinez, & Polovsky, 2005; Jacobs, Burns, & Yendol-Hoppey, 2015; Li, Hallinger, & Ko, 2016). Some researchers who have investigated a direct relationship between principals and individual teacher learning have found that teachers who feel supported by their principal are more likely to use practices from professional development (Heck et al., 2008; Supovitz & Turner, 2000; Wetzels et al., 2016). In a case study of two schools that sent cohorts of elementary teachers to a summer institute intended to support their adoption of a new engineering curriculum, Douglas, Rynearson, Yoon, and Diefes-Dux (2016) illustrated the direct role that principals can play in teacher take up of ideas from professional development. At one school, the principal provided encouragement and emotional support, as well as assistance forging connections with local engineers and acquiring resources to implement ideas from professional development. At the other school, although five teachers had attended the summer institute, the principal prohibited two of them from enacting the new curriculum. She was focused on boosting students' standardized test scores, and the three implementing teachers felt pressured to prove that the engineering curriculum would help students on the test. Ultimately, the teachers at the first school implemented and expanded the curriculum, whereas the teachers at the second school abandoned it. While this example provides evidence that the principal can have a direct effect on individual teachers, ultimately more important is the principal's role in establishing and maintaining the school-level contexts for professional learning, influencing orientations and beliefs about learning, directing the school's practices and norms of practice, and building the collective capacity to realize learning goals.

The structures that principals and other administrators put into place impact professional learning. In particular, decisions about how and with whom teachers will

spend their time impact teacher learning. For instance, administrators can support teacher learning through creating common planning time and providing teachers with release time to participate in professional learning activities (Mouza, 2009; Wood, 2007).

Increasingly, administrators are formalizing school-based communities of practices and requiring teachers to participate in groups such as professional learning communities, data teams, and grade level teams (e.g. Coburn, 2001; Datnow, 2011; Wood, 2007).

While such structures can promote collective professional learning, what happens in the group varies. The formalization of these structures creates a tension between autonomy and administrative direction (Wood, 2007). Collective learning may be promoted or impeded when administrators play an active role in creating agendas and setting tasks for these small groups (e.g. Coburn, 2001; Datnow, 2011; Wood, 2007).

Orientations and beliefs about teaching and learning, as well as norms of practice, can be longstanding and pervasive in schools. If administrator turnover is high, these aspects of the school-level learning system may outlast the administration. However, school administrators attempt to influence collective orientations and beliefs about learning, and accompanying norms of practices in various ways. Many principals establish and promote shared learning goals for the school (Coburn, 2001; Firestone et al., 2005; Gehsmann & Woodside-Jiron, 2005). As they convey messages about what matters for teaching and learning, and set expectations for what they want to see when they visit classrooms, they influence school-wide orientations and beliefs as well as norms.

As learning standards have come to the fore in most schools across the country, teachers are expected to teach in a way that will enable students to meet the standards, as

assessed on standardized tests. In the last decade many states have rolled out complicated new teacher evaluation systems, which include value-added measures to estimate teachers' impact on students' learning (Harris & Hetherington, 2015). There is concern that the inclusion of value-added measures encourages more teaching to the test and shallow instruction (Darling-Hammond, Amrein-Beardsley, Haertel, & Rothstein, 2012). Additionally, the new evaluation systems require more paperwork, which teachers find time-consuming and cumbersome (Goe, Wylie, Bosso, & Olson, 2017). Some teachers report that the whole process increases their stress (Jiang, Sporte, & Luppescu, 2015).

Accountability pressures have led to the development of new norms in some schools. For instance, teachers may be expected to follow pacing guides, marching through mandated, standards-aligned curriculum in lockstep (Achinstein & Ogawa, 2006). School norms may include writing the relevant learning standard on the board for all to see. Additionally, weeks or even months of class sessions devoted exclusively to test preparation have become commonplace in many schools (Booher-Jennings, 2005).

School-level responses to accountability pressures interact with teachers' professional learning. In some school contexts, professional learning opportunities are focused on increasing student test scores and implementing district mandates (Jacobs et al., 2015). Many teachers make decisions about whether and how to enact ideas from professional development based on their relevance to the standards; there is a tendency to deprioritize content that is not perceived as directly relevant to the standards (Douglas et al., 2016; Dritz-Esser & Stark, 2015; Fore et al., 2015; Van Duzor, 2011). Furthermore, when teachers try to implement ideas from professional development, they may be forced

to curtail their efforts in order to focus on test preparation (Brady, 2009; Brownell et al., 2014; Fore et al., 2015). This limits their ability to learn through experience.

For three decades, researchers have been studying school norms regarding teacher collaboration (e.g. Daly, 2009; Hargreaves & Fullan, 2012; Little, 1990). Teachers interact in many ways, from telling stories to sharing resources to planning lessons; these interactions do not all offer the same opportunities for learning (Little, 1990). It is widely accepted that schools with higher levels of trust and cooperation among teachers support teacher learning (e.g. Daly, 2009; Li, Hallinger, & Ko, 2016). Qualitative researchers have illuminated some of the ways in which a collaborative culture can help support teacher learning, from novice teachers who learn the fundamentals of competent practice from their colleagues (Bianchini & Cavazoz, 2007), to experienced teachers who transform their beliefs and practices through shared inquiry (e.g. Horn, 2005; Kazemi & Franke, 2004; Lachance & Confrey, 2003). These findings add nuance to the conclusion from the professional development effects literature that collective participation is a core feature of high quality professional development.

A school's capacity to realize learning goals is influenced by its human and material resources. Multiple researchers have found that teachers who participated in professional development focused on science or technology were limited in their learning by a lack of access to hands-on science materials, computer software, and technology support personnel (Fore et al., 2015; Mouza, 2009; Supovitz & Turner, 2000; Van Duzor, 2011).

When schools simultaneously undertake multiple initiatives, competing demands can interfere with teacher learning (Dagen & Bean, 2014; Wood, 2007). Administrators

can improve schools' capacity to realize learning goals by aligning school priorities with professional learning opportunities (Coburn, 2001; Gehsmann & Woodside-Jiron, 2005). By clearly communicating priorities to teachers and devoting financial and human resources to these priorities, administrators increase the chances for meaningful teacher learning (Li et al., 2016; Wood, 2007). However, shared learning priorities do not always correspond with individual teachers' learning needs; schools that mandate participation in professional development without regard to teachers' experience or the subject they teach may inadvertently limit some teachers' learning (Firestone et al., 2005).

Interactions among Three Systems: One Teacher's Learning Process.

In the preceding sections, I summarized the research on three overlapping complex systems that interact as part of teachers' learning. I dissected teacher learning processes, holding up key mechanisms to the microscope one by one in an effort to illustrate their roles at the intersection of the professional development and individual teacher learning systems. However, as discussed above, a complex system is more than the sum of its parts; breaking it apart undermines the nature of the system. It is necessary to examine a system holistically to understand its workings. Thus, to illustrate how learning mechanisms can work together to promote teacher learning in the context of three overlapping systems, I use Gallucci's (2008) study of one teacher's experiences with job-embedded professional development. Gallucci details the experiences of Caryn, a veteran second grade teacher, as she participated in school-based professional development focused on balanced literacy. Drawing on ideas from sociocultural theory, Gallucci employs the Vygotsky Space, described above (see Figure 1), to analyze the role of individual and social experiences in public and private locations. I extend her analysis

by highlighting the role of experience, dialogue, and reflection, in order to concretize how learning can be understood from the perspective of a sociocultural model of professional learning. Furthermore, I draw on concepts from complexity theory to illustrate that this model can complement a complex systems perspective. Caryn's story is not intended as a generalization to all teachers, but rather as one example.

Throughout a school year, Caryn assumed the role of a studio teacher; she hosted other teachers and administrators in her classroom on six days for demonstration lessons, which were usually taught by an external literacy consultant. On "studio days" teachers, literacy coaches, and administrators from two schools came together for half-day meetings facilitated by the external literacy consultant. These were opportunities for the consultant to present new ideas and to demonstrate them in practice in studio teachers' classrooms. On one of these days, participants observed Caryn conduct a reading conference with a student. During a public debrief, the consultant questioned Caryn about her practice, asking her about her intentions for the conference. The idea of intention was new to Caryn and most of her colleagues. Unable to articulate an intention, Caryn responded, "I have *no* idea. There was no direct instruction going on. I don't really go in with intention" (p. 557).

The consultant's question about intentions triggered Caryn's awareness of and critical reflection on the gap between her current practice and the ideals of balanced literacy. Her discomfort precipitated transformative learning. In order to appropriate this new idea about conferencing with intention, Caryn began to research balanced literacy practices. In collaboration with the school-based literacy coach, Caryn turned to external

sources about teaching reading. She also conferred with colleagues, visiting the classrooms of other teachers in her community of practice to see how they taught reading.

Based on her research, Caryn began to change her approach to reading conferences in her classroom. She created, tried out, reflected on, and tweaked new systems for reading conferences, transforming what she had learned from her research in order to make reading conferences work in her classroom context. At a spring studio day, Caryn publically presented a video of a recent reading conference that she had conducted with a student, and she discussed what she had learned about bringing intention to her work with all readers. In this presentation, she demonstrated her learning to others, and gave them a chance to learn from her through dialogue.

This is a clear example of learning as a social process; Caryn learned through her participation in face-to-face interactions as well as through her interaction with texts. It was not a linear process, but rather took place as Caryn moved back and forth between the four quadrants of the Vygotsky Space, shuttling between private and public settings as well as individual and social practices. The consultant facilitated Caryn's dawning awareness of the gaps between these new ideas and her current practice by engaging with her dialogically about her intentions. Through her social practices, she was exposed to new ideas from others in her community of practice as well as from external sources. Classroom experience was her bedrock for understanding and trying out new ideas, and reflection offered a feedback loop between new ideas from professional development system and her experiences.

From a complex systems perspective, Caryn's learning can also be analyzed in terms of the conditions within and the interactions among three overlapping systems.

Caryn's learning was influenced by the school context in which she worked. The school-embedded professional learning activity was aligned with the school's established learning goals and embraced by the principal. Furthermore, her learning has much to do with her own learning system, including her motivations for participating in the professional development, and her prior knowledge about literacy instruction. A sociocultural model of learning is useful to understand the processes through which learning occurred for Caryn, but her learning can only be fully understood in the context of these three complex systems.

Conclusion

In the above literature review, following Opfer and Pedder (2011), I painted a picture of three complex systems that interact in teacher learning: the professional development activity regarded as a complex system, the teacher regarded as a complex system, and the school as a complex system. I critiqued the professional development effects literature for its linear perspective that does not reflect the complexity of teacher learning. A focus on identifying "core features" does not help us to understand how, why, and under what conditions individual teachers actually learn. Although other researchers have identified factors at the level of the school-as-system and the teacher-as-system that are associated with teacher learning, as I discussed, there is little research that takes a holistic perspective on learning.

I was only able to locate three extant studies that explore teacher learning through professional development from a complexity perspective (Taylor, 2017; Walton, Nel, Muller, & Lebeloane, 2014; Wetzels et al., 2016). In each of these studies, the researchers employ Opfer and Pedder's (2011) framing of teacher learning as a complex system to

analyze the varied outcomes following professional development for specific teachers in specific schools. These studies serve as empirical test cases for the utility of complexity theory in explaining teacher learning through professional development. However, complexity theory is used in a limited, post hoc way to account for differences (Cochran-Smith, et al., 2014). The researchers did not attempt to generate theory.

This is where this dissertation adds to the literature. As Opfer and Pedder (2011) assert:

There are generalizations that we should be able to make about the way the professional learning activities relate to teacher learning that are true across different teachers and different school contexts. Good teachers affect student learning by making a distinction between what is unique to a specific context and what is generalizable to other contexts and student groups. That is, they understand that teaching has both contextualized and decontextualized properties. An adequate explanatory theory of teacher learning should likewise be able to distinguish between those aspects of professional learning that are unique and those that are generalizable to other teachers and contexts of practice. (p. 394)

Following Opfer and Pedder, I theorize that the relationships among the three, interconnected, complex systems involved in teacher learning are patterned. In this dissertation, I offer an approach for thinking about teacher learning holistically that accounts for what is unique to the local and individual contexts. I suggest this approach may be useful for examining the learning of different teachers in different contexts, and thus may be a step in the direction of generating an explanatory theory of teacher learning.

CHAPTER THREE

Research Design

The purpose of this study was to investigate the learning processes of teachers participating in ongoing, collective professional development. I addressed the following research questions:

1. What is the nature of four, complex, nested, and overlapping systems: a professional development initiative that grew out of a university-school research partnership, the school in which the professional development occurred, and two teachers who participated in the professional development?
2. What do two teachers learn about language-focused instruction for emergent bilingual students in the course of participating in the professional development initiative?
3. How do three complex learning systems (the teacher, the professional development, and the school) interact and combine to influence the teachers' learning?
 - a. What are the control parameters and complex, contingent, causal mechanisms that promoted or hindered their learning?
 - b. What role do the actions of the facilitators play in influencing their learning?

These questions and the methods that I used to answer them were informed by my theoretical framework, which had significant methodological implications, as described in the next section.

Researching Complex Systems

Complexity theory has been put to enormously varied uses by researchers, who have employed a wide range of methods in their inquiries (Davis & Sumara, 2006). Although complexity theory does not point to a particular method, complexity-informed research is united by a holistic view of systems. Unlike researchers operating from a positivist paradigm, complexity theorists do not try to provide definitive answers to various versions of “what works?” questions about learning and other phenomena. Rather, as discussed in the previous chapter, complexity theory is premised on the idea that social systems are unpredictable and cannot be explained with simple causes and linear effects. This means that it is unrealistic for educational researchers to attempt to isolate simple causes, which can lead to solutions that will “work” regardless of context (Radford, 2006). Furthermore, when researchers focus on isolating measurable variables to determine causation, they are liable to ignore the interactions between system elements and the significance of the whole (Morrison, 2008). As the expression goes, they miss the forest for the trees. Complexity theorists instead attempt not just to see the whole forest, but to understand it as an ecosystem.

Much of the existing educational research informed by complexity theory takes a descriptive approach (Cochran-Smith et al., 2014). Radford (2006) argues that such research is well-suited to “uncovering complex connections and examining how policy and practice develop” (p. 186). In addition to describing what happens, complexity-informed research can also explain why and how it happens. Byrne and Callaghan (2014) posit, “the tracing of the ways things change kinds over time... for us is one of the most valuable of all investigative techniques in the repertoire of complexity science as an

empirical project” (p. 74). By analyzing complex systems over time, researchers can identify complex causal mechanisms that, in combination, under specific conditions, and in particular sequences, bring about change (Byrne & Callaghan, 2014; Opfer & Pedder, 2011).

In this study, I sought both to describe learning and to explore its causes. By describing the nature of the particular systems involved in teacher learning (RQ1), identifying changes in the ways that teachers articulated and enacted their understanding (RQ2), and investigating the control parameters within and between overlapping systems as well as the complex, contingent, causal mechanisms that brought about the changes, (RQ3), I hoped to be able to theorize and explain the learning processes of the teachers who were the focus of this study. I agree with those complexity theorists who argue that local theories about how things happened in one system, under particular conditions and in specific circumstances, may have application beyond that system (e.g. Byrne, 2005; Byrne & Callaghan, 2014; Cochran Smith et al., 2014; Opfer & Pedder, 2011). That is, it is possible to make limited generalizations about changes in complex systems by comparing the patterns of change identified within one system with changes in other similar systems in order to develop a deeper understanding of causes and effects and how causes combine and interact to lead to various outcomes (Byrne, 2005; Byrne & Callaghan, 2014). Byrne and Callaghan wisely advise using caution in specifying the systems to which a generalization might apply:

Our generalization is absolutely dependent upon scoping, on a carefully formulated and delimited account of the range, with time being a dimension of

that range, across which any generalizable account holds. So it is an account of for what, when and where. (p. 195)

In other words, only when two systems share a largely similar history and context, would we expect to see the same configuration of complex and contingent causes leading to changes. Opfer and Pedder's (2011) call for studies of teacher learning in different circumstances with different teachers is premised on this idea. By carefully delineating "what is specific and idiosyncratic to individual teachers or contexts" (p. 383), they argue that it is possible to locate patterns of learning that can help to explain the learning of teachers in other contexts. Ultimately, the goal of this dissertation was to contribute to identifying and explaining these learning patterns.

Research carried out within a complexity paradigm requires methods for understanding systems holistically. This includes "variable-inclusive" research designs (Opfer & Pedder, 2011) that collect "rich" data, which are detailed and varied (Maxwell, 2011). It also necessitates studying a system over an extended time period, rather than at one or a few time points (Byrne & Callaghan, 2014; Gerrits, 2008; Haggis, 2008; Maxwell, 2004, 2011). Although a "continuous longitudinal approach" is time-consuming, Gerrits (2008) argues that collecting detailed data is essential:

The non-linear emergence of structures cannot be traced back to its roots mechanically. The nature of complexity makes it inevitable that it is reconstructed afterwards and in order to find these roots a high resolution of past developments should be obtained. This minimizes the risk of overlooking certain developments that appear in the context of cases that prove to be determinants. (p. 24)

An intensive approach is likely to lead to the collection of some data that is not meaningful; however, this is unavoidable, as it is impossible to predict with certainty what will be of importance.

Through intensive, long-term involvement with a system, it is possible to recognize and account for complex causation (Byrne, 2005). Maxwell (2011) compares the study of social processes and physical processes:

In the same way that a detailed, chronological description of a physical process (for example, of waves washing away a sand castle...) often reveals many of the causal mechanisms at work, a similar description of a social setting or event can reveal many of the causal processes taking place. (p. 43)

While changes within social systems are rarely, if ever, open to direct observation in their entirety, nevertheless, through subjecting rich data from multiple sources to rigorous analysis, it is possible to generate compelling, complex causal explanations.

Case Study Research

Many researchers working from a complexity perspective have adopted case study methods to serve the purposes described above (e.g. Anderson, Crabtree, Steele, & McDaniel, 2005; Beswick, Watson, & DeGeest, 2012; Gerrits, 2008; Hetherington, 2012; Wetzels et al., 2016). Although not explicitly developed for the study of complex systems, “case study research arises out of the desire to understand complex social phenomena” (Yin, 2014, p. 4). In order to fulfill this need, researchers have developed qualitative case study methods that permit in-depth exploration of a contemporary entity (the “case”) within its real-world context (Stake, 2005; Yin, 2014). Case study researchers are able to investigate many variables of interest in each case, by gathering

evidence from various types of data sources, including observations, interviews, and artifacts (Yin, 2014). Case studies emphasize the context surrounding the case, thus “retain[ing] the holistic and meaningful characteristics of real-life events” (Yin, 2014, p. 4). Case study research typically illuminates some of the many contexts (e.g. historical, cultural, physical, social, economic, and political) surrounding the case, “especially the problematic ones” (Stake, 2005, p. 12). Case study methods are well suited to exploring questions of process and cause, which necessitate tracing multiple, contextualized links over time (Shavelson & Towne, 2002; Stake, 2005; Yin, 2014).

This dissertation about teacher learning from a complexity perspective lent itself to case study methods, which allow for in-depth examination of the multiple, interrelated factors that impact teacher learning. Anderson, Crabtree, Steele, and McDaniel (2006) recommend that researchers using complexity theory extend case study designs in several key ways. They suggest focusing on interdependencies and interactions among system elements and analyzing the dimensions of relationships in order to understand how the system is organized. Additionally, they encourage researchers to attend to “nonlinearities,” or events that are disproportionate with their outcomes, as such nonlinearities can provide key information about the system. In addition to helping researchers to understand a system, case study’s emphasis on context surrounding a case is a good fit with complexity theory, with context interpreted as the multiple, overlapping systems in which a particular system is nested. Case study methods allow researchers to heed Byrne and Callaghan’s (2014) reminder “to pay attention both to the components, complex and interacting components of course, which constitute the case *and* to the relations of the case” (p. 156).

Defining and Bounding Cases

Manuals on case study research advise researchers to carefully define and bound their cases (Yin, 2014). For researchers operating from a complexity perspective, however, this is inappropriate, given the open and unbounded nature of complex systems. Any boundaries that the researcher imposes may limit her understanding of the range of interactions that impact the case (Davis & Sumara, 2006; Hetherington, 2013). Rather than selecting a traditional case study unit of analysis, such as an individual, an institution, or an event, it is helpful to equate a complex system with a case, in order to study the system as an integrated whole (Anderson et al., 2006; Hetherington, 2013). In this study, the cases were two teachers' learning systems. A teacher's learning system consists of an extremely large number of elements—experiences, knowledge, beliefs, and practices—which are far from equilibrium, constantly changing, as they interact with each other and with their environment. Treating a system as a case means studying the relations among these constantly shifting elements.

Although I can define the cases as specific systems, bounding them is inconsistent with complexity theory, as understanding how they operate requires exploring their interactions with other systems. Following Opfer and Pedder (2011), I conceptualize teacher learning systems as overlapping with school-level learning systems and professional development systems. Not only did I seek to understand the interdependencies and interactions among elements within each case as recommended by Anderson et al. (2006), but I also investigated the interdependencies and interactions among the teacher-level learning systems, the professional development activity system, and the school-level learning system.

While treating the cases expansively was necessary, some boundary-setting provided focus for the research. The larger curriculum development project itself was bounded in scope and in time, which offered a useful set of boundaries for the research. The cases focus on learning that occurred in the context of participating in the professional development and implementing lessons from the curriculum, during the 2016-2017 school year.

Case Study Design

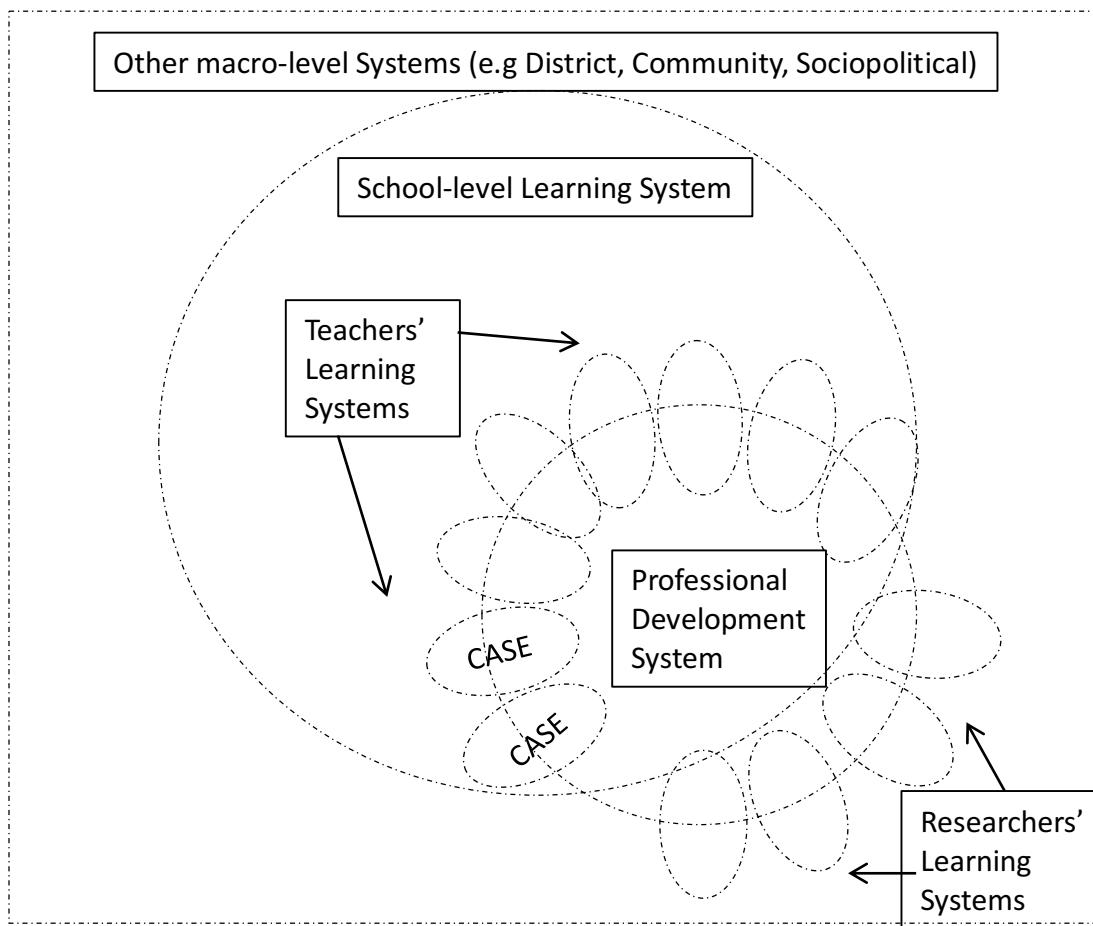


Figure 2. Case study design.

The case study design is depicted in Figure 2. It includes the major systems interacting with the teachers' learning systems, as it is impossible to understand teacher

learning without considering the context. The cases are two teacher learning systems. In the figure, the teacher learning systems overlap with the professional development system, demonstrating that the teacher learning systems were partially nested in the teacher working group. They are surrounded by circles representing the learning systems of the other teacher working group participants, including both the other teachers and the researchers. Furthermore, the cases are depicted nested within the larger school-level learning system, which is represented by the largest circle. This is in turn nested within a box that represents macro-level systems, such as the district, the community, and larger sociopolitical systems. The dotted lines signify that the systems were open, continuously exchanging information with each other.

The study has features of a multiple-case study, which is a research design for closely examining several cases that are bound together by a common characteristic or condition. Stake (2005) posits that multiple-case research is the optimal way to explore variation between individual cases that respond differently in complex situations. Given previous research findings (e.g. Spelman & Rohlwing, 2013; Whitworth & Chiu, 2015), I expected to encounter variation in the learning of the teachers implementing the curriculum. Traditionally, researchers carefully delineate boundaries between cases, and among cases and context; however complexity theory suggests that system boundaries are permeable. While the design depicted above includes two cases, it also emphasizes the nested and overlapping nature of complex systems, which allowed me to examine how systems interacted, while maintaining a holistic view.

Practitioner Inquiry

This study arose in the context of the Language Awareness and Dialogic Reasoning project, a large, curriculum development study for which I was a research assistant from 2014 to 2017. Throughout that time, I facilitated the monthly teacher working group sessions at which members of our research team met with a group of teachers. The curriculum that we developed in consultation with the teachers is described in detail later in the chapter. During the 2016-2017 school year, four members of the teacher working group implemented the curriculum. I took on a new role as professional developer with the explicit goal of supporting the learning of the implementing teachers. This dissertation came about as I prepared for this role. I recognized that I needed a better understanding of how learning takes place through professional development, in order to design learning environments and facilitate meaningful learning experiences. I had questions about adult learning, professional learning environments, and facilitation. Initially, I went to the existing literature on professional development to find answers. However, as described in Chapter Two, there are no simple answers to how learning takes place, because learners are complex, and complex systems are unique. Likewise, there are no simple answers about how to facilitate professional development, because facilitators are themselves complex systems, interacting with other complex systems. Ultimately, the literature cannot and should not offer simple best practices that facilitators can adopt wholesale. Instead, I realized that what teachers would get out of any professional development that I designed would depend in a large part on the interactions of the complex systems involved (the teachers, the school, and the professional development activity of which I was a part). To become an “effective” professional

developer, or an educator who successfully promotes learning for all teachers, I needed a better understanding of all the systems involved.

My research focused on the professional development that I helped to plan and facilitate through the Language Awareness and Dialogic Reasoning project, and the systems that interacted with the professional development to promote or constrain teacher learning. Answering my research questions meant engaging in practitioner inquiry.

Practitioner inquiry is research in which an education practitioner simultaneously takes on the dual roles of practitioner and researcher and studies problems and issues that arise in the professional context (Cochran-Smith & Lytle, 2009). This is vastly different from more traditional research in which practitioners are the topic of someone else's study.

Practitioner inquiry has emerged from the work of teachers and teacher educators, “whose attempts to better understand the problematic worlds of teaching and learning have led to an increasing focus on their work so that researching their practice better informs them about their teaching and enhances their students' learning” (Loughran, 2004, p. 9). Like these other educators, I hoped to develop a deeper understanding of my work with teachers, in order to inform my work with the teachers participating in the study as well as the other teachers with whom I anticipate working in the future. Research question 3B directly speaks to this motive, calling for an examination of my own actions as a professional development facilitator, in relation to the teachers' learning.

Like other research, practitioner inquiry is systematic and intentional, involving careful documentation (Cochran-Smith & Lytle, 2009). Although it does not call for any particular method of data collection or analysis, two important methodological implementations merit mention. First, practitioner inquiry is driven by contextual factors;

it is carried out by a particular person or people, with a particular problem, in a particular setting. When practitioner inquiry is written up, an understanding of this context should be integrated into the report (Loughran, 2004). In this way, practitioner inquiry is highly compatible with complexity theory, and case study methods are a logical fit. Secondly, practitioner researchers document their insider perspectives, including their questions, interpretive frameworks, changing views, and dilemmas, as part of the data corpus (Cochran-Smith & Lytle, 2009).

Positionality

Herr and Anderson (2015) caution that researchers need to address “sticky positionality issues” in order to carry out a valid and ethical study (p. 52). Researchers must consider their positions within organizational and social hierarchies, as well as their positions vis-à-vis dominant groups in society (e.g. class, race, ethnicity, gender, age, educational level), as these aspects of positionality can influence research relationships. My demographic profile is similar to my participants in several ways. I am a former elementary school teacher with a Masters degree in education. Like the participants, I am a White woman and a native English speaker. These aspects of my identity served to equalize the power in our relationships. However, I was aware that my roles as a researcher, curriculum developer, and professional developer could alter the balance of power in my favor. I recognized that teachers might feel uncomfortable having me observe their lessons and discussing their teaching with me due to a concern that I would evaluate their performance. During interviews, participants might feel that they had to respond positively when asked about their participation in professional development.

I attempted to minimize the impact of these power dynamics by building and maintaining trusting relationships with the participants, whom I had already known for two years prior to the start of dissertation research. I sought to position myself as a former classroom teacher and a future professional developer, rather than a judgmental researcher. When I observed teachers' lessons, I was careful to lead with positive feedback and to ask for their reflections; I rarely offered critical feedback. Additionally, I designed the interview protocols to minimize the pressure that participants might feel to respond positively about the professional development. I avoided asking them to make value judgments about their learning; instead I asked them to identify and reflect on specific instances of learning.

Another issue needing attention was how my positionality led to preconceptions that shaped my research (Rubin & Rubin, 2012). In Chapter Two, I laid out the conception that teachers perceive new learning events through the lens of their own complex learning systems, which are shaped by their knowledge, experiences, practice, and beliefs. The same was true for me. I could not help but interpret teachers' learning through the lens of my own experiences and beliefs. To counteract this tendency, I used interviews with the participants to seek out their perspectives on their learning. Additionally, I shared my data and analyses with others: 1) I asked colleagues on the research team who were familiar with the Bilingüe teachers to look over my analyses and suggest alternative explanations, and 2) I conducted member checks with Martina and Kelly, in which I shared my analyses of their learning processes, to ensure that my interpretations resonated with their own experiences. By seeking out the perspectives of others, I sought to increase the validity of my results.

Research Setting and Cases

The Language Awareness and Dialogic Reasoning Project

The data for the study were gathered as part of a larger, grant-funded research project. Researchers from two universities in the Northeastern United States, in consultation with elementary teachers, developed and tested a curriculum to be used with emergent bilingual students to foster language awareness, oral language proficiency, and reading comprehension. Designed to be implemented with small groups of upper elementary students, the curriculum consists primarily of five-day, text-based lesson cycles on topics related to science and social studies. On days one and two of each cycle, students read a written text, watch a related video, and discuss key vocabulary words connected to these texts. Days three and four focus explicitly on language; students use the texts as a springboard to develop understanding of and skills in semantics, morphology, and syntax. Students discuss semantic relationships between vocabulary words, build and segment words containing target prefixes and suffixes, and construct sentences with specific syntactic structures. On day five, students engage in dialogic reasoning discussions, which are small-group, peer-led discussions about a contentious issue related to the texts (Ossa Parra et al., 2016). Appendix A provides an overview of the curriculum.

As a research assistant on the project from 2014-2017, I played multiple roles, including curriculum developer, teacher, site liaison, professional developer, and researcher. The first two years of the project were the curriculum development stage. Using principles from design-based research (Design-Based Research Collective, 2003) and practice-embedded educational research (Snow, 2015), the research group engaged in

an iterative process of curriculum development and implementation. In the role of curriculum developer, I collaborated with other research assistants to develop unit and lesson plans and materials, and I consulted with teachers during monthly teacher working group meetings for the purpose of getting suggestions for and feedback on curriculum materials. During implementation periods, I assumed the role of teacher, facilitating lessons with small groups of fourth grade students.

The 2016-2017 school year ushered in the second stage of the study. The research team conducted a small-scale, experimental pilot study to evaluate the efficacy and feasibility of the curriculum. Teachers at seven schools in southern New England and the Mid-Atlantic implemented the curriculum with randomly selected “intervention students,” while “control students” from the same homerooms continued to take part in the regular classroom activities. Throughout the year, the implementing teachers participated in school-based professional development facilitated by the researchers. I took on the role of professional developer. My new responsibilities included planning and facilitating a five-hour orientation for all the participating teachers in New England, planning and facilitating monthly teacher working group sessions at one school, observing teachers as they implemented lessons from the curriculum, and providing feedback about fidelity during debrief conversations.

Throughout the project, I was a site liaison to the Bilingüe School as well as a researcher. As site liaison, I was the primary point of contact between the university-based research team and the partnering teachers. I coordinated logistics such as obtaining student consent forms, distributing curriculum materials, and scheduling lessons, meetings, and assessments. In this role, I exchanged dozens of emails with the teachers in

the teacher working group, had numerous, quick, face-to-face conversations with individuals, and talked “business” during teacher working group sessions. While I collected and analyzed data throughout the three years of the project, in the final year research became a larger priority, due to the demands of this dissertation.

The Bilingüe School

I conducted the study at The Bilingüe School², where I was site liaison between 2014 and 2017. Bilingüe is located in a semi-urban district in southern New England. It is an elementary school with a two-way bilingual program that provides Spanish and English instruction. The school defines its mission in the following terms:

The mission of Bilingüe School is to prepare our students to become successful global citizens. We challenge them to reach their academic potential and teach them the value of cultural, economic and learning differences, with an emphasis on bi-lingualism and biliteracy.

In the fall of 2016, the emphasis on bilingualism and biliteracy was readily apparent.

Visitors were greeted in the lobby with a large banner reading:

Bienvenidos a Bilingüe una Escuela Bilingüe de Doble Via

Welcome to Bilingüe a Two-Way Bilingual School

Bilingual signs were posted in the lobby and throughout the school building to remind students of school rules, identify rooms, and provide information. The student work lining the walls in the hallways varied in language. Spanish and English works intermingled in a display of 3rd grade personal narratives, while other collections featured one language or the other, presumably reflecting the language of instruction during the

² The names of the school and the participating teachers are pseudonyms.

lesson. Listening in at classroom doors, I could hear teachers and students speaking both languages.

Bilingüe is a large elementary school, with four or more homerooms at each grade level in the two-way program. Students in the upper elementary grades receive 50% of their instruction in English and 50% in Spanish. In some cases, one teacher provides instruction in both languages, while other teachers teach in one language and partner with another teacher who instructs in the other language. ESL teachers provide support to students in grades 3-5 who are still considered to have limited English proficiency. Each grade is officially required to have a dedicated ESL teacher, but staffing issues have meant that this is not always the case.

Approximately 700 students attended Bilingüe during 2016-2017. The student body was 70% Hispanic, 23% White, 4% African-American, 3% Multi-race, and less than 1% Asian. Many of the children came from homes where Spanish was the primary language, with 60% of students speaking a first language other than English. Forty-seven percent of students were classified as economically disadvantaged³. Bilingüe is located in a district with school choice; students come from all over the district because their parents have sought out the two-way bilingual program.

The Teacher Working Group

During the 2016-2017 school year, eight teachers participated in the Bilingüe teacher working group alongside the principal investigator and three university-based research assistants, including myself. The teacher working group had four main goals: 1)

³ Students are classified as “economically disadvantaged” if they participate in state-administered programs that provide assistance to low-income children and families. According to literature from the state department of education, this metric tends to undercount low-income students.

support the implementing teachers so that they could better implement the curriculum; 2) gather feedback from the implementing teachers to inform future iterations of the curriculum; 3) develop a Spanish-language analog to the existing English-language curriculum; and 4) enable teachers to develop curriculum for their own classrooms using Language Awareness and Dialogic Reasoning project principles (see Table A3 in Appendix A for a list of the principles). Four of the teachers implemented the curriculum as part of the larger study, while the other four teachers focused on curriculum development. All teachers received an annual stipend of \$1,000 for their participation in the project.

The teacher working group met once per month. I co-facilitated these sessions with the other research assistants. Meeting times were divided between large group activities and small group breakout sessions, intended to offer more targeted time for teachers who were involved with different aspects of the project. I facilitated breakout sessions with the four implementing teachers, while the other research assistants facilitated sessions with the teachers who were developing curriculum.

The Cases

I initially collected data on the learning systems of the four Bilingüe teachers in the teacher working group who were implementing the Language Awareness and Dialogic Reasoning curriculum: Kelly, Martina, Helen, and Carol. I selected two of them for detailed analysis, in order to keep the data collection and analysis demands manageable. To narrow down to two cases, two criteria were used: 1) relevance to other teachers in other schools, and 2) the size of the gap between the teacher's current classroom practices and those espoused in the professional development system. The first

criterion ruled out Helen, who was the school's literacy coach. Her primary responsibility was to support teachers in the areas of literacy pedagogy and curriculum, through one-on-one coaching and support for grade-level teams. She did not teach students on a regular basis. Her situation as literacy coach was so different from most teachers' situations, that her learning process was less likely to hold patterns that would be relevant to others. To determine who fit the second criterion, I conducted an initial analysis of the three remaining teachers' instructional practices. I reviewed my field notes from classroom observations and watched some of the videos I had collected during the first few months of the year to get a general impression of the extent to which their practices corresponded with the Language Awareness and Dialogic Reasoning pedagogical principles. From my analysis, it was apparent that Carol's teaching style was the most dialogic, corresponding most closely with the ideas promoted in the professional development, and thus already closely aligned with the goal of the program. Kelly's and Martina's practices were less dialogic, and they seemed to have more potential for significant learning through the professional development than did Carol. Thus I selected Kelly and Martina as my two cases for further data collection and in-depth analysis.

Both Kelly and Martina were White women and native English speakers, who developed fluency in Spanish during or after college. Both had Masters degrees in education. While these aspects of their profiles were similar, there were notable differences in their experiences and roles. Kelly was a 4th grade classroom teacher with twenty-five years of teaching experience. She had been teaching at Bilingüe for ten years; in addition to her teaching responsibilities, she was an active member of the school's leadership committee, helping to plan professional development for faculty and staff.

Kelly was a teacher working group member for all three years of the Language Awareness and Dialogic Reasoning project. During the project's first two years, she permitted us to work with small groups of her students during the implementation cycles of the development process. Kelly presented about the project at two bilingual education conferences; she was a co-presenter alongside the university-based research team in the spring of 2016, and, at her own initiative, was the lead presenter at a conference in the fall of 2016. During the 2016-2017 year, Kelly implemented the Language Awareness and Dialogic Reasoning curriculum with a small group of Spanish-dominant students from her own homeroom.

Martina was the 4th grade ESL teacher. This was her first year in the role. Previously, she had been a classroom teacher for approximately ten years. Martina participated in the teacher working group during the 2014-2015 school year, spent the following year studying and travelling in South America, and rejoined the Language Awareness and Dialogic Reasoning project upon returning to Bilingüe in the fall of 2016. During the 2016-2017 year, she taught two Language Awareness and Dialogic Reasoning groups, consisting of Spanish-dominant students from multiple 4th grade homerooms.

Data Sources

I used a variety of different data sources, including direct observations and interviews, as well as documents, archival records, and artifacts. Table 1 provides an overview of the data sources that I collected. Each data source is described in detail in the sections that follow.

Table 1

Data Sources

Data Source		Frequency/Description	Total	
Direct Observation	Teacher Working Group Sessions	Monthly	10	
	Classroom Observations	1-2/ teacher / month (December – May)	9-10/ teacher	19 in all
Interviews	Lesson Debriefs	15-minute debriefs after some classroom observations	2-6/ teacher	8 in all
	Interviews	Extended interviews with each teacher (Fall & Spring)	2/teacher	4 in all
		Principal interview		1
Documents, Archival Records, Artifacts		Ongoing	~100	

Teacher Working Group Sessions

As described above, teacher working group sessions were the hour-long, monthly meetings in which the Bilingüe teachers met with the researchers. I was involved in the sessions as a facilitator. These sessions were a key data source for identifying change or stasis in teachers’ verbalized knowledge and beliefs. During the sessions, I took notes on the key points that came up in conversation. I returned to these notes within 24 hours afterwards to add more detail about my observations and my impressions. Additionally, I audiotaped and transcribed all teacher working group sessions to facilitate subsequent analysis.

Classroom Observations

I conducted observations of each participant teaching lessons from the Language Awareness and Dialogic Reasoning curriculum, for the purposes of identifying changes in the teachers’ language-focused instructional practices. I observed each teacher once or

twice per month throughout the period of curriculum implementation (December 2016 - May 2017), for a total of nine to ten half-hour observations per teacher. All observations were video-recorded. Selected excerpts were later transcribed.

Before observing a lesson, I reviewed the lesson plan to re-familiarize myself with what I was about to observe. The curriculum includes detailed lesson plans that describe lesson procedures in detail. Teachers had been provided with most of the lesson materials, including texts, PowerPoint presentations, game cards, worksheets, and so forth. Although it is not a scripted curriculum, per se, teachers were asked to implement the lesson plans as written in accordance with the experimental design of the pilot study. The observations also served as fidelity observations for the larger Language Awareness and Dialogic Reasoning project. The research team subsequently evaluated teachers' fidelity of implementation on the basis of the video recordings and field notes.

While observing, I use the project-designed fidelity observation protocol to take notes. Portions of the protocol were irrelevant for the purposes of my study, such as columns for fidelity rankings and rationale. However, the form also included space for field notes, which I used to take detailed notes on the language-focused activities in the lesson, including explicit teaching about language, discussions about language, students' oral production of language, and teacher facilitation of student conversations. I summarized all lesson activities and included verbatim quotations from the teacher and students when possible.

As soon as possible, and not more than 24 hours, after observing the lessons, I reread the field notes and watched portions of the video in order to elaborate on skimpy data. At this point I also wrote a memo about the lesson. I noted what went well and what

was less successful, as well as connections or differences between the teacher's practice and ideas discussed during teacher working group sessions. Based on my knowledge of the teacher's other professional development experiences and school-wide learning initiatives, I speculated about other influences on her instruction.

Debrief Interviews

A key source of case study evidence (Yin, 2014), interviews provide access to “the lived experience of other people and the meaning they make of that experience” (Seidman, 2013, p. 9). Learning is a meaning-making process; in order for me to understand what and how teachers learned through their participation in professional development, I needed to ask them directly about their experiences. To do so, I conducted both short lesson debrief interviews, as well as extended interviews. All interviews were audio-recorded and transcribed for analysis.

I conducted debriefs lasting from 5-20 minutes with participants as soon as possible after the classroom observations, as minimizing the time that passed between the event in question and the interview is intended to facilitate recall (Lyle, 2003). Due to scheduling constraints, it was not possible to conduct debriefs after every lesson. I was able to conduct two debriefs with Kelly and six with Martina. The goal of the debriefs was to understand how the participants made sense of their teaching, and in so doing to better understand whether they were learning through their participation in professional development, what they were learning, and how they were learning it.

To prepare for a lesson debrief, I selected one or two episodes from the lesson to discuss with the teacher. Episodes were brief parts of the lesson, ranging from a few seconds through a few minutes. I chose episodes for one of four reasons: 1) The teacher's

actions suggested that she was trying to put into practice something that was discussed during a teacher working group session; 2) the teacher did not implement a practice discussed during a working group session at a moment when it might have been appropriate; 3) the teacher acted differently than she did during a comparable episode in a previously observed lesson; or 4) the teacher deviated from the lesson plan.

During the debrief, I used a semi-structured conversational guide to ask the teacher about the lesson (see Appendix B). I began by asking the participant how she thought the lesson went. This was intended to surface the teacher's pedagogical beliefs, which were likely to interact with her learning. A negative self-evaluation might also reveal places where the teacher had developed knowledge through professional development that she was not yet putting into action. Additionally, I asked teachers about one or two pre-selected episodes from the lesson. For this portion of the debrief, I employed stimulated recall, which is an introspection procedure in which passages of behavior are replayed/ reconstructed to stimulate an individual's recollection of her concurrent cognitive activity (Lyle, 2003).

My adaptation of stimulated recall is similar to the approach taken by Kennedy (2005) to investigate how teachers account for their practices. I shared the lesson episode(s) by playing back the video. I asked the teacher a series of questions to uncover four areas of interest: 1) How did the teacher understand the episode?; 2) Why did the teacher act as she did?; 3) Had the teacher always acted in this manner?; and 4) If not, what brought about the change? I used a suite of related questions, corresponding with each of these overarching questions, to pursue the issue.

Stimulated recall has been criticized on the grounds that thought processes are fleeting and cognitive details can be quickly forgotten (Ericsson & Simon, 1993). Interviewees may report a new view, based on meta-analysis and reflection, rather than reporting their thinking at the moment in question (Lyle, 2003). Although these concerns are valid, I was less interested in a teacher's thought processes in the moment, than with their conclusions, which were likely to reflect their current thinking, including newly emergent beliefs. I was aware that the third and fourth lines of questioning, regarding whether teachers' practices had changed, would be more challenging for teachers to answer, as they required a degree of metacognition that might not be available to all teachers.

Another critique of interviews generally is that respondents may answer the questions in a manner that they hope will please or impress their interviewer. Throughout the debriefs I tried to keep my views out of the conversations as much as possible. When asking about lesson episodes, I limited what I said about the events, in order not to influence the teachers' thinking with my interpretations or judgments. However, the teachers were already familiar with some of my views from my participation in teacher working group discussions. Their responses may well have been influenced by their perceptions of what I wanted to hear as a representative of the Language Awareness and Dialogic Reasoning project and a facilitator of professional development. Therefore, rather than treating these debriefs as faithful portrayals of teachers' pedagogical beliefs and values, I triangulated teachers' statements with the theory-in-use that I observed in their teaching (Maxwell, 2011).

Interviews

I conducted two responsive interviews (Rubin & Rubin, 2012) with each participant with a duration of 40 to 75 minutes. Emphasizing flexibility of design, responsive interviewing is a variety of semi-structured interview that calls for the researcher to adapt the line of questioning fluidly based on the interviewee's replies. The interviewer typically prepares a handful of main questions, designed to uncover the participants' perspective on the research question(s) ahead of time, but asks follow up questions spontaneously during the interview, for the purposes of obtaining depth and detail and clarifying concepts. I used conversational guides (see Appendix C), which include main questions and possible follow up questions. However, I omitted, changed the order, and added additional questions as needed.

Informed by complexity theory, the conversational guides were designed to elucidate the participant's learning system and its interaction with the school- and professional development-level systems. The first round of interviews, which were conducted with participants in the fall of 2016, focused on aspects of the teacher-level system that previous researchers have identified as impacting learning, including roles, responsibilities, workload, teaching experience, self-efficacy, previous experiences with professional development, pedagogical beliefs, and motivations and expectations for participating in the professional development (e.g. Opfer & Pedder, 2011; Wetzels et al., 2016; Whitworth & Chiu, 2015). It also addressed the participants' perceptions of the school as a learning system. The second round of interviews, which was conducted in June of 2017, focused on teachers' perceptions of what they had learned through their participation in the Language Awareness and Dialogic Reasoning project, and how they learned it. Some of the questions were aligned with the four quadrants of the Vygotsky

Space (Harré, 1983) to explore a sociocultural perspective on professional development. Others probed the interaction between teacher learning and the school-level system. Teachers were also invited to speak more generally about their learning processes, in order to understand their perspectives on their learning.

Additionally, I interviewed the Bilingüe principal in June 2017 to gain more insight into the nature of the school as a complex learning system, using a conversational guide for the interview (see Appendix C). Questions focused on aspects of the school as learning system that other researchers have concluded have an impact on teacher learning, including the principal's support of teacher learning (e.g. Wetzels et al., 2016); collective orientations and beliefs about teaching and learning and norms for instructional practice (e.g. Gehsmann & Woodside-Jiron, 2005); contexts to support teacher learning (e.g. Coburn, 2001); and the capacity to achieve learning goals (e.g. Fore et al., 2015). I also asked the principal about her perception of the congruence between the Language Awareness and Dialogic Reasoning project and the school overall as a learning system.

Documents, Archival Records, and Artifacts

A variety of documents, records, and artifacts were collected to provide a holistic picture of the cases (teacher learning systems), as well as the school-level and professional development-level systems with which they interacted. Table 2 lists the categories of materials that I collected, organized by system level.

Table 2

Documents, Archival Records, and Artifacts Collected

System	Documents, Archival Records, and Artifacts
School-Level System	<ul style="list-style-type: none"> • School Improvement Plan • School profile data
Professional Development System	<ul style="list-style-type: none"> • LADR Lesson plans and curriculum materials • My written plans for teacher working group sessions • Notes from my conversations about the teacher working group with other researchers • Articles shared with teachers • Materials distributed during teacher working group sessions
Teacher-Level Systems	<ul style="list-style-type: none"> • Teachers' annual goals for student learning and professional practice • Teacher-developed materials (for LADR lessons and LADR-inspired lessons) • Charts created during LADR lessons • Email correspondence

Data Analysis

The intention of this dissertation was to use two theoretical frames to explicate the nuances of teachers' professional learning in two cases within the same school context. Data analysis thus required a deliberate balancing act between analytic processes that would allow me to stay very close to the data with its rich details and intricacies, on one hand, and processes that would support the application of the lenses of complexity theory and sociocultural theory to the data. Thus, I developed an overall analytic strategy that combined a bottom-up, inductive approach with a theoretically informed, deductive approach.

I interwove data analysis with data collection. Simultaneous data collection and analysis can help researchers to recognize gaps in their data and figure out what additional data may be needed, while they are still in the field (Miles, Huberman, & Saldaña, 2014). In keeping with this approach, I wrote analytic memos throughout the data collection process to document my reflections and thinking about the data and its meaning (Miles et al., 2014; Saldaña, 2013). This was particularly important in this project, given the unbounded nature of the complex systems I was investigating. As I gained a more holistic understanding of each system through analysis, I identified system elements of potential significance and interactions with other systems that needed further investigation. This prompted me to return to the field expressly to collect data that would provide a more nuanced picture of the systems under study, as well as data that could confirm or disconfirm my hunches about how the systems worked. As described above, during this period I selected two cases for detailed analysis from among the four teacher learning systems and focused my continued data collection efforts on these cases.

When data collection was complete, I prepared the data for further analysis by transcribing all debrief meetings, interviews, and teacher working group sessions in their entirety. I also created detailed synoptic records of all the classroom observations and transcribed all the teacher talk during the language-focused portions of the lessons.

The next step was to immerse myself in the data, developing deep familiarity with the entire corpus, prior to coding it. Yin (2014) suggests that researchers “play” with their data, manipulating it in various ways, to help start an analytic strategy (p. 135). I manipulated my data by reading through the corpus in three different ways. My first reading was chronological, in the order that I had collected the data. For the second read

through, I read all the data sources pertaining to one particular system (i.e., school, professional development, Martina, Kelly), before turning to the next system. For the third reading, I clustered the data sources by type—that is, I read all the interviews, followed by all of the lesson observations, and so forth. These three readings not only made me thoroughly knowledgeable about the corpus of data, but also allowed me to think both inductively and deductively. For instance, as I read the data by system, I used complexity theory as a lens to understand how the systems operated. As Anderson et al. (2005) suggest, I focused on the relationships and interactions within and between systems that are essential to understanding complex systems. When reading by data source, however, I read the teacher working group transcripts through a sociocultural theory lens. That is, I attended to the teacher working group as a community of practice, and conceptualized learning activities in terms of the four quadrants of the Vygotsky Space (Raphael et al., 2014). At other times, I approached the data more inductively, attending to the particulars of Martina’s and Kelly’s words and actions, and to the specifics of the Bilingual School and the Language Awareness and Dialogic Reasoning project. Throughout the three readings, I used the comments feature in Microsoft Word to make marginal notes about emerging ideas related to specific sections of data. I also wrote memos focusing on ideas for codes and plans for further analysis.

This iterative process of reading through the data led to the development of a coding scheme, which was informed by theory and previous research, as well as grounded in the details of particular teachers in a particular context. The final coding scheme is depicted in Table 3. In accordance with the conceptualization of teacher learning as a system at the intersection of teacher-, school-, and professional

development-level systems, I treated each level of system as a distinct category and created an additional category called *across systems* to code data that revealed interactions among different systems. Most of the codes within each category were informed by the literature on teacher learning that I reviewed in Chapter Two. I used a more inductive approach to develop the subcodes. To illustrate, within the category *teacher-level codes*, I created the codes *teacher experience*, *practice*, and *knowledge or belief* to capture the components of a teacher-level learning system (Opfer & Pedder, 2011). However, at another level, I developed subcodes for “teacher practice”, including *allowing negotiation of meaning* and *asking known-answer question*, by attending to the observed practices that the teachers were actually using as they taught the Language Awareness and Dialogic Reasoning lessons.

I coded much of the data in HyperResearch in order to make it easier to retrieve and cluster relevant segments for the purposes of deeper analysis. I coded the data one system at a time, reevaluating, revising, and operationalizing the codes as I went.

Table 3

Coding Scheme

<u>Category</u>	<u>Codes</u>	<u>Subcodes</u>
Across Systems	Interaction	
School-Level System	Structure: Agent Capacity for learning Collaboration practice Curriculum & pedagogy Priorities	Professional learning activity structure School structure

<u>Category</u>	<u>Codes</u>	<u>Subcodes</u>
Professional Development-Level System	Structure:	Curriculum structure Professional learning activity structure
	Agent Experience Priority	
Teacher-Level System	Knowledge or belief:	Language awareness Purpose of student talk Student capabilities Teacher's role
	Practice:	Allowing negotiation of meaning Asking follow up question Asking known-answer question Asking open-ended question Encouraging participation Encouraging student interaction Evaluating student's idea Presenting information Prompting metalinguistic awareness Repeating student's idea
	Change	Self-identified change Self-identified change process
	Cognitive process Experience Learning preference Motivation	

The research questions called for different analytic strategies. Maxwell (2011) distinguishes between categorizing strategies and connecting strategies. Categorizing strategies group data based on resemblances or commonalities; coding is the most widely used categorizing strategy. Connecting strategies, on the other hand, focus on relationships of contiguity, presuming a real association in which one thing directly impacts another. Maxwell posits that qualitative researchers can fruitfully combine the two types of strategies. “At each point in the analysis, one can take either a categorizing

step, looking for similarities and differences, or a connecting step, looking for actual (contiguity-based) connections between things” (p. 119). Some of my research questions called for categorizing strategies, while others necessitated connecting strategies or a mix of the two. In the sections below, I describe the approaches that I took to answer each research question, which are reproduced for reader convenience.

RQ1: What is the nature of four, complex, nested, and overlapping systems: a professional development initiative that grew out of a university-school partnership, the school in which the professional development occurred, and two teachers who participated in the professional development? To answer RQ1, I used a categorizing strategy. I organized the data that I had coded into four system descriptions. In order to create descriptions that would be useful for understanding each system as an integrated whole, I followed Anderson et al.’s (2005) suggestion of focusing on the patterns of interactions among system agents and between systems. Thus, for each system, I developed a framework that enabled me to organize the rich data about the elements of that specific system, while also examining how those elements interacted with each other and how the system as a whole interacted with other systems. I employed the same descriptive framework for Martina and Kelly’s learning systems, to facilitate cross-case comparisons (Yin, 2013). For each teacher learning system, I organized the data into six categories: knowledge, beliefs, practices, experiences, interactions, and control parameters. I used different frameworks to construct descriptions of the school and professional development systems. As both were social systems, it was helpful to include some of the same categories, namely structures, agents, and interactions. Other aspects of the frameworks were specific to the type of system, such as curriculum and

pedagogical norms, school priorities, and capacity for learning for the school-level-system, and professional development content for the professional development-level system.

While HyperResearch made it easy to pull from the entire data corpus as I constructed the case descriptions, certain data sources proved to be particularly informative. The interviews and debrief conversations with the teachers were the key sources for the teacher case descriptions, while the principal interview was the most important data source for the school-level system description. Transcripts of the teacher working group meetings, as well as my planning notes, were the key data sources for the professional development system.

RQ2: What do two teachers learn about language-focused instruction for emergent bilingual learners in the course of participating in the professional development initiative? In accordance with the idea of learning as change in participation, answering RQ2 called for locating changes in the ways that the teachers talked about and enacted language-focused instruction for bilingual learners. Accomplishing this task required organizing data about each learning system chronologically (Gerrits, 2008), which I did by constructing matrices.

I created event-listing matrices (Miles et al., 2013) organized as shown in Table 4 to track each teacher's knowledge and beliefs throughout the year. Within each matrix, the columns represent time periods throughout the year, while each row represents a topic that was a theme during teacher working group conversations. I drew on data from the teacher working group sessions, teacher interviews, and lesson debriefs to fill in the matrices. I included verbatim quotes and summarized speech that demonstrated the

teacher’s verbalized knowledge and beliefs, and left blank any cells for which I lacked evidence. By reading across the rows, it was possible to spot ideas that changed, indicating learning (defined as changes in participation), as well as those that remained static.

Table 4

Sample Event Listing Matrix: One Teacher’s Knowledge and Beliefs

		Time Periods		
		Getting Underway (Sept. – Jan.)	Mid Instruction (Feb. – March)	Completing Instruction (April-June)
Knowledge & beliefs about...	Student Talk			
	Language Awareness			
	Student Capabilities			

I created an additional set of matrices to identify changes in each teacher’s classroom practice. As discussed above, the Language Awareness and Dialogic Reasoning curriculum includes multiple lesson types. Through my initial readings of the data, I noticed that the teachers employed different pedagogical practices in different types of lessons. Thus, in order to identify changes in practice over time, it was necessary to compare lessons of the same type. To do so, I created matrices like Table 5 for four different lesson types (semantics, syntax, morphology, and dialogic reasoning) for each teacher. The rows list specific pedagogical practices that were related to the topics discussed during teacher working group sessions. For each lesson, I listed the number of times that the teacher employed that practice. I also included one or more representative example of each practice. After filling out the matrices, I looked for both quantitative changes (i.e. practices that a teacher was employing significantly more or less than in the

prior lesson) as well as qualitative changes (i.e. practices that were being employed in a different manner or on different occasions).

Table 5

Sample Event Listing Matrix: Pedagogical Practices in Morphology Lessons

	Morphology Lesson 1		Morphology Lesson 2	
	Number of occurrences	Examples	Number of occurrences	Examples
Allowing negotiation of meaning				
Asking follow up question				
Asking known-answer question				
Asking open-ended question				
Encouraging participation				
Encouraging student interaction				
Evaluating student's idea				
Presenting information				
Prompting metalinguistic awareness				
Repeating student's idea				

RQ3: How do three complex systems (the teacher, the professional development, and the school) interact and combine to influence the teachers' learning? What are the control parameters and complex, contingent, causal mechanisms that promoted or hindered their learning? What role do the actions of the facilitators play in influencing their learning? Answering the final research

questions necessitated a shift from categorizing analysis to connecting analysis. Maxwell (2004) argues that qualitative researchers can develop and evaluate causal explanations for processes which are not entirely open to direct observation by developing a theory about the process, identifying and interpreting evidence that supports or challenges the theory, and developing and evaluating alternative theories. This calls for analytic strategies that identify connections between events and processes in a particular context, tying together data temporally, while eliminating factors that are not germane (Maxwell, 2011). Drawing upon my findings from the first two research questions, I used connecting strategies to identify and explain the configurations of control parameters and mechanisms that led to and/or hindered learning within each teacher learning system.

To determine which of the control parameters contributed to the learning or stasis identified in RQ2 and which mechanisms were involved in the process, I used process-tracing, an approach in which the researcher considers alternative paths that may have led to an outcome, and maps out one or more causal paths that are consistent with the evidence and outcome in a case (George & Bennett, 2005). There are several varieties of process-tracing. I used analytic explanation, which requires converting a historical narrative into an analytic causal explanation by employing explicitly theoretical forms (George & Bennet, 2005, p. 211). Analytic explanations may be partial if the researcher is unable to document all steps in a theorized process.

To create analytic explanations of the teachers' learning, I began with the changes that I had identified while addressing RQ2. I sought to explain each change by reconstructing the sequence of events preceding it and using ideas from complexity theory and sociocultural theory to understand and explain which of the events were

contingent, causal mechanisms that, in conjunction, led to the observed change. I had discussed some of the changes with teachers during interviews and debrief conversations. I treated the teachers' verbalized explanations as important sources to construct a sequence of events for these changes, while triangulating them with other data sources. For changes that I had not discussed with the teachers, I reconstructed as much of the sequence as possible, given the data I had. I considered key concepts from my theoretical frameworks, such as feedback loops and perturbations (Cilliers, 1998) and the Vygotsky Space (Raphael et al., 2014), to see whether these could help explain portions of the narrative. In this way, I theorized how specific events in the sequence functioned as complex, contingent, causal learning mechanisms that combined in the teachers' learning processes. In addition to analyzing mechanisms, I paid particular attention to the control parameters within each system, which I had identified for RQ1. I searched for connections between control parameters and instances of both learning and stasis. Developing and testing analytic explanations was an iterative process, which necessitated returning to the data many times.

With connecting analysis, it is essential to thoroughly explore all plausible explanations, in order to assess the alternatives and decide on the best explanation (George & Bennett, 2005; Maxwell, 2004). I used several strategies to deal with causal validity. I used the "modus operandi" approach, in which the researcher identifies an alternative explanation and searches for "clues" as to whether these processes were operating and had causal influence (Scriven, 1974). With any plausible explanation, I triangulated data from multiple sources, for instance triangulating explanations based on interview data with observational data (Yin, 2013), searching for additional confirming

evidence, and keeping an eye out for any disconfirming evidence (Maxwell, 2004). To illustrate, after concluding that Kelly had learned little about language-focused instruction, I generated a long list of potential, contingent causes for her stasis. I then returned to the data corpus, looking for evidence of each. I eliminated those that lacked an evidentiary warrant, and noted those with a slim warrant, based on only one data source. Once I had generated analytic explanations for each teacher learning system that were supported by the data, I asked colleagues to examine the explanations. I also shared my analysis with the participants, using member checks to confirm whether my analysis of their learning processes corresponded with their own (Lincoln and Guba, 1985). Using the analytic strategies outlined above, I generated, refined, and tested my assertions about Martina's and Kelly's learning processes, and ultimately developed the arguments that I make in the remainder of this dissertation.

CHAPTER FOUR

Two Learning Systems and their Constraints: The Professional Development and School-Level Learning Systems

In this dissertation, I explore what and how two teachers learned about language focused instruction while participating in a school-based professional development initiative. Following Opfer and Pedder (2011), I conceptualize teacher learning as occurring at the intersection of three complex systems: 1) a teacher's learning system; 2) the professional development system; and 3) the school-level learning system. A teacher's learning system is both an autonomous system and simultaneously a subsystem, nested within these larger complex systems (Davis & Sumara, 2006). Understanding teacher learning through professional development thus requires exploring the nature of these three systems and their interactions with each other.

In the next three chapters I present my findings about how these three systems interacted and combined to influence Martina's and Kelly's learning. This chapter is the first of three findings chapters. In this chapter, I use complexity theory to offer an analytic description of the professional development system and the school-level learning system in which the teachers' learning systems were nested. This description is necessary background for my analysis in Chapters Five and Six of what and how each teacher learned. Here, I address my first research question about the nature of these complex, nested, and overlapping systems. I describe in turn the nature of the school-level learning system and of the professional development system, including discussion of system agents, system structures, the information exchanged within each system, and other

system conditions. I conclude with a discussion of the interactions between the two systems, which were overlapping and interpenetrating, in the sense that eight teachers were part of both systems.

Throughout the chapter, I argue that the structure of both the professional development system and the school-level learning system constrained teacher learning. That is, both systems were set up in ways that made it challenging for teachers to enact in their practice ideas that were espoused within the system. A complex system includes structural elements that give the system its form. Some of these elements emerge from within as the system self-organizes, which is the process through which a complex system reconfigures itself in order to survive (Morrison, 2008). Self-organization is internally generated through the interactions of the system agents. Other structural elements are externally imposed on the system by larger systems in which it is nested. Externally imposed structures are difficult to change from within the system, and can serve as obstacles to the emergence of learning (Hetherington, 2012). I show that externally imposed structures limited the possibility of learning within both the professional development and the school-level learning systems.

In addition to differentiating between structures that are internally generated versus externally imposed, it is necessary to understand how system structures interact with each other to determine the form of the system. As discussed in Chapter Two, those structural elements that shape the system are called control parameters (Byrne & Callaghan, 2014). In a complex human system, such as the school and the professional development systems, they include the rate at which information flows within a system, the richness of connectivity between agents in the systems, the level of diversity within

and among agents, power differentials, and levels of anxiety containment (Stacey, 1996). Stacey theorizes that control parameters have a critical point that allows a system to operate at the edge of chaos, which is the place at which a system is able to be “spontaneous, adaptive, and alive” (Waldrop, 1992), the place at which radical change can happen when something perturbs the system. In a human system with control parameters below the critical point, information moves slowly, system agents have similar viewpoints and interact with relatively few other individuals, while power differentials between system agents cause information from agents with more power to be prioritized above information from less powerful agents. Such a system is likely to remain static. Conversely, a system is likely to disintegrate when control parameters are above the critical point, as highly diverse agents rapidly share discrepant information with numerous other agents with relatively equal power. My analysis demonstrates that the control parameters of both the professional development system and the school-level learning system were below the critical point. Thus conditions within the two systems and interactions between them created an environment in which teacher learning about language-focused instruction was possible, but not optimal.

School-Level Learning System

The Bilingüe School was a complex system consisting of hundreds of students as well as dozens of faculty and staff. As an organization, the Bilingüe School was responsible for the education and well being of its students as well as the livelihood of its faculty and staff. The school had to establish and maintain systems to keep students safe and healthy while they acquired knowledge and skills laid out in the state’s curriculum frameworks, and while students in the two-way program developed proficiency in

Spanish and English. Carrying out this mission for hundreds of students was no small task, and the degree to which the school was able to do so is in large part a consequence of the school's learning system (Opfer & Pedder, 2011), or those school-level norms, structures, and practices that can enable or constrain faculty or staff. In this section, I describe the nature of Bilingüe's learning system, demonstrating that, despite the espoused prioritization of teacher learning and efforts to create a coherent learning system, the control parameters of the school-as-system, including those imposed by larger systems in which it was nested, constrained the degree to which teachers could actually learn.

Information in the School-Level System

Within school-level learning systems in the United States, there is great interest in information that can help the school to improve, as schools are held accountable for demonstrating improvement in student achievement each year (Datnow, 2011). The specific school improvement priorities at Bilingüe were determined through interactions with the school district and the state department of education, two complex systems in which Bilingüe was nested. The state required that all districts and schools create annual Improvement Plans, which would identify outcomes in need of improvement, set strategic objectives, and outline an action plan for achieving these objectives. District leadership offered guidelines to individual schools on the improvement planning process, including specifying the domains of the objectives and requiring that school plans be aligned with district objectives. Thus, through interactions with these larger systems, each school defined its priorities and set an official direction for the school-level learning system.

For the 2016-2017 school year, the Bilingüe School had established learning goals in five domains: social-emotional learning, literacy, math, language development, and family and community engagement. While the school was working toward all five goals, some were prioritized above others. The oral language development goal was a particular focus. The goal stated, “As a school, at least 70% of students will be observed practicing their expressive language skills by actively participating in academic conversations or content-based discussions in whole class, small group, or partner formats” (Bilingüe artifact 1). The school had been pursuing related goals for the past several years, in conjunction with a district-wide focus on expressive language. Fourth grade teacher Kelly, who was a member of the Bilingüe School Leadership Team, explained that throughout that period, the overall goal has been “to help students express their ideas in a way... that makes sense and that’s really getting at the root of what they’re trying to say” (Kelly, interview 1). In order to achieve this larger goal around clarity of expressive language, the annual School Improvement Plan’s action steps included developing a checklist of observable expressive communication skills and collecting data on these skills. This data would be shared with staff for use in lesson planning, in order to achieve the desired outcome of classroom instruction in which “language use [was] more student centered” (Bilingüe artifact 1).

In addition to the oral language goal, the social-emotional learning goal also received significant attention. That goal was to develop “a comprehensive set of logical consequences for problem behaviors, in order to ensure a safe, positive, and productive learning environment for all students” (Bilingüe artifact 1). A subcommittee of teachers and administrators was assigned to research logical consequences in the classroom, with

the aim of creating a guide to be used throughout the school. While various teachers and administrators were given responsibility for the other three strategic objectives, only the oral language and social-emotional goals received much school-wide attention. System agents focused on learning and sharing information relevant to these goals, and system structures became the conduits for this information, with the goal that learning would emerge within the system, fostering improvement for the Bilingüe School. The goal was not radical change for the system, but rather incremental change toward multi-year goals.

School-Level System Agents and Structures

The school learning system was made up of agents and structures that were put in service of the aforementioned priorities. On the human side, the school's large staff was quite experienced; the majority of teachers had been teaching for more than ten years, and several had more than 20 years of experience. In Kelly's opinion, the staff as a whole was dedicated to their work:

We have a really nice community of people who want to work together and focus on things together, and also be true to, you know, the standards, and make sure that we're teaching the kids what they really need to know. (Kelly, interview 1)

In order to achieve these goals, the faculty and staff generally viewed professional development as a means of learning new information. According to Kelly, "We're always stretching ourselves and trying new things, and going with what the research says is the best way to teach. We're always looking for those best practices" (Kelly, interview 1). From a complexity perspective, the Bilingüe faculty and staff can be understood as proactively seeking out interactions with ideas from researchers who offered diverse perspectives, unlike those they were likely to encounter in their interactions with

colleagues within the building. This trait fostered learning within the system. The principal summed it up: “It is part of the culture that people are always learning” (principal interview).

The Bilingüe learning system included various structural elements intended to promote teacher learning, some of which had been established by larger systems (e.g. the school district set the school calendar, designating a set number of hours for school-based professional development), while others had been initiated at the school level (e.g. the principal set up instructional rounds and the literacy and ESL coaches organized book studies). The school administrators and the Leadership Team strove to unite these disparate elements into a coherent overall structure for professional learning. Kelly described the intentionality with which the Leadership Team worked to bring coherence:

So as the Leadership Team talks about PD [professional development], we’re always thinking about, what is our, sort of, our school focus, and how can we advance that focus in a way that’s meaningful to everybody in the building. So because we’re required to have a School Improvement Plan, we always have these goals that we set, and then we sort of think about those goals, and we try to make the PD match what our goals are, so that we can accomplish things in a way that, you know, the least amount of effort with the most amount of results. (Kelly, interview 1)

By aligning school goals with school-based professional development, the leadership team attempted to focus the system on a few priorities, keeping the diversity among schemas at a manageable level. Researchers have shown that when schools undertake multiple simultaneous initiatives, the competing demands can inhibit teacher learning

(Dagen & Bean, 2014; Wood, 2007). In complexity terms, these systems are characterized by too much diversity, without the redundancy that is a necessary for complex emergence to occur (Davis & Sumara, 2005). Davis and Sumara argue that while a certain level of diversity is necessary as a source of new ideas, diversity only leads to learning when it can be appreciated by other system agents. This necessitates redundancy. In other words, system agents need to have enough in common that they can understand each other well enough to learn from and with one another. The leadership team at Bilingüe attempted to foster teacher learning by creating an overarching learning structure that kept the diversity of agents' schemas at a manageable level by focusing on only one or two new initiatives at a time, while incorporating redundancy in the form of multiple professional development activities oriented around the same select initiatives.

The careful coordination of learning structures was evidenced during the 2016-2017 school year, as multiple structures were harnessed in service of the school's priorities, in particular the oral language goal. A number of teachers voluntarily participated in a book study on *Making Thinking Visible: How to Promote Engagement, Understanding, and Independence for All Learners* (Ritchart, Church, & Morrison, 2011), which promotes the use of thinking routines, or classrooms practices in which students orally articulate their ideas and understandings. The book study introduced a subset of system agents to a new perspective, which began to alter their schemas. Several staff meetings and extended day professional development sessions were dedicated to the oral language goal, including sessions where teachers shared the strategies they were using to make thinking visible in their classroom. This increased the richness of connectivity and allowed information to flow quickly between the teachers participating

in the book study and the rest of their colleagues. Additionally, the school used two different structures in which teachers observe in other classrooms, to foster connections and enable information to flow between teachers. During learning walks, teachers collected data on how students were making their thinking visible, while instructional rounds focused on teachers' efforts to promote extended discourse in the classroom. Finally, the state-mandated supervision and evaluation process was tied into school priorities; teachers were encouraged to set goals related to the school's strategic objectives. At the end of the school year, the principal summed up how the school-level professional learning structures had been functioning to promote system goals:

I think we have done good work through... the school learning walks, which are all connected to the School Improvement Plan goals, which are connected to the work of the committees, so I think the base level systems in most cases are in place, and those systems are working and are beneficial. (principal interview)

In her assessment, the system control parameters were enabling learning to happen. To the extent possible, the principal and her team had worked within state and district structures to establish coherent structures through which a willing staff could learn how to help the school achieve its objectives. However, the principal could only establish control parameters for the system; she could not cause learning. As discussed above, in a complex system learning occurs through self-organization, as system agents interact with each other as well as with other systems.

External Structures

While the school learning system was oriented toward the goals described above, achievement of these goals was hampered by the reality of life in a complex school,

which was nested within complex macro-systems, including the school district and the state department of education. The 2016-2017 school-level priorities for oral language and social and emotional learning were constrained by existing school-level structures, as well as by structures imposed by external systems. This negatively impacted the ability of the school's learning system to promote learning and change for individual teachers as well as for the school as a whole. In particular, three types of system structures hampered learning: schedules, curriculum, and testing.

The Bilingüe School had a strict daily schedule. This was due in part to externally imposed demands from larger systems. The district mandated how much time must be spent in each content area, for instance requiring that students have an hour of math daily. Similarly, state policies governed the provision of services to individuals, such as setting the number of minutes per day that students designated as English Language Learners must receive ESL services. The schedule was made all the more inflexible by the challenges of creating a two-way dual language program. As explained in Chapter Three, most upper elementary teachers at Bilingüe swapped students with a teaching partner, in order for students to have instruction in both English and Spanish. All these mandates meant that teachers had little flexibility in how they used their time. Third grade teacher Caitlin commented:

I just sometimes get tired of, like, everything is timed. Maybe if I had my own classroom and I had the same group of kids all day I wouldn't feel like that. It's just in the two-way, it's constantly like, I only have 40 minutes. That's it. (Caitlin, TWG 5)

This lack of flexibility was in tension with the school's oral language objective. In their interactions with administrators during professional learning activities, teachers were encouraged to try out student-centered teaching practices, in which students do more of the talking and teachers do less. Such practices can take more time and require teachers to cede control over timing to their students. However, administrators were inhibited in their ability to alter the school schedule to better align with such teaching. They continued to uphold the rigid schedule, which hampered teachers' efforts to achieve the school's goal. Thus, despite the administration's effort to manage the diversity of schemas within the system in order to focus on a few priorities, the system status quo was rife with dissonant messages. This limited the possibility of teacher change.

Not only were teachers' attempts to institute change constrained by tightly timed classroom schedules, they were further constrained by limited time outside of the classroom in which to plan or reflect, individually or with colleagues. As Kelly put it, "Everybody here is incredibly busy. Nobody is sitting around with free time on their hands" (Kelly, interview 2). The Bilingüe school day ran from 9am until 3pm. During that time, teachers had half an hour for lunch and a one-hour prep period, in which there were many things to accomplish. Many teachers arrived well before the school day began to do additional preparation and stayed late in the afternoons to complete their work. Kelly explained that juggling many things is just "the nature of teaching:"

There are so many different things that we have to do every day, and they all require, you know, looking at the curriculum prior, so that you have some ideas about how the lesson is supposed to go, pulling together whatever materials are required. In my room there is a lot of furniture rearranging, because it's small, and

then I have to like move things around depending on what I am gonna be needing, and so every period I am running like a chicken with my head cut off, you know, trying to get everything in place. And no matter how much I do, or think I do in advance, I always forget something or something happens. (Kelly, interview 2)

These chaotic conditions were among the control parameters that determined the rate of information flow and the richness of connectivity within the system. A teacher “running like a chicken with [her] head cut off” was hard-pressed to find time to plan how to incorporate information from professional learning activities into her classroom or to collaborate with colleagues in the service of changing their practice.

In addition to an inflexible school schedule, centralized curriculum also hampered learning within the school learning system. Curriculum was adopted at the district level. Teachers were handed new curriculum materials, sometimes only days ahead of when they were supposed to begin using them, and were required to use these materials, regardless of how prepared they were to teach with them. Historically, the set curriculum made it challenging for teachers to implement the school’s priorities. Within recent years, the school organized book studies on several books, including *Academic Conversations: Classroom Talk that Fosters Critical Thinking and Content Understandings* (Zwiers & Crawford, 2011) and *Bringing Words to Life: Robust Vocabulary Instruction* (Beck, McKeown, & Kucan, 2002). Kelly often participated in book studies and found the books to be inspiring. However, she reported that she had not been able to use much of what she learned:

So we get all these great ideas, but then the struggle is, how do you take all those great ideas and then actually apply them in the classroom, considering all of the

things that we're expected to do already? So the problem that I have with the book studies is that we read this awesome book, but then it doesn't jibe with the curriculum that you're handed. (Kelly, interview 1)

During the 2016-2017 school year, teachers were supposed to figure out how to incorporate opportunities for active participation in academic conversations and content-based discussions, within the confines of an existing curriculum that they were required to teach. By making it harder for teachers to try out new ideas, the externally-imposed curriculum can be understood as a control parameter that limited the connectivity between discussions in professional development and actual classroom practice and reduced the likelihood for learning to emerge.

Externally-mandated tests were yet another structure that interfered with teacher learning. The state required students to take annual high stakes tests and assigned school levels based on students' test performance. The principal expressed frustration with the testing system, which she perceived as interfering with teacher and student learning:

I think the pressure that it puts on teachers forces them to spend time on test prep that I don't feel is, that I would rather have people spending different time on. I think it definitely is stressful. It's definitely stressful. And I think it, the collaboration that they—the discussions that they do have aren't always able to be focused on the developmental needs of the children or where they are as learners, as much as we try to make it such, because you are still always worried about where they are supposed to be. (principal interview)

Frustrated that testing was making it harder for the teachers to focus on the needs of children, not to mention on implementing the school's learning objectives, the principal

sought to reduce the external pressures as much as possible. She had already successfully campaigned to exempt the school from a standardized assessment that the district had required schools to administer multiple times per year. During 2016-2017, she took on another district-imposed accountability structure: curriculum timelines specifying what should be taught when. Despite the principal's efforts to insulate teachers from accountability pressures, her messages were not resonating for some teachers, who continued to report "pressure to get through curriculum" and "stress about testing and assessments and scores" (Kelly, debrief 1). In keeping with Stacey's (1996) identification of levels of anxiety containment as a control parameter influencing learning in human systems, the level of anxiety around testing in the school was clearly not adequately contained. As a result, high levels of anxiety influenced how teachers interpreted information about testing. In accordance with the nonlinear nature of interactions, in which information can change in scale, teachers seemed to barely register the principal's messages about her priorities. Conversely, information gleaned through other interactions, such as stories in the media and district curriculum maps, ballooned in importance. Thus, due in part to the anxiety that it created among teachers, testing interfered with the school learning system's objectives.

Under-Resourced Conditions

Another set of challenges facing the school learning system had to do with overcrowded conditions within the school building and a lack of resources for the school. In the previous five years, the student population of Bilingüe had increased by 50%. While the school had hired classroom teachers to accommodate its growing student body, there had not been a proportionate increase in the number of administrators, intervention

teachers, and other specialists. This understaffing impacted the operation of the school learning system by reducing the rate of information flow between system agents and increasing teacher isolation. Stretched thin, the administrators were supporting more classroom teachers than ever before, while specialists were working with students from more classrooms than ever. As a result, administrators and specialists could meet less frequently with classroom teachers for support and/or consultation. The principal complained:

I would say in the last few years, it's been a little frustrating because we have really been understaffed in terms of support for the social-emotional needs of the children, and so I have felt that my role as an instructional leader has been hampered by the lack of resources. (principal interview)

She noted that she was in classrooms frequently to support students' social-emotional needs, but rarely to support teachers' development. Furthermore, without a second assistant principal with whom to divide supervision and evaluation responsibilities, she had to supervise more than thirty teachers. She believed that the evaluation process had great potential, when accompanied by professional conversations about teachers' practice and students' learning. However, with so many teachers to supervise, she had not been able to participate in the process in a thoughtful way with everyone. With limited occasions to interact directly with teachers in learning-focused conversations, the principal was not able to exchange ideas with them, opening up spaces for learning.

Not only had the student population grown, but teachers perceived that students also had more needs, which the understaffed school was not equipped to handle. The

teachers mentioned several changes in the student body. Kelly felt that students' language abilities and resulting readiness to learn had diminished in recent years:

In the ten years that I've been here, I've seen a real shift in the sort of readiness to learn among the kids. So my first years here, we had a true 50-50 program, where 50 percent of the kids were English speakers, no Spanish at home, and 50 percent were Spanish speakers, and a lot of them had really strong language models at home. Now, what we see is a lot of the kids coming in here are, they're not strong in either language, and so we don't have those really good role models for language on either side, a lot of the times. (Kelly, debrief 1)

Leaving aside for now the beliefs about students implied in the quote above, which I return to in Chapter Five, Kelly's statement points to the fact that students' language abilities did not meet school expectations of proficiency. The ESL teachers reported that larger numbers of students continued to need ESL services in the upper elementary grades than previously. In addition to students' language needs, teachers also reported that the student body had both huge behavioral needs and significant academic needs, with many students reading far below grade level.

Whether caused by overcrowding, understaffing, or a student population with many needs, the resulting school environment was described by Kelly as "frenetic" and "stressful" (Kelly, debrief 1). Rather than focusing on learning, teachers and administrators had to devote time and energy to putting out fires. The principal explained:

It feels like running a crisis-management a significant amount of time. And when you have to work seven days a week just to keep up with the functioning of the school, you have no time in your brain to reflect. (principal interview)

Indeed, the first time that I went to interview her, the principal cancelled our interview after I had already been waiting in her office for 15 minutes, because she needed to attend to a crisis with a student. We ultimately rescheduled for the late afternoon on another day, when she was less likely to be called away. When we spoke, the principal lamented that, between responding to crises and keeping up with the day to day functioning of the school, she rarely had time to meet with the assistant principal “to really think carefully and to analyze and reflect and then plan going forward” (principal interview). While she felt that the base level professional learning structures discussed above were working, she recognized that she did not have enough time to dedicate to learning, and neither did teachers. The frenetic school environment was another control parameter that limited connections and reduced the flow of information within the learning system.

Teachers generally agreed that professional learning structures including book studies, instructional rounds, and learning walks were useful. Everyone seemed to be aware of the oral language goal, and many teachers mentioned their efforts to make their classrooms more student-centered. There was evidence that the school learning system was functioning well enough to promote some minor changes in the practice of individual teachers, although no radical changes were apparent. This is unsurprising, given the nature of the system that I have described. It was far different from the sand pile poised for an avalanche, described in Chapter Two (Bak & Chen, 1991). Unlike a system on the edge of chaos, in which new ideas may overthrow the status quo (Waldrop, 1992), the school-level system and its teacher agents were constrained by structures imposed by macro-systems and by control parameters that limited the free flow of information.

The structures constraining learning within the Bilingüe learning system are hardly an anomaly. Rather, learning conditions at Bilingüe were probably better than average for U.S. public schools, as the school is located in a state recognized for its excellent schools and in the top ten for per pupil spending (U.S. Census Bureau, 2017). While the school had higher percentages of economically disadvantaged students, students with disabilities, and English language learners than the state average, it also had a lower average class size and lower student: teacher ratio. In short, the under-resourced conditions impacting teacher learning at Bilingüe were no worse than at many schools in the state, and probably better than at many schools in the country. In schools throughout the country, it is the norm for a teacher to “run around like a chicken with [its] head cut off,” as Kelly phrased it, in order to carry out the responsibilities of a busy teaching schedule, with little time to prepare or reflect (OECD, 2014). Meanwhile as public school systems nationwide have centralized decision-making, externally-imposed structures such as high stakes testing and district-mandated curriculum are likely causing high levels of stress and anxiety among teachers nationwide (Daly, 2009). As I have shown, these conditions result in school-level learning systems with control parameters that make any kind of teacher learning through professional development difficult, and radical change extremely unlikely. Before examining what the teachers learned while being a part of the professional development system, it is necessary to turn to the professional development-level learning system. The teachers’ learning systems can only be understood in terms of their interactions with these two larger systems, in which they were nested.

The Professional Development System

The professional development system was nested within the larger Language Awareness and Dialogic Reasoning research project, which was itself a complex system, interacting with even larger macro systems. In 2016-2017, the project was in the final year of a federally funded development and innovation grant. In accordance with the design established therein, the research team was conducting a small-scale, experimental pilot study to evaluate the efficacy and feasibility of the curriculum that had been developed during the two previous years. Seven schools in two northeastern states had agreed to be implementation sites. The plan was for teachers at these schools to implement the entire curriculum, consisting of a total of 41, half hour lessons. The teachers were given detailed plans for each lesson. The syntax lesson plan included as Appendix D illustrates the pattern of a typical lesson, including multiple activities with suggested timings, precise steps to be followed, and questions for teachers to ask.

It is important to note that teacher learning was not the goal of the Language Awareness and Dialogic Reasoning project. Rather, the professional development system arose as a support system to help teachers implement the curriculum with fidelity. Each school had its own site-based professional development system, which employed two primary structures: a five-hour orientation to the Language Awareness and Dialogic Reasoning project for all teachers in the state and monthly, school-based Teacher Working Group (TWG) meetings. While the professional development systems were centrally conceptualized, each self-organized, influenced by the agents in that system as well as the school in which the system was operating.

Professional Development System Agents

Complex systems consist of interdependent agents with the capacity to exchange information with each other and with their environment and to adjust behavior accordingly (Cilliers, 1998). The professional development system at Bilingüe included 12 agents: four university-based researchers and eight Bilingüe teachers, as shown in Table 6. We brought diverse experiences, knowledge, beliefs, practices, and intellectual motivations into the system. As we interacted with each other, the system self-organized. Below, I outline the roles and responsibilities of the agents in the professional development system and describe our goals for the system.

Table 6

Professional Development System Agents

Affiliation	Name	Title	Primary Project Responsibilities
University	Jada	Research Assistant	Professional Development Co-Facilitator, Data Collection
University	Jessica	Research Assistant	Develop Spanish Curriculum
University	Meredith	Research Assistant	Site Liaison, Professional Development Facilitator
University	Paul	Principal Investigator	Oversee Study
Bilingüe School	Amy	5 th Grade Teacher	Develop Curriculum
Bilingüe School	Caitlin	3 rd Grade Teacher	Develop Curriculum
Bilingüe School	Carol	5 th Grade ESL	Implement Curriculum
Bilingüe School	Helen	Literacy Specialist	Implement Curriculum
Bilingüe School	Jo	3 rd Grade Teacher	Consult on Spanish Curriculum
Bilingüe School	Kelly	4 th Grade Teacher	Implement Curriculum
Bilingüe School	Martina	4 th Grade ESL	Implement Curriculum
Bilingüe School	Tara	5 th Grade Teacher	Develop Curriculum

The Researchers. Jada and I were research assistants on the Language Awareness and Dialogic Reasoning project who had been working with teachers and students at Bilingüe for the two previous years, during the project’s curriculum

development phase. I was the designated site liaison for 2016-2017, and I took the lead in facilitating the teacher working group sessions. However, Jada and I jointly planned most of the sessions, and she co-facilitated some of them.

Paul, the principal investigator of the Language Awareness and Dialogic Reasoning project, attended most of the teacher working group sessions. As principal investigator, he was responsible for carrying out the research design as conceptualized in the grant. At times, he used teacher working group sessions to convey information about the project. However, during most sessions he played the role of conversation participant.

We were joined in 2016-2017 by a third research assistant. A first year doctoral student, Jessica was tasked with developing a Spanish language awareness curriculum, as an analog to the English version of the curriculum. As we had done while developing curriculum during the two previous years, Jessica was expected to consult with Bilingüe teachers to get suggestions and feedback throughout the curriculum development process. She hoped to use the teacher working group sessions as an opportunity to discuss the Spanish curriculum with teachers. As the year went on, she became increasingly involved with planning and co-facilitating sessions.

All four researchers were accountable to the larger research project. It was our job to ensure that the study was carried out as planned, to support implementation of the curriculum with fidelity, and to collect the data needed to document what happened. However, Jada and I also approached the professional development system with other goals, which were shaped by our experiences with the Language Awareness and Dialogic Reasoning project and by our own research interests.

Jada and I brought two years of experience with the curriculum to the professional development system. We had been intimately involved with every step of the iterative curriculum design and implementation process. Not only had we gone through three curriculum design and implementation cycles, but we had theorized extensively about language-focused instruction. Based on a review of empirical and theoretical literature on second language development and an initial analysis of data from the first two years of the Language Awareness and Dialogic Reasoning project, we had developed a set of curricular and pedagogical principles for language-focused instruction that we believed could be fruitfully employed by teachers and other local curriculum developers to design curricula for their own contexts. The principles, which are listed in Appendix A, Table A3, included learning objectives (language awareness and skills), curricular approaches (text-based language learning), and instructional practices (explicit, dialogic instruction; structures that support student talk; EL supports). We had already presented together on these principles at one conference and would present twice more during 2016-2017. Thus, on top of the project's goal of supporting teachers with implementation, we hoped to use professional development to help teachers understand the key principles of language-focused instruction so that they could create their own curriculum. Along these lines, in a May teacher working group session, I encouraged the teachers to:

Think about how you might be able to apply these principles to your materials, so that [the Language Awareness and Dialogic Reasoning project] will live on, not just in its—the current curriculum that we've been developing... but how could this be more widespread? And then maybe go beyond you all to your colleagues within the building. (Meredith, TWG 9)

Committed to the principles for language-focused instruction, we viewed professional development as a way to disseminate what we had learned to the eight teachers in the room and potentially to their colleagues as well.

Additionally, Jada and I had individual research interests that diverged from the project's focus, but that we hoped to pursue through the professional development system. Jada was interested in exploring students' development of metalinguistic awareness through dialogic pedagogy. Building on the work that we had already done to frame the principles of language-focused pedagogy, she was developing a conceptual framework incorporating dialogic (e.g. Aukerman, 2013) and third space (Gutiérrez, 2008) pedagogies, which positions emergent bilingual students as valued contributors to language classrooms, and calls for students and teachers to analyze and co-construct meaning about language. Framing research as praxis (Lather, 1986), Jada hoped to explore her emerging ideas with the teachers in the teacher working group. I came into the 2016-2017 school year planning to use the professional development system as the context for this dissertation. I hoped that the teacher working group would become a community of practice (Lave & Wenger, 1991), which is a group that shares cultural practices reflecting collective learning. Communities of practice unite around a joint enterprise in which they engage mutually as partners (Wenger, 1998, 2000). Thus, I hoped to maximize the time spent in collective learning activities, through which the group would develop common practices to use toward a shared goal. What teachers learned was less important to me than that they united around some goal and had opportunities to learn collectively.

The varied objectives for the professional development system described above were often in tension. Using teacher working group sessions to plan research logistics and/or develop the Spanish analog curriculum was in tension with maximizing professional learning time and/or exploring dialogic, third space pedagogy, as our time was limited. How we facilitators ultimately decided to use that time was strongly influenced by the teacher working group's nested position within the larger Language Awareness and Dialogic Reasoning project. We research assistants understood that our goals had to be subordinate to the goals of the larger project. Required to adhere to the plan laid out in the grant, it was often necessary to use teacher working group time for discussions of project logistics, which resulted in less time for learning-oriented activities. As a result, the combination of time limitations and nestedness within the larger research project led to a system in which teacher learning was secondary to other goals.

Incongruence also created tension among our objectives. Supporting implementation of the curriculum with fidelity was inherently in conflict with some of the principles that Jada and I hoped to disseminate, as the curriculum did not fully embody these principles. This incongruence is discussed in detail in the section on conflicting information below. Although our goals were at times incongruent, as researchers on the same project, with responsibility for facilitating the teacher working group, we were co-dependent agents, working together to set a direction for the professional development system. As Davis and Sumara (2006) discuss, intelligent, collective action can emerge within a system, as agents with different and even self-interested goals participate in co-dependent activity. Each of us acted with purpose

toward our goals, while exchanging information with and responding to one another and to the teacher agents in the system. Ultimately, whether or not we made progress toward any of our multiple, competing objectives depended not just on we four researchers, but on what emerged through the course of our interactions with the teacher agents.

The Teachers. There were eight teacher agents in the professional development system, each bringing her own ideas and motivations into the system and interacting with other agents in ways that influenced the nature of the system as a whole. Table 6 lists their positions at Bilingüe along with their roles in the Language Awareness and Dialogic Reasoning project. Amy, Caitlin, Helen, Jo, Kelly, and Martina had already been part of the teacher working group for at least one year, while Carol and Tara were new to the project. In Chapters Five and Six, I focus on two of these teachers: Kelly and Martina. However, in this section I discuss all eight teachers, because, as system agents, all shaped and were shaped by the system.

Many of the teachers came into the 2016-2017 school year eager for a chance to think about how to apply ideas from the Language Awareness and Dialogic Reasoning project to their own teaching. At the first teacher working group session of the year, Jo described her hopes:

Every time I look at these great things, the way that vocabulary is explicitly taught, and all the grammar and all that, I just, it would be so useful to, you know, have the time to really pull that together, you know, and extend the lessons. (Jo, TWG 1)

Several other teachers agreed. Tara and Amy expressed a desire to develop curriculum for science or social studies. Helen and Kelly were interested in developing curriculum in

Spanish, noting a deficit of high quality, language-focused Spanish curriculum. Going into the school year, these teachers hoped that teacher working group time could be devoted to curriculum development.

Initially unified in their goal, the teachers split into groups with different priorities as the implementation phase of the project got underway. Four of the eight teachers, Kelly, Martina, Carol, and Helen, implemented the curriculum as part of the larger research project. Once they realized that they would be teaching the curriculum, Kelly and the other implementing teachers prioritized using teacher working group time to troubleshoot and reflect on lessons with their colleagues over spending time developing curriculum. However, the four teachers who were not implementing the curriculum continued to favor using the time for additional curriculum development work. Amy, Tara, and Caitlin decided to develop new units, using the principles of language-focused pedagogy, that would fit with their existing classroom curriculum, while Jo offered to consult with Jessica on the development of the new Spanish analog curriculum. Thus, the teacher agents brought competing desires into the system that were different from the goals of the researcher agents.

We facilitators worked to accommodate all the varied goals. Jada, Jessica, and I had many planning discussions about how to achieve the larger project's objectives and our own goals, while simultaneously meeting the learning needs of all the teacher agents. During our November teacher working group session, we were transparent with the teachers about this challenge:

This group has multiple purposes and multiple people doing different things.

Since you've got four of you guys who are implementing the curriculum, and

others who are involved with curriculum development, and then the implementation folks will hopefully be able to do curriculum development too. So we've been talking about how we can use our time together to further all of those goals. (Meredith, TWG 3)

While we sought to organize the professional development system in the best way possible to accommodate these goals, ultimately the system self-organized. As facilitators, Jada, Jessica, and I were able to specify objectives, create agendas, and design learning activities in the hopes that learning would emerge. However, the system itself was out of our control, organizing itself through the interaction of all the agents with each other, with other systems, and with the environment. In the sections on structure and information below, I discuss what emerged as the professional development system self-organized, demonstrating that the system offered only limited opportunities for learning.

Professional Development System Structures

As I described above, the professional development system was part of an existing research project, which had already been working with Bilingüe teachers for two years. In 2016-2017, we repurposed an existing group, the teacher working group, and an existing structure, the monthly working group session, for professional development. Unsurprisingly, the control parameters of this preexisting group influenced the nature of the professional development system that developed. The resulting structures were not ideal for change and learning to occur, as I discuss in more detail below.

For the two previous years, the teacher working group's primary functions were consulting on the development of the curriculum and providing logistical support to

enable the researchers to pilot the curriculum with students. Teachers attended working group sessions one Friday afternoon per month, from 3:30-4:30. The researchers set the agenda for these meetings. A typical agenda might include asking the teachers for feedback about lesson plans in development or showing video from a lesson taught by a research assistant. Additionally, the agenda included topics such as student selection, scheduling, and other logistical considerations. We researchers always brought snacks and coffee to these sessions to foster a relaxed, casual environment. Teachers began to trickle into the room just before 3:30. They would help themselves to food and coffee, settle in, and chat informally. We would wait until close to 3:40 to dive into the meeting agenda. Despite starting late, we usually ended right on time at 4:30, out of consideration for the teachers' busy schedules. For most of the project's initial two years, we asked little from the teachers beyond attendance at these monthly sessions.

These preexisting structures were not ideal for a learning-oriented community of practice, nor did they offer enough time to accomplish the varied goals of the agents in the learning systems. Therefore, Jada, Jessica, and I sought both to transform the existing structures and to create new structures that would be more conducive to learning. At the first teacher working group session of the year, which was primarily devoted to logistics, I announced our intentions to the teachers.

This year, we are really hoping to intentionally use this time and this space for collaborative learning together.... We're going to be making a big effort to save most of our time in here for that sort of thing, as opposed to for all the scheduling and other stuff that we've just spent the last 45 minutes talking about. (Meredith, TWG 1)

Jada tried to establish additional time beyond the designated monthly sessions for teachers to engage in Language Awareness and Dialogic Reasoning project-related work. She set up extra meetings with the teachers who were developing classroom curriculum to consult on their progress, and she asked them to commit to putting in time outside of the sessions to actually develop curriculum. Likewise, Jessica found additional times to work with Jo on the Spanish curriculum. While I would have liked to provide implementation support outside of the monthly hour, I decided against asking the implementing teachers for any additional meetings, as I had heard from Martina that some of the implementing teachers felt it was unfair that they were being asked to do more work than their colleagues, despite receiving the same stipend amount. Instead I focused on using the session as effectively and efficiently as possible. My planning conversations with Jada and Jasmine routinely included discussions about time: Was it better to have full group learning activities before or after small group breakout sessions? Could we address logistical issues while the teachers were trickling into the meeting, or, better yet, move logistical conversations to email?

In an effort to better promote learning within the existing time constraints, we sought to establish new structures to promote learning, in accordance with our understanding of adult learning (e.g. Merriam et al., 2012; Schön, 1987). Increasingly, we planned active learning activities such as discussing articles, watching and analyzing videos, and analyzing lesson plans. We developed handouts that were intended to foster learning during and beyond these activities. Whereas we had previously written up brief agendas, listing discussion topics, we began to write detailed meeting plans, containing

objectives, materials, and activities, which often included a sequence of discussion questions to foster reflection and lead to the exchange of ideas among agents.

Despite our attempts to alter the conditions within the teacher working group to promote learning, some things proved hard to change. As discussed above, complex systems self-organize as agents mutually adjust their behaviors to cope with a changing environment (Cilliers, 1998). Thus, as we tried to institute changes, teachers adjusted their behaviors, requiring us to make further adjustments. For instance, when we asked teachers to read an article in advance of a teacher working group session, some teachers made time to read the articles. Other teachers, who did not get around to reading the article prior to the session, became less vocal during the session. This required further adjustments on our part, such as beginning sessions with a review of key points from the reading, in order to orient those who had not read it. Similarly, although we wanted to begin sessions on time, when some teachers continued to arrive after 3:30, we adjusted the plan, scrapping the idea of starting with whole group discussions in favor of using the first ten minutes to coordinate logistics with individuals. Co-dependent with the teacher agents, we could not simply introduce new learning structures and expect teachers to engage as we envisioned. Instead, the learning structures evolved through the interactions of all the agents.

Initially, in addition to structuring the teacher working group as a community of practice that would be a site of collective learning, the research team discussed creating a new observation and coaching structure that would help to promote individual learning for the implementing teachers during one-on-one conversations. However, the establishment of this structure was constrained by a number of factors, including the

professional development system's nested position within the larger project. Jada, Jessica, and I were agents in both systems, dually positioned as researchers in the Language Awareness and Dialogic Reasoning project and facilitators in the professional development system. There were inherent tensions in this dual positioning, which impacted our ability to enact our roles. As researchers, we were obliged to enter teachers' classrooms to collect data. In order to help the teachers feel comfortable with us observing them teach, we framed ourselves as non-evaluative parties. When I first explained my dissertation research to the teachers, I described it in these terms:

It's not me saying, 'Are you doing it well or not?' It's me trying to make sense of the process and the differences in the processes, using a case study approach, recognizing that there are likely to be big differences in what you all do with this.

(Meredith, TWG 1)

After positioning ourselves as non-evaluative observers, it would have been challenging for us to also enact a coaching role. This was compounded by other factors, including the teachers' expectations; none of them expected to or expressed a desire to be coached by us. Thus, after classroom observations, we tended to offer positive or neutral feedback, rarely, if ever, initiating negative feedback. Rather than the observations serving as a jumping off point to initiate coaching conversations in which information would be freely exchanged, increasing the likelihood that learning could emerge, observations were a structure mainly for data collection. Thus, the nested position of the professional development system within the larger project foreclosed the creation of a structure that might have promoted individual teacher learning.

Both the initial conditions within the professional development system and the system's nested position severely limited the facilitators' ability to establish structures that might have allowed teachers to engage deeply in active learning or to receive ongoing feedback and follow up, two of the conditions that have been found to be generally beneficial to teacher learning through professional development (e.g. Desimone, 2009; Kennedy, 2016). Instead, the professional development system included only those limited structures for promoting teacher learning described above. System control parameters, such as short meeting times and observations without feedback, served to limit the richness of connectivity between system agents and the diversity of perspectives that were shared. Furthermore, given our limited time together, and the multiple, competing goals of system agents, it was hard to come together as a community of practice, united in a shared enterprise, learning collectively in pursuit of this enterprise. Collective engagement in learning is another condition found to be conducive to teacher learning (e.g. Coburn, 2001; Desimone et al., 2002). Thus, learning conditions in the system were far from ideal.

My analysis of how the professional development system promoted teacher learning, and how it did not, offers a nuanced perspective on how structural elements of a professional development system interact. As I discussed in Chapter Two, much of the research literature on professional development has been concerned with identifying features that promote teacher learning (e.g. Garet et al., 2001; Heck et al., 2008). This literature has led to a growing consensus on "critical features" of professional development, including content focus, active learning, coherence, duration, and collective participation (Desimone, 2009). However, focusing on the features in isolation does not

lead to an understanding of how they operate together, nor can it explain those situations when professional development that includes the critical features does not seem to result in teacher learning (e.g. Kennedy, 2016).

A complexity-informed analysis of a professional development system enables us to understand these features in structural terms, as the control parameters that, in interaction with each other, shape the system. For instance, collective participation may be associated with teacher learning because, when there are limited power differentials among system agents, as among teachers from a school, grade, or department, the teachers are able to learn from and with each other. Through their collective participation, teacher agents become increasingly connected, and these connections become deeper over time, when professional development is of extended duration. Furthermore, when teachers collectively participate in active learning experiences, reflecting upon and discussing a content-focused activity, these conversations involve a fast flow of information and opportunities to share diverse perspectives. Thus, a complexity-informed analysis enables us to better understand whether a professional development system is likely to promote learning, not merely by checking off a list of features, but by analyzing how the professional development structures, in interaction, may promote the rapid exchange of information among richly connected agents of equal status with diverse viewpoints. While we understood that the teacher working group would not be an ideal professional development system, because teacher learning had to be subordinate to the goals of the federally-funded Language Awareness and Dialogic Reasoning curriculum project, we facilitators remained committed to the goal of fostering teacher learning to the maximum extent possible. I turn next to the topic of what it was that we hoped teachers

would learn and how the information in the professional development system self-organized.

Information in the Professional Development System

While the teacher working group sessions were not the only site of professional development, and learning occurred outside of these sessions, as explored in Chapters Five and Six, they were the only occasions on which all the agents in the professional development system came together with the possibility of learning as a community. Thus, my discussion of the information that was exchanged within the professional development system focuses on the content of these sessions. Table 7 lists the topics and activities that were addressed over the course of the year's sessions. As the table illustrates, we used teacher working group sessions to serve all of the multiple goals described above. Project logistics were major topics during the September and October sessions, as well as the final two sessions in May and June. We used a breakout group structure during six of the sessions to allow implementation support and discussions of implementation logistics to occur concurrently with Spanish curriculum development consultations and curriculum developer check-ins. Learning-focused conversations around the principles of language-focused pedagogy began in November and occurred in every subsequent month except February. These principles-related conversations varied in length from less than ten minutes in November and June, to the whole hour in April. As a whole, Table 7 illustrates the disjointed nature of a system working toward multiple objectives simultaneously. Due to all of the other demands on teacher working group time, we devoted less than half of our time, a mere four hours in total, to face-to-face, content-focused, collective learning activities.

Table 7

Teacher Working Group Session Topics and Activities

Date	Topics/ Activities
September	<ul style="list-style-type: none"> • Planning for implementation: identifying students, teachers • Pre-assessment scheduling • Orientation to project website • Overview of support structures for implementing teachers • Discussion of what teachers hoped to get out of participating in the teacher working group
October	<ul style="list-style-type: none"> • Pre-assessment schedules • Breakout groups (implementation group; classroom curriculum development; Spanish curriculum development)
November	<ul style="list-style-type: none"> • Election processing / discussion of conditions at Bilingüe • Introduction to the principles of language-focused pedagogy • Discussion of dialogic reasoning and student-centered conversations • Breakout groups (implementation group; classroom curriculum development; Spanish curriculum development)
December	<ul style="list-style-type: none"> • Discussion of article about dialogic reasoning • Viewing of dialogic reasoning video from Martina's classroom • Discussion of teacher facilitation of dialogic reasoning • Breakout groups (implementation group; classroom curriculum development; Spanish curriculum development)
January	<ul style="list-style-type: none"> • Breakout groups (implementation group; classroom curriculum development; Spanish curriculum development) • Discussion: what is dialogic instruction? • Viewing of word web video from Kelly's classroom • Discussion about dialogic instruction
February	<ul style="list-style-type: none"> • Breakout groups (implementation group; classroom curriculum development; Spanish curriculum development)
March	<ul style="list-style-type: none"> • Discussion of turn-taking patterns in classroom discourse • Analysis of a turn-taking patterns in a LADR lesson plan • Scheduling LADR instruction from now until end of year
April	<ul style="list-style-type: none"> • Review of turn-taking patterns in classroom discourse

Date	Topics/ Activities
	<ul style="list-style-type: none"> • Small group analysis of turn-taking patterns in a lesson plan
May	<ul style="list-style-type: none"> • Breakout groups (implementation group; classroom curriculum development; Spanish curriculum development) • Presentation of pre-assessment results • Interactive Presentation: Developing Language Focused Curriculum for Emergent Bilingual Learners – Applying Principles of Language-Focused Pedagogy
June	<ul style="list-style-type: none"> • Planning for final data collection • Presentation of “Guide for ‘LADRizing’ existing curriculum materials” • Planning for ongoing partnership between Bilingüe and University • Completion of online teacher questionnaire

In a complex human system, such as the professional development system, the information that agents exchange with each other can take many forms. People may share experiences, gossip, facts, suggestions, theories, beliefs, even jokes. As information is exchanged, learning can emerge for individual agents and for the system as a whole. In a professional development system, the information that is exchanged includes ideas that the facilitators bring to the professional development, which can be thought of as the content. This content can be verbalized during face-to-face interactions with teachers as well as expressed in written or visual form, through handouts, presentations, articles, and other shared resources. In many professional development models, the content is established ahead of time, and teachers begin the professional development expecting to learn something in particular. How they engage with that content varies from individual to individual, based on differences both in the teachers’ learning systems and in the other systems in which teachers are nested. However, the content itself is fixed. In such systems, there is limited opportunity for information that facilitators bring into the system to co-evolve through interaction with the teachers, potentially limiting the learning of all

the system agents. According to Morrison (2008), “Emergence and self-organization require room for development; tightly prescribed, programmed and controlled curricula and formats for teaching and learning, and standardised rates of progression are anathema to complexity theory” (p. 23). Applying this idea to professional development, these experiences should be learner-centered, evolving on the basis of what the teachers bring into the system. When the content of a professional development system is pre-programmed, there is much less room for new, context-specific knowledge to emerge within the system that could benefit teachers and facilitators alike.

The content of the Bilingüe professional development system was not pre-determined. Although we anticipated introducing information based on Jada’s research interests and our joint goal of promoting understanding of the principles of language-focused pedagogy, we did not have a set plan. The established goal of offering teachers support with implementing the Language Awareness and Dialogic Reasoning curriculum with fidelity was broad enough to allow the professional development content to be co-constructed by the researchers and teachers. Our intention was to respond to the teachers’ needs, rather than to prescribe what they were to learn. In so doing, we hoped to foster a community of practice in which teachers and facilitators would mutually undertake a shared enterprise and collectively develop tools and representations to carry out the enterprise (Wenger, 1998). In such a community, as members exchange information about an enterprise in which they are invested, ideas emerge that are relevant and meaningful for the teachers. It would thus be likely that teachers’ interactions with the professional development system would influence their classroom practice, leading to a co-evolution of participation in teacher working group sessions and in classroom practice.

While we always had to juggle multiple demands on our limited teacher working group time, we facilitators attempted to foster a responsive community of practice, through incorporating feedback to help us plan the content of upcoming sessions. Complex systems learn and change through feedback loops, as system agents interact and provide each other with feedback (Cilliers, 1998). Jada, Jessica, and I met for planning meetings prior to each session, during which we reflected on the feedback that we had received from the teacher agents. Occasionally we sought out explicit feedback. For example, at the November session, after introducing the principles of language-focused pedagogy, Jessica asked the teacher agents whether there was a specific principle with which they would like support. Kelly and Jo were the first to answer, expressing agreement that they would like to learn about dialogic pedagogy:

Kelly: As a first time implementer, I would most want to dive into the dialogic instruction, and the dialogic conversation part.

Jo: That keeps intriguing me too. Because I think it motivates the students.

Kelly: Yeah. And the rest of it is, at least, things that I've taught before and that I understand how it works with the kids, but that, for me as a teacher, is the hardest part. Like how do you get kids to do that successfully without me mediating?

(TWG 3)

This conversation provided us with the feedback we needed to select a topic for the next few sessions: dialogic reasoning and dialogic pedagogy more generally. More often the feedback came in the form of the questions, experiences, knowledge, and ideas that teachers shared in response to the content of teacher working group sessions, as well as the teachers' practices, which we witnessed during our observations of Language

Awareness and Dialogic Reasoning lessons. As the year progressed, we planned sessions on the basis of our understanding of the needs within the system as a whole and of individual teachers' needs. Ultimately, we introduced content related to two interrelated topics: language awareness and dialogic instruction.

Language awareness. The Language Awareness and Dialogic Reasoning curriculum was designed to promote language awareness, and, naturally, this was an ongoing topic of the information that we facilitators brought into the professional development system. However, we rarely took up the subject of language awareness explicitly. We initially presented our rationale for creating a language awareness curriculum in the November teacher working group session in a document summarizing the principles of language-focused pedagogy. “Bilingual learners will increase their comprehension and fluency through developing language awareness and skills in semantics, morphology, and syntax” (TWG Artifact 1). At that point in the year, we did not offer an explanation of the term language awareness, emphasizing the importance of teaching language explicitly, without delving into what should be taught. Furthermore, we did not give the teacher agents a chance to share their ideas on the subject of language awareness. As the year went on, we facilitators continued to mention language awareness, as well as metalinguistic awareness, or the ability to consciously reflect on language and its components (semantics, morphology, syntax, etc.), but rarely took them up explicitly as topics of discussion. Instead, we used the language awareness curriculum as the backdrop for session activities focused on dialogic instruction, which was more of a concern for the teachers. By limiting the degree to which we exchanged information with the teacher agents in the system about language awareness, we limited the chance

that learning about language awareness would emerge within the professional development system. Instead, we left the teachers to make sense of language awareness and metalinguistic awareness individually, using their background knowledge, as well as ideas from the curriculum. Absent an exchange of information, Kelly and Martina did not develop new ideas about language awareness over the course of the year, as I show in Chapters Five and Six.

Dialogic instruction. The primary focus of the information that we brought to teacher working group sessions was dialogic instruction. The term dialogic instruction refers to teaching that occurs through talk in which both teacher and students share their perspectives and interact with each other's ideas. It can be contrasted with monologic forms of instruction, such as direct instruction, in which only one perspective (the teacher's perspective) is considered to be authoritative (Wells & Auraz, 2006). We devoted four sessions to exploring different aspects of dialogic instruction.

As researchers with a strong commitment to dialogic instruction, we hoped that the teachers in the group would embrace dialogic instruction as an approach to teaching language, in accordance with the principles of language-focused pedagogy. Informed by ideas about teacher learning from complexity theory (e.g. Morrison, 2008) and sociocultural theory (e.g. Raphael et al., 2014), we recognized that we needed to approach the topic of dialogic instruction dialogically, giving the group a chance to exchange ideas, rather than trying to transmit our own knowledge and values. Thus, in the January and March teacher working group sessions, we spent time collaboratively defining dialogic instruction and discussing its benefits. Teachers articulated multiple benefits, including that it lets students practice language skills, develop new ideas, and

deepen their understanding through expressing ideas, while giving teachers a chance to assess student understanding and explore misunderstandings. These benefits were widely agreed upon in the group.

Going beyond the consensus view that dialogic instruction helps individual learners to learn established skills and ideas, Jada brought up another idea, positing that dialogic instruction is a means for a group to develop socially situated understanding:

And the meaning, if the meaning is different for different individuals in a more spread out way, it comes together a little bit better through the discussions, and so it offers the opportunity to correct misunderstanding and come to a socially kinda situated, like everybody sort of thinks about it in this way, at least everybody within our group. (Jada, TWG 5)

In contrast to the widely embraced emphasis on individual students and teachers, Jada's idea focused on the group. The teacher agents did not initially share this idea. During this session, no one responded directly to Jada's idea, and the conversation moved on.

However, Jada, Paul, and I raised this point again in subsequent sessions, attempting to introduce a perturbation, or an event that disrupts the status quo and precipitates radical change within a system (Davis & Sumara, 2006; McQuillan, 2014). We hoped to bring about a radical change in teachers' perceptions and practices of dialogic instruction, in which the dialogue was generally viewed as requiring heavy teacher mediation in order to move students toward right answers. In this effort, we used concrete examples from our own experiences teaching the Language Awareness and Dialogic Reasoning curriculum to exemplify how students and teachers can develop a shared understanding of language through multi-vocal, dialogic instruction. Eventually, some of the teachers began to

respond, as in the March teacher working group session, when Carol followed up an example that I shared with an example from her own group (TWG 7). In this instance, exchanging information and situating it in a context familiar to teachers (the Language Awareness and Dialogic Reasoning curriculum) contributed to a shift for individual teachers in the group, who began to perceive dialogic instruction in ways that were aligned with our views.

In keeping with complexity theory, as information was exchanged, it did not always stay static. Rather, on occasion new ideas about dialogic instruction emerged within the system that none of us had held previously. This occurred during a discussion in March about when to use dialogic instruction. I encouraged the teachers to invite dialogue among students when introducing new concepts in morphology, syntax, and semantics lessons. Martina questioned whether these lessons should really be taught dialogically, arguing, “My instinct is to make it a more traditional lesson, because it’s something that they don’t have a lot of familiarity. It’s like, there’s still a time and a place for direct instruction” (TWG 7). This response initiated an unplanned discussion about when teachers should use dialogic instruction. We discussed an example that had come up in Martina’s class recently. She had asked students what word parts they noticed in the word captivity, and one student suggested “cap.” Martina had not acknowledged this response, encouraging students to notice the end of the word instead. In the teacher working group session, she explained that she felt it was not worth spending time discussing “cap” as it would not help students to understand the word “captivity.” In response to Martina’s example, which was bolstered by support from Kelly and Carol, I changed my initial blanket call for dialogic instruction, remarking, “I guess it’s about

seizing the opportunity for what are the productive things” (TWG 7). The idea of “productive dialogue” had emerged. In other words, it was a new idea that did not exist for anyone in the group prior to this discussion, but developed spontaneously through our interactions. As a group, we went on to discuss how teachers would need to use their judgment to evaluate when and whether engaging students in dialogue would be productive. We continued to hold differences of opinion about what constituted productive dialogue. Whereas Paul and I both agreed with Martina that it was not worth spending time in dialogue about “cap” in relationship to “captivity,” Jada argued that even discussion of a student’s wrong answer might support the development of language awareness. In this conversation, as system agents shared their perspectives and responded to one another, the knowledge within the system changed. Even though individual agents, including facilitators, continued to harbor discrepant beliefs, as a whole the system was learning, in the sense that it contained new information that had not heretofore existed.

In the course of the approximately three and a half hours that we spent exploring dialogic instruction about language, the system agents exchanged ideas about different facets of dialogic instruction, including teacher facilitation and the affordances of different turn taking patterns. Of the ten hours we spent together in teacher working group sessions, these three and a half hours were the most likely occasions of learning, as they were neither programmed nor prescribed, but rather allowed for an exchange of ideas from all system agents. However, the potential for the learning that emerged during these conversations to co-evolve with individual teachers’ classroom practice was limited, not just by the structural constraints outlined above, but also by the introduction of conflicting information due to externally imposed structures, as discussed below.

Conflicting information. While we facilitators articulated certain information about dialogic instruction and language awareness both verbally and in the resources we shared with teachers, we simultaneously gave them conflicting information about implementing the curriculum with fidelity and completing the curriculum within a set timeframe. We were constrained by the structures and information of the larger research project, which were in many ways dissonant with our goals for teacher learning as well as the teachers' own goals.

The curriculum as written contributed to this dissonance. Although we encouraged teachers to employ dialogic instruction and to prompt metalinguistic awareness, we handed them a curriculum that was not always aligned with these pedagogical principles and asked them to implement it with fidelity. This lack of alignment between the curriculum and the principles that we espoused during teacher working group sessions had its origins in the curriculum's development within a complex research system, consisting of multiple agents with diverse viewpoints. The Language Awareness and Dialogic Reasoning project had co-principal investigators from two different universities, with disparate experiences, knowledge, and beliefs. Paul, who had a background in bilingual education, was committed to creating opportunities for students to negotiate meaning through talk, while the co-principal investigator, who had a background in special education, was committed to presenting information clearly through direct instruction. The final version of the curriculum that we asked teachers to implement was the product of an uneasy compromise, combining practices from two discordant epistemologies.

That epistemological compromise is manifest in all the language awareness lessons, which include a mix of dialogic and direct instruction along with shifting emphases on language awareness and metalinguistic awareness. The syntax lessons in particular tended toward a traditional, direct instruction approach. For example, the lesson plan on compound sentences and coordinating conjunctions (see Appendix D) includes this language:

Tell students today they will focus on compound sentences, which are made of two or more independent clauses. Explain that independent clauses are clauses that can stand on their own as complete sentences. Independent clauses are connected by conjunctions (linking words).

The plan continues in this vein, prompting the teacher to present information monologically, rather than to engage students with language dialogically. Additionally, while in teacher working group sessions we encouraged teachers to invite dialogue by employing open-ended questions, the plans included primarily known-answer questions. The same syntax lesson includes a series of known-answer questions to prompt students to analyze compound sentences: “What does the first part say? What does the second part say? How are these parts of the sentence connected?” No follow up questions are suggested that might give students an opportunity to articulate their understanding, perhaps developing metalinguistic awareness. Indeed, with an emphasis on terminology and sentence diagramming, this lesson plan reads almost like a traditional grammar lesson. Only the final step of the last activity points toward a different epistemological stance. Teachers are directed, “If time and student level allows, have students experiment with using different conjunctions and changing the order of the clauses. Guide them to

notice how the meaning changes.” While such an activity would indeed require students to think metalinguistically and might involve them in dialogue, it is optional, sending the message that it is less important than other aspects of the lesson. Thus, as teachers interacted with us as well as with the curriculum, they received dissonant information.

Furthermore, the lesson plan timings and project timeline were externally imposed control parameters that hindered learning within the professional development system. Although we were aware that aspects of the curriculum were dissonant with our beliefs about teaching and learning, due to our positioning as research assistants for the Language Awareness and Dialogic Reasoning project, we were compelled to work within these constraints. The lesson plans were only allotted 30 minutes, but the teachers found that they consistently took longer to teach. At times, we suggested that teachers should split lessons over two days, slowing them down even further, rather than sacrifice opportunities for rich conversations, which, we acknowledged, take time. However, we constantly reminded teachers that the end of the year was approaching. During the January teacher working group session in which our whole group conversation focused on defining dialogic instruction and talking about its benefits, I asked the implementing teachers:

Given that it seems like lessons are still taking a long time, and here we are at the end of January, how can we get through this curriculum this school year? Like have you been thinking about mapping out where you’re going to be, month by month? (Meredith, TWG 5)

Within one hour, I was both encouraging the teachers to “get through” the curriculum and asking them to introduce more dialogue into the already crammed lesson plans. Just as

the Bilingüe administrators sent conflicting messages to teachers about student-centered instruction, we researchers voiced contradictory messages in our interactions with teachers. This probably reduced the likelihood that our encouragement of dialogic instruction would perturb the system and provoke radical change among the teachers.

The traditional model of professional development posits that the learning activity provides teachers with new information, which they take back to their classrooms in the form of changed practices and/or changed beliefs. In contrast, when professional development is understood as a complex system, it is apparent that such a linear model of teacher learning is a fallacy. The Language Awareness and Dialogic Reasoning professional development system, like all complex systems, was characterized by multiple, short-range, nonlinear interactions (Byrne & Callaghan, 2014). Rather than information following a linear path in one direction, flowing from facilitator to teacher to classroom, within the professional development system, agents exchanged information, which flowed in every direction between facilitators, teachers, and classrooms. In the process, the information changed in scale and, at times, altogether new information emerged. In this conceptualization, it is clear that what teachers might learn through professional development is unpredictable. The unpredictability of the professional development system was compounded by its nested position in the larger research project, which imposed structures and ideas that were dissonant with the content. We facilitators were not in control of the professional development system, nor of the teacher learning systems nested within. As I have shown, we did what we could to foster learning within a system in which teacher learning had to be a secondary goal. While my analysis focuses on the particulars of one professional development system, any professional

development system could be analyzed in the same way. The information that individual teacher agents take away is never quite the same information as that which the facilitator agents bring into the complex system.

Overlapping Systems

The professional development system and school level learning systems described above were overlapping, interpenetrating systems, with eight teacher agents who were part of both systems, as illustrated in Figure 2 (see Chapter Three). The teachers brought information from the school-level system into the professional development system and vice versa. This included information about system priorities, beliefs, and practices. As the teachers who were simultaneously agents in both systems exchanged information with other agents in both systems, the two systems interacted, influencing the self-organization of each system. Furthermore, each system was impacted by structures that originated in the other system, including the school's schedule and the Language Awareness and Dialogic Reasoning curriculum. Below I analyze areas of congruence and dissonance between the two systems that impacted teacher learning

The principal initially welcomed the larger Language Awareness and Dialogic Reasoning project into the school because she believed the project's goals were similar to the school's priorities, a sentiment that was echoed by the teachers. Kelly expressed a belief that, as teacher consultants to the project, she and her teacher colleagues had been able to shape the curriculum so that it incorporated some of the best practices that they had read about in book studies, but had struggled to implement at Bilingüe:

One of the things that I love about [the Language Awareness and Dialogic Reasoning project] is that it takes a lot of those things that we learned about. We

were able to bring a lot of that into our planning for this curriculum, and then it does fit in with what we're doing, because we've made it fit, because we had the help to do that. (Kelly, interview 1)

Kelly felt that the resultant curriculum addressed several recent school priorities, including rich vocabulary instruction, attention to cognates, and student-centered conversations. The school's 2016-2017 oral language goal of developing expressive language skills through increased participation in content-based discussions was congruent with the curriculum's goal of creating opportunities for emergent bilingual learners to develop their expressive language through use. Thus the Language Awareness and Dialogic Reasoning project was perceived as another means for teachers to work toward the school's goal, in the process potentially learning something about student-centered classroom instruction that could inform the rest of their teaching. However, this similarity between school and professional development system goals masked differences between the two systems that may have impacted what emerged within the professional development system and for individual teachers.

Teachers and researchers had different visions for an ideal classroom, particularly with regard to dialogic and student-centered instruction. The Bilingüe School's norms for student-centered instruction had been influenced by Zwiers and Crawford's (2011) *Academic Conversations* and Ritchart et al.'s (2011) *Making Thinking Visible*. Bilingüe teachers had embraced Zwiers and Crawford's concept of *academic conversations*, which are paired student conversations employing carefully designed conversation tasks that require both partners to talk.⁴ Teachers implemented *academic conversations* as a

⁴ The term *academic conversations* is italicized to alert the reader that it refers to the specific model of conversation described by Zwiers and Crawford (2011).

discrete add-on to the existing curriculum. For instance, third graders had a separate language development block once a week that was devoted to teaching *academic conversation* skills. Increasingly, teachers were incorporating Ritchart et al.'s "thinking routines," which are patterned conversations in which students articulate their ideas verbally. These were being treated as games, also implemented outside of regular instruction. This separation of dialogic practices from the rest of instruction differed from the approach for which we researchers advocated in the professional development system. We encouraged teachers to use dialogic instruction throughout all their lessons, not just during designated dialogic reasoning discussions. Instead of carefully controlled partner conversations, or patterned "thinking routines," we envisioned small group conversations in which students and the teacher all talked freely.

Furthermore, the school-level learning system's norms for what conversations should sound like differed from the norms of the researchers in the professional development system. Within the school-level learning system, much import was placed on the form of conversations; in keeping with recommendations from Zwiers and Crawford (2011), teachers embraced sentence starters as an effective tool to teach students to use academic grammar and vocabulary when discussing academic topics. They encouraged students to initiate turns with phrases such as, "I agree with _____ because _____." In contrast, we facilitators placed much less emphasis on form and structure, believing that the understanding students developed through dialogue was more important than their use of a particular set of grammatical or conversational conventions. In some of the conversations that we considered to be exemplars of dialogic instruction, students spoke in incomplete sentences, interrupted each other, and talked over one

another. In sum, despite the apparent congruence in the school-level system's and professional development system's embrace of dialogic instruction, ideas about when and how to do this differed significantly between the two systems.

Although we researchers were aware of the dissonance between our ideas about student-centered discourse and the school's norms, we were constrained by the professional development system's structures from taking the time to thoroughly surface and explore these differences with teachers. Activities that help teachers to examine their preexisting knowledge and beliefs may create conditions for radical change (Putnam & Borko, 1997). In the absence of such activities, it was possible for the teachers to ignore these differences, mapping their own vision of student-centered instruction onto our discussions during teacher working group sessions, and enacting this vision while implementing Language Awareness and Dialogic Reasoning lessons, without realizing that their vision differed from ours. In short, as the professional development system and teachers' learning systems self-organized, in interaction with the school learning system, the ideas that teachers held onto and the new ideas that emerged did not necessarily correspond to the researchers' ideas. As facilitators, we could establish dialogic instruction as the topic for a professional development session, but we could not actually control how teachers understood dialogic instruction.

Not only was there dissonance in the norms and beliefs embraced by agents in each system, so too was there dissonance in system structures. The structures were congruent up to a certain point. Having signed on to partner with the Language Awareness and Dialogic Reasoning project, the Bilingüe principal had agreed to align the structures to some extent. For instance, teachers were able to teach the curriculum as part

of their regular teaching load, rather than as an additional responsibility. However, the inflexible school schedule described above limited the extent to which teachers could actually put into action the ideas that we were discussing in working group sessions. Figuring out how to fit Language Awareness and Dialogic Reasoning lessons into already busy schedules was in and of itself a challenge: teachers reported that their 30-minute blocks were reduced to 25 minutes when they accounted for transitions. Actually teaching the curriculum twice a week turned out to be another challenge, as normal school schedules were all too often interrupted by district- and state-mandated standardized testing, during which regular instruction was sidelined. Under these conditions, our recommendations that teachers should not just make time to teach the Language Awareness and Dialogic Reasoning curriculum, but should extend the lessons so as to provide enough time to engage in student-centered conversations about language was stymied by system structures. Constrained by the structures of both systems, it was a challenge for teachers to enact emerging ideas about making time for productive, student-centered conversations.

Through the preceding analytic descriptions of the professional development system and the school level learning system, I have portrayed the nature of the two systems that were the context for and interacted with individual teacher learning. I have demonstrated that emergence within each system was constrained by control parameters, including the imposition of structures from larger systems, which limited connectivity and reduced the rate of information flow. Together, the two systems worked congruently to focus teachers' attention on developing students' expressive language through participation in content-based discussions. However, dissonance in information and in the

system structures impacted what teachers could actually learn through their participation in the professional development system. In the next two chapters, I turn to an analysis of individual teachers' learning, with the cases of Kelly's and Martina's learning systems.

CHAPTER FIVE

A Complexity Analysis of Teacher Learning through Professional Development: Learning under Stasis Conditions

When teachers from the same school participate in collective professional development, their learning from this shared experience may nonetheless be quite different (e.g. Brownell et al., 2014; Spelman & Rohlwing, 2013). Imagine three teachers from the same grade level. The first continues to teach as she always has, as if she had not been part of the professional development. The second makes small modifications to his practice, such as introducing a new activity based on something he learned about in professional development. The third concludes that certain aspects of her practice are not congruent with her beliefs, and significantly transforms those aspects of practice so that beliefs and practices correspond.

Although learning can and does vary dramatically from teacher to teacher, there are also patterns that repeat across individuals in different circumstances. A major goal of this dissertation is to identify some of those patterns, in order to push the field toward an explanatory theory of teacher learning. This dissertation takes up Opfer and Pedder's (2011) call for research that helps us to understand "under what conditions, why, and how teachers learn" (p. 378). In the next two chapters, I present and employ an analytic framework, based on analysis of the data, that can be used to generate complex, contingent, causal explanations of teacher learning through professional development, in the service of ultimately developing an explanatory theory.

The first section of this chapter outlines a complexity analytic framework for teacher learning through professional development, which I developed by analyzing the two teacher cases through the lens of complexity theory. Creation of an analytic framework is often a major goal of qualitative study because it provides a way to theorize an important educational phenomenon—in this case teacher learning in the context of school-based professional development—which can be useful well beyond the study site. I argue that when teachers participate in professional development, they do so under a particular set of learning conditions that result from the interaction of their own learning systems, the learning systems of the schools where they work, and the professional development system. I assert that the conditions can be conceptualized as continua, ranging from “stasis conditions” that promote minimal learning, to “modification conditions” that promote incremental learning, to “transformation conditions” that promote transformational learning. In the sections that follow, I outline the control parameters that create the learning conditions. Furthermore, I posit that the mechanisms through which teachers actually learn through participation in professional development are contingent upon the learning conditions.

In the second section of this chapter, I use the analytic framework I developed to analyze the case of Kelly, a 4th grade classroom teacher who took part in the Language Awareness and Dialogic Reasoning professional development. Through a complexity analysis of Kelly’s learning system, I offer a causal explanation of why she learned little through the professional development. I argue that she experienced professional development under stasis conditions, in which only weak contingent, causal learning mechanisms could operate. Using Kelly to illustrate a pattern of learning, I explain more

generally why professional development does not lead some teachers to change their practices. In Chapter Six, I use the same analytic framework to present the case of Martina, a 4th grade ESL teacher who also participated in the Language Awareness and Dialogic Reasoning project. She initially experienced professional development under modification conditions, but, in the spring, transformation conditions developed. From her case, I derive causal explanations of learning under modification and transformation conditions.

Toward a Complexity Analytic Framework of Professional Development Learning Conditions

Based on an in-depth analysis of teacher interviews, professional development sessions, and classroom observations, I developed a framework to analyze how the conditions under which teachers participate in professional development impact the potential learning outcomes. This explanation is consistent with Opfer and Pedder's (2011) conceptualization of teacher learning as a complex system that evolves at the intersection of three overlapping systems: the individual teacher as a system, the school as a system, and the professional development activity as a system. The framework helps to explain Martina's and Kelly's learning and can be usefully applied to other teachers. However, given that this framework is based on the idea that professional learning is complex, the framework is almost certainly incomplete and is subject to revision as other examples of teacher learning are analyzed.

Figure 3 represents the framework for analyzing professional development learning conditions. The framework clusters learning conditions together—stasis conditions, modification conditions, and transformation conditions. The diagram depicts

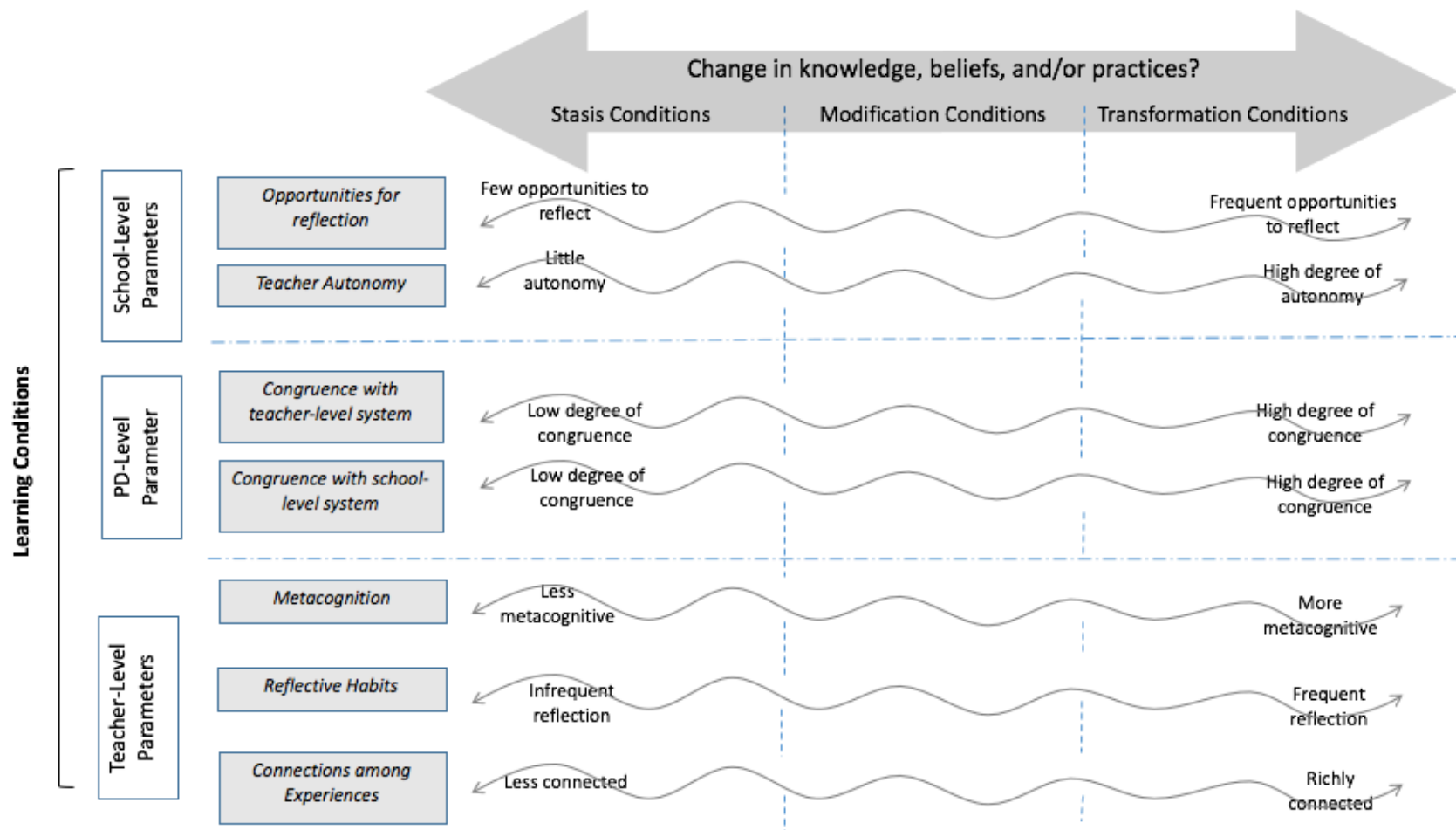


Figure 3. Analytic framework for professional development learning conditions

these three clusters of conditions along a continuum with arrows on either end to illustrate that there are varying degrees of difference between locations along the continuum. The vertical dashed lines represent the fluid nature of learning conditions along the continuum. Under stasis conditions, a teacher's learning system, which is comprised of her knowledge, beliefs, practice, and experiences, changes very little, or in ways that are inconsistent with the goals of the professional development activity. Internally, her ideas about teaching and learning may shift slightly, but externally, her classroom practice remains the same. Conversely, she may alter her practice slightly, without a corresponding shift in knowledge or beliefs. Under modification and transformation conditions, teachers learn, but the type and extent of change that occurs differs. Modification conditions permit incremental changes within a teacher's learning system, while transformation conditions, as the name suggests, allow for transformation of a teacher's learning system. In Chapter Two I used the analogy of a pile of sand in which individual grains are added one at a time to represent changes occur in a complex system. Although a pile of sand is not a complex system, the analogy is nevertheless helpful for visualizing change in a complex system (Cilliers, 1998). Under modification conditions, a teacher's learning system is like the growing sand pile. As the teacher learns, new ideas are added alongside other elements. At times system elements must move around, as with the sand pile's small avalanche, to accommodate these new ideas, but overall, the change in the system is relatively minor. Under transformation conditions, a teacher's learning system is like the sand pile at the critical point where it is

no longer growing; a small event can trigger an avalanche-like transformation of the system, which nonetheless maintains its systemic integrity (Byrne & Callaghan, 2014).

In the field of adult learning, it is common to characterize learning dichotomously as either informational or transformational (Kegan, 1994; Mezirow, 2000; Rohlwing & Spelman, 2014). Informational learning is additive; the learner increases in knowledge and skills, elaborates on existing frames of reference, or adds new frames of reference (Rohlwing & Spelman, 2014). Transformational learning, as the name suggests, transforms the learner's point of view or habits of mind (Mezirow, 2000). Informational learning increases *what* someone knows, whereas transformational learning changes *how* someone knows, in the sense that the learner views things through new lenses (Kegan, 1994). I argue that these two types of learning necessitate different learning conditions. Informational learning through professional development occurs under modification conditions. Through this additive learning, a teacher's learning system changes incrementally. It adapts to assimilate new ideas, but the components of the system remain organized in essentially their original form. For instance, informational learning occurs when a teacher learns a new strategy for teaching reading comprehension and incorporates it among other strategies in his existing repertoire of practices for teaching reading comprehension. This teacher's learning system is slightly changed, or modified; the system elements now include a new idea about teaching reading and a new practice for teaching reading, alongside preexisting knowledge, practices, and beliefs. In contrast, transformational learning only occurs under transformation conditions. These conditions make it possible for a teacher to develop a new point of view, requiring her to question existing beliefs and practices, and take on new ways of thinking and doing. To illustrate,

transformational learning takes place when a teacher who has previously understood teaching as transmission embraces constructivist learning principles. This embrace of constructivism leads her to reject many of her old beliefs about how students learn as well as her transmission-oriented teaching practices. Her learning system self-transforms in radically new ways. A teacher could not experience such learning under modification conditions. Under modification conditions, the teacher would reject a new perspective that would require her to reevaluate her existing beliefs and alter her current practices, and would return to her traditional ways of knowing, thinking, and doing.

In this study, I found that professional development learning conditions were created by a constellation of seven control parameters. As I discussed in Chapter Two, control parameters are the structural elements that, in conjunction with one another, shape a complex system (Byrne & Callaghan, 2014). In human systems, control parameters determine the rate at which information flows within a system, the richness of connectivity among system agents, the level of diversity within and among agents, and the power differentials between agents (Stacey, 1996). In this study I found that there were multiple structural elements that shaped the interaction of the teacher-level learning systems with the school- and professional development-level systems within which they were nested. Namely, these were opportunities for reflection, teacher autonomy, and congruence among the teacher-, school-, and professional development-level systems. I also found that there were structures that impacted the cognitive processes through which information is exchanged within a teacher-level learning systems. These included metacognition, reflective habits, and connections among a teacher's experiences. Table 8 summarizes how each of these seven control parameters shaped the system of teacher

learning. The control parameters I identified based on my analysis of the data are listed on the left side, and the effects on the system of teacher learning are listed along the top. The X's indicate how each control parameter shaped the complex system of teacher learning. For instance, opportunities for reflection impacted both the rate of information flow and the richness of connectivity within a teacher's learning system. I illustrate and discuss these control parameters at length in the subsequent analyses of Kelly's and Martina's learning processes. For now, suffice it to say that, in conjunction, this constellation of key control parameters shaped the learning conditions for teachers participating in professional development.

Table 8

Effects of Control Parameters on the System of Teacher Learning

		Effects on the System of Teacher Learning			
		Rate of information flow	Richness of connectivity	Level of diversity	Size of power differentials
Control Parameters Impacting Teacher Learning Conditions	Opportunities for reflection	X	X		
	Teacher autonomy				X
	Congruence among teacher- and PD-level systems		X	X	
	Congruence among school- and PD-level systems		X	X	
	Metacognition		X		
	Reflective habits	X	X		
	Connections among experiences		X	X	

It is hard to depict complex systems visually, because they are multi-leveled and nested (Davis & Sumara, 2005). A teacher's learning system is simultaneously a discrete system and a component of the school learning system and the professional development system. Due to the challenge of representing these relationships in two dimensions, Figure 3 shows the three systems instead as three levels, separated by dotted lines to indicate that they are open systems. The top level is the school learning system in which the teacher's learning system is nested. I found two parameters impacting teacher learning at this level that shaped the interaction of the individual teachers' learning systems with the school-level system: teacher autonomy and opportunities for reflection. These parameters resulted from the particular intersection of an individual teacher's learning system and a school-level system, rather than characterizing the school-level system as a whole. Two teachers in the same school can experience differing degrees of autonomy or encounter more or fewer opportunities for reflection. Figure 3 represents control parameters as continua, since they vary in intensity or degree. In keeping with the nonlinear nature of complex systems, the continua are represented by curves, rather than straight lines. The location along the continuum illustrates the learning conditions for a particular teacher within the larger school-level learning system.

The middle level depicts the professional development system in which the teacher's learning system is nested. I found two control parameters at this level that influenced teacher learning: congruence with the teacher-level system and congruence with the school-level system. These control parameters characterize the intersection of the professional development system with one particular teacher-level learning system

and one particular school-level learning system. I found that they can vary from teacher to teacher, even when teachers from the same school participate in professional learning activities collectively.

Finally, the bottom level is the teacher-level learning system. This includes three individual teacher characteristics, identified in my analysis, that impact teachers' learning through professional development: metacognitive awareness, reflective habits, and connections among experiences. It is essential to note that I found these characteristics to be situation-dependent. A teacher may be reflective in some situations, but not in others. This framework accounts for a teacher's characteristics as they are manifested in their interactions with a particular professional development system and school-level system, at a particular point in time. Each of the control parameters varies in intensity. For instance, during a particular professional learning activity, I found that teachers could be more or less metacognitive. Similarly, there could be significant variation in their reflective habits as well as in the degree to which their experiences were connected to each other.

My analysis of the data suggested that these parameters operate in conjunction to create learning conditions that can foster either stasis, modification, or transformation. Stasis conditions are characterized by many parameters on the low side of the continua, while modification conditions have multiple parameters of medium intensity or degree, and transformation conditions are characterized by parameters on the high side. However, I found that the intensity or degree of any individual parameter did not necessarily correspond with the overall teacher learning conditions. For instance, stasis conditions may include one or two parameters of medium intensity, or modification conditions

might have a few parameters of high intensity. Rather, the conditions depend on the overall intensity or degree of the parameters. The vertical dashed lines in Figure 3 are broken around the continua to suggest that they are not borders. A causal explanation of teacher learning through professional development should start with an examination of the control parameters that establish the learning conditions in which a particular teacher, from a particular school, participates in a particular professional learning activity.

Learning under Stasis Conditions: The Case of Kelly's Learning System

I turn now to a detailed causal explanation of why some teachers seem to learn very little through their participation in professional development. I argue that for these teachers, the key control parameters combine to establish what I call stasis conditions, under which learning is extremely difficult. I use Kelly to illustrate, because she underwent little change while participating in the professional development system during the 2016-2017 school year. Figure 4 offers a visual representation of the stasis conditions that shaped Kelly's learning experience. The top diagram represents conditions in the fall, when the professional development began, while the bottom diagram represents the spring. Notably the two diagrams are the same because Kelly's learning conditions remained more or less the same. Both diagrams illustrate stasis learning conditions. The intensity or degree of each control parameter is indicated by the location along the continuum of the gray box that labels that parameter. For example, the label for metacognition is located close to the low end of its continuum to illustrate that Kelly demonstrated relatively little metacognition with regards to her experience in the professional development. Most of the other parameters are further along their respective continua. Six of the seven continua are on the low end, while connections among

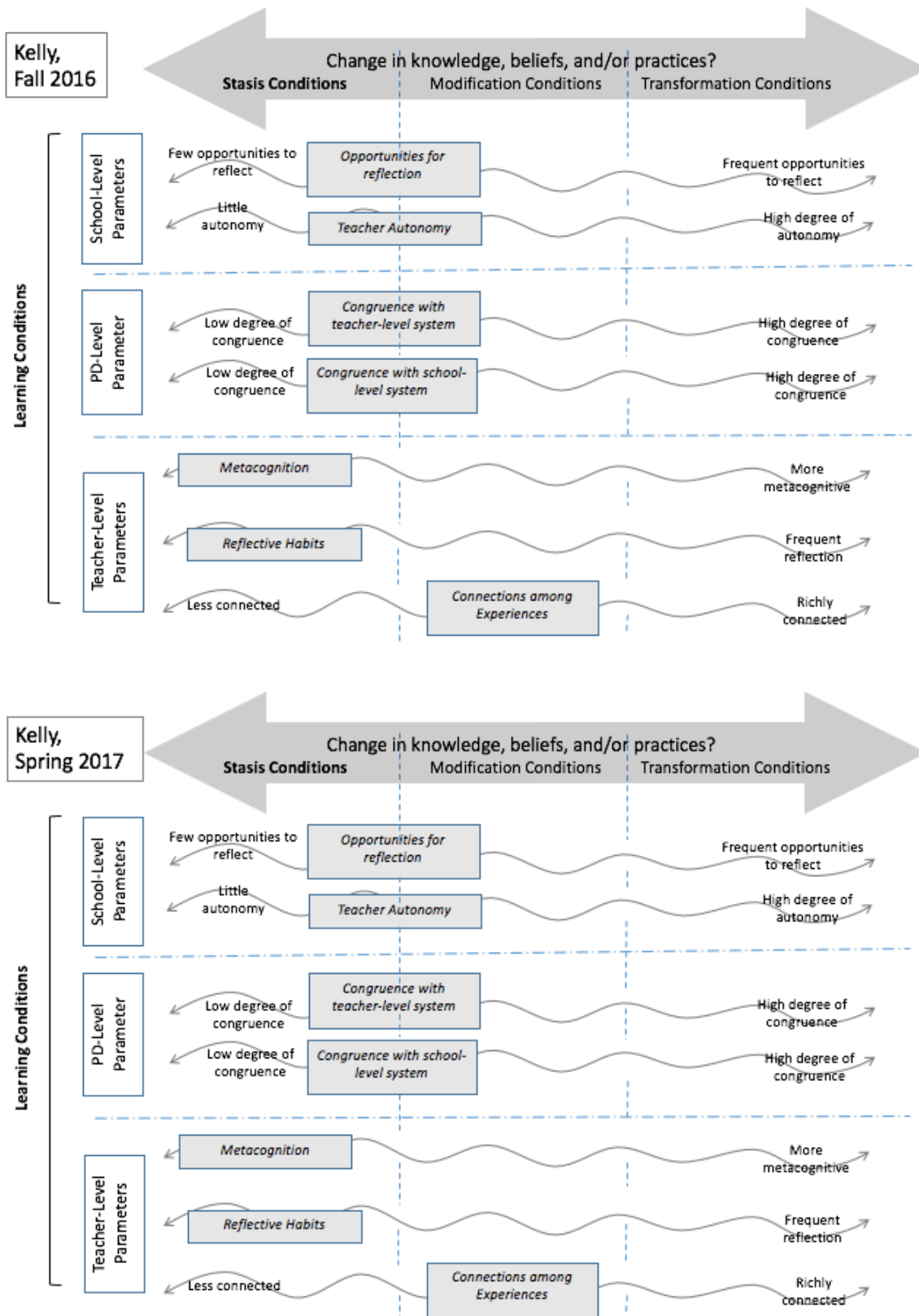


Figure 4. Stasis conditions: Kelly, fall 2016 and spring 2017.

experiences is at the midpoint. This figure is derived from my analysis of Kelly's learning system and its interactions with the school- and professional development-level systems in which it was nested. These parameters would probably not be identical for another teacher experiencing professional development under stasis conditions; some parameters might fall further to the left or to the right along the seven continua. However, for any stasis conditions, the overall weight of the control parameters would fall on the lower ends of the continua.

Figure 4 serves as a roadmap for my analysis of teacher learning under stasis conditions. In the sections below, I explain Kelly's placement along each of the continua using interview and observational data, and I paint a picture of how these seven control parameters shaped her learning system and its interactions with the school- and professional development-level systems. I then describe her practices and beliefs for engaging in language-focused instruction with bilingual learners, which remained relatively unchanged throughout the year. I describe a mechanism that caused a slight change to her knowledge, and analyze how the constellation of control parameters prevented any significant changes in her learning system. Throughout the chapter, I ground the causal explanation in rich description and analysis of Kelly's learning system over the course of the year as she participated in professional development about language focused instruction for emergent bilingual students.

The 2016-2017 school year was Kelly's 24th year of teaching and her tenth year at Bilingüe. Although she had held different teaching positions in her career, including Spanish teacher and reading specialist, she had been a 4th grade classroom teacher for the past nine years. A native English speaker, Kelly had majored in Spanish during college;

she was therefore able to teach her students in both English and Spanish. This was Kelly's third year participating in the teacher working group. She expressed great enthusiasm for the project. At her own initiative, she even presented about the Language Awareness and Dialogic Reasoning curriculum at a bilingual education conference during the fall of 2016. Despite Kelly's enthusiasm, she learned relatively little about language focused instruction from her participation in the project during 2016-2017, as I show later in the chapter. I now address, in turn, the school-, professional development-, and teacher-level parameters that created stasis conditions.

School-Level Control Parameters

Whether or not a teacher learns through professional development depends not just on conditions within the teacher's learning system, but on the intersection of that learning system with school- and professional development-level learning systems. In this section I discuss two key control parameters at the school-level that I found shaped learning conditions for the teacher-level learning system: opportunities for reflection and teacher autonomy. In Chapter Four I described Bilingüe's school-level learning system, arguing that, as a whole, the control parameters of the school-as-system constrained teacher learning. While this was generally true, these constraints varied depending on a teacher's role within the school. Here, I show that, due to her role, Kelly had few opportunities to reflect and limited autonomy, which contributed to her stasis.

Opportunities for reflection. Reflection plays an essential role in teacher learning (e.g. Rohlwing & Spelman, 2013; Schön, 1987). In complexity terms, reflection can be understood as a feedback loop that connects the discrete elements of a teacher's learning system: the knowledge, beliefs, practices, and experiences. As a teacher reflects

on her practice, her knowledge, her beliefs, or her experiences, she does so in relation to the other elements of her learning system. Reflection offers a structure through which the elements of a teacher's learning system interact, exchange information, and forge new connections with one another. The learning systems of highly reflective teachers are characterized by rich connectivity and a high rate of information flow, providing regular feedback. These teachers are likely to change their practices through reflecting on their knowledge, including knowledge developed during professional development. Likewise, they deepen their existing knowledge and develop new knowledge from reflecting on their practice. Conversely, teachers who do not engage in reflection regularly receive less feedback, prompting less change. Infrequent opportunities for reflection thus contribute to stasis conditions.

Given the important role of reflection in teacher learning, schools that hope to foster professional learning should create opportunities for teachers to reflect. Some reflection can occur during school-based professional learning activities that incorporate reflective dialogue among colleagues. Ideally there would also be reflective opportunities throughout the regular school day, so that teachers could continuously reflect on their practice and learn from their experiences. While this would be ideal, opportunities for reflection are rarely built into the day in American public schools, which tend to be hectic places. The typical school schedule in the United States calls for teachers to spend the majority of the school day engaged in instructional activities (OECD, 2017), permitting them little time for reflection on the job. Different teachers within the same school may have more or fewer opportunities to reflect, depending on factors including their role in the school, as well as which school-based professional learning activities they participate

in and with whom. Just how much reflection occurs impacts the conditions of teacher learning. Teachers with few opportunities to reflect are likely to experience stasis.

All the teachers at Bilingüe took part in some of the school-based professional learning activities described in Chapter Four. Kelly participated in many of them, for she tended to volunteer for everything. Some of these activities afforded Kelly opportunities to reflect on her practice in relation to new ideas and information. She spoke positively about the book studies, which “got us all sort of thinking about how to, how to bring some new strategies into our teaching” as well as the Learning Walks, during which she and her colleagues collectively analyzed classroom data in order to “see what are people doing well, and what do we need to work on more as a staff” (Kelly, interview 1). As Kelly reflected with her colleagues during these professional learning activities, feedback loops arose between the practice, knowledge, and beliefs that comprised Kelly’s learning system. These reflective conversations offered occasions for learning.

Unfortunately, these reflective opportunities were too rare. As a classroom teacher at Bilingüe, Kelly was constantly busy. In her role, she had to prepare and teach five or six different lessons every day, each of which called for her to look at curriculum and gather or make materials. As discussed in Chapter Four, she felt that she was constantly “running like a chicken with my head cut off” in order to get everything in place to teach her lessons (Kelly, interview 2). For most of the school day, she was surrounded by a class of 25 noisy 4th graders, all needing her attention. The usual hectic situation was made all the more difficult during the 2016-2017 school year because Kelly had a group of students whom she described as “very challenging” (Kelly, interview 2). Kelly expended a lot of time and energy responding to students’ behaviors and dealing with

classroom management. On top of the challenges of carrying out her classroom teaching responsibilities, Kelly had voluntarily taken on other duties within the school. She was a co-chair of the school's social-emotional committee and a member of the school's leadership team, which added additional meetings and work to her already jam-packed schedule. When she went home at the end of the school day, she was exhausted and needed to "switch gears" (Kelly, interview 2). Under these conditions, she had few opportunities to reflect during or after the school day.

Kelly's role as a classroom teacher also limited the extent to which she could learn through reflection-in-action while teaching the Language Awareness and Dialogic Reasoning curriculum. Reflection-in-action refers to reflecting in the midst of activity, without stopping what we are doing (Schön, 1987). For instance, while teaching a lesson, a teacher may notice something that is not going as planned, think critically about what is happening, and begin on-the-spot experimentation to try to fix the problem. However, as she indicated, it was difficult for Kelly to reflect-in-action because of the conditions in which she was implementing the curriculum. Kelly worked with four students in a corner of her classroom, while her other 21 students were supposed to be working independently. Not surprisingly, many of her lessons were interrupted. Even when students did not interrupt, Kelly had to split her attention between the small group and the rest of the class. Thinking back at the end of the year, Kelly observed:

Having to teach the lessons in this room with all the other kids in here, so that made, I think, made it a little more challenging than it would have been had I been able to go off to another space and just had my four students. (Kelly, interview 2)

Not only was it hard for Kelly to make time for and teach a 30-minute lesson to four students, while responsible for a whole class of 25, under the circumstances it was hard for her to reflect-in-action while teaching. Given her role as a classroom teacher at Bilingüe, Kelly had limited opportunities to reflect, which meant that she was not able to benefit from the ongoing feedback loop that reflection provides. In this way, the interaction between the teacher- and school-level learning system shaped her learning conditions. When school-level structures offer few opportunities for teachers to reflect, they thus contribute to the creation of static professional learning conditions.

Teacher autonomy. In the current era of high stakes testing and accountability measures, many schools and districts have responded to externally imposed pressures by limiting teacher autonomy, for instance by requiring teachers to implement a set curriculum according to centrally-determined pacing guides (e.g. Achinstein & Ogawa, 2006; Daly, 2009). Such practices constrain teachers from putting into practice any new ideas about curriculum or instruction that deviate from the status quo. They even limit teachers' ability to make adjustments to their own practice on the basis of what is and is not working within their own classroom. Due to the power differentials between administrators and teachers, teachers are often required to maintain the status quo. However, learning in a complex system happens when the system is "spontaneous, adaptive, and alive" (Waldrop, 1992). Learning occurs when the system adapts to new information. In order for teachers to learn, they need a school environment where they have some freedom to make decisions about what to do in their classroom on the basis of new information. When schools limit teachers' autonomy, they limit the potential for

learning. Teachers with little autonomy are likely to experience stasis conditions for professional learning

Due to her role as a classroom teacher at Bilingüe, Kelly had relatively limited autonomy. As I described in Chapter Four, classroom teachers were mandated to use curriculum that was adopted at the district level. Kelly had tried to deviate in the past, without success. She recounted, “We have this word study program that we’re forced to use that I abhor. It doesn’t work very well, but I have to use it because every time I’ve tried not to, they yell at me” (Kelly, interview 1). In addition to district mandates that limited Kelly’s autonomy over what to teach, the challenges of coordinating schedules with a teaching partner, also described in Chapter Four, further limited her ability to make autonomous decisions about how to teach. For instance, Kelly was not able to make spontaneous adjustments to her schedule on the basis of students’ needs, such as allowing students to have extra time to work on a writing project, because she was required to switch students with her partner teacher at a scheduled time. These limits to her autonomy hindered her from making use of new information from professional development. While Kelly had permission to use the Language Awareness and Dialogic Reasoning curriculum with her students, she did not have the flexibility to adjust other aspects of the curriculum or schedule. Thus, she had limited opportunities to actually apply the ideas discussed during teacher working group sessions to other aspects of her teaching. Kelly’s lack of autonomy, combined with limited opportunities for reflection, created school-level conditions that promoted stasis rather than learning through professional development.

Professional Development-Level Parameters

The second set of parameters that create the conditions for teacher learning are located at the intersection of the professional development-level learning system with the other two systems. I found two parameters at this level that impacted learning conditions. Namely, these parameters are the congruence of the professional development system with the teacher-level system and with the school-level system. Congruence is “the fact or condition of according or agreeing; accord, correspondence, harmony” (Oxford English Dictionary, 2018). The congruence between a professional development-level system and a school- or teacher- level system refers to the extent to which the two systems agree with one another or fit well with each other. Systems that share similar or complementary beliefs, norms, or priorities have a high degree of congruence, while systems that hold conflicting beliefs, norms, or priorities are characterized by incongruence.

To apply the concept of congruence to teacher-, school-, and professional development-level learning systems, it helps to consider a different but related definition of the term that comes from geometry. Two shapes are congruent when they are “capable of being exactly superposed” (Oxford English Dictionary, 2018), or when they are precisely the same size and shape. While this definition refers specifically to two-dimensional shapes and cannot literally apply to the information within a learning system, it is nevertheless helpful to think about congruence as having to do with sameness. Congruent systems are likely to have some of the same information, or, to use Davis and Sumara’s (2005) term, to have redundancies. As discussed in Chapter Four, redundancy is a necessary condition for learning to occur within a complex system. Redundancies enable system agents to exchange information easily and effectively within

systems, and they also facilitate the exchange of information between systems. By helping to facilitate communication, redundancies create conditions in which system agents and systems can learn with and from one another.

To illustrate how redundancies impact learning conditions, imagine two teachers from the same elementary school who were required to take a course on teaching sheltered English immersion to English Language Learners. One was a 5th grade teacher who majored in elementary education. He had been thinking about academic language development since his undergraduate studies, which included several courses on teaching bilingual students. Furthermore, he had been working closely with an ESL teacher colleague to support the academic language development of his bilingual students. Much of the information shared by the instructor of the sheltered English immersion course was already familiar to him. The information was redundant with his existing knowledge, beliefs, and practices. These redundancies made it possible for him to easily process, reflect on, and ultimately act upon new information that was presented during the course. Contrast this with the school's math specialist, who majored in math. The conversations that took place during the course had so little in common with her work teaching math that the course may as well have been conducted in a foreign language. The low degree of congruence between her learning system and the larger professional development system made it unlikely that she could learn much from the course. A lack of congruence between the professional development system, the school-level learning system, and the teacher's learning system is an important parameter that creates stasis conditions for teacher learning. Below, I explore these areas of congruence in turn and show that

relatively low levels of congruence characterized the intersection of the professional development system with Kelly's learning system and with the school learning system.

Congruence of the professional development system and teacher learning system. One aspect of congruence is the correspondence between a teachers' perceived needs and the information within the professional development system. Teachers are much more likely to learn from professional learning activities that are congruent with their perceived needs. As other researchers have shown, teacher learning is more likely to occur when teachers participate in professional development by choice and find the topic interesting (Kennedy, 2016; Wetzels et al., 2016), when they see the professional development as offering practical strategies and techniques that will help them improve (Cameron et al., 2013; Grant et al., 1996), and when they see the content as relevant to their contexts and appropriate for their students. In essence, teachers are in a position to learn from their participation in professional learning activities when they perceive professional development as offering something that they want or need to learn.

Kelly initially believed that the teacher working group would be congruent with her needs. In November, she described her hopes for the year's working group sessions:

I like the idea of having some people focusing on the development of the Spanish language curriculum.... And my personal students are desperate for that to be developed in time for me to do it this year. So I would say, you know, for those of us who are going to be teaching it for the first time, if we can maybe dedicate some of the time to maybe, sort of, sharing our experiences, not necessarily with everybody but at least with each other, and sort of talking through any, you know, issues that we might be having, or sticky parts of the curriculum that maybe

somebody has a good idea for getting it across, or things like that. And maybe at some point kind of thinking about how, moving forward, like you said, how we can find other texts and other topics to... LADRize. (Kelly, interview 1)

Here, Kelly articulated three areas that she wanted to focus on: developing the Spanish language analog curriculum, discussing teaching issues with the other implementing teachers, and what she referred to as “LADRizing” texts and topics from her curriculum, or adapting her curriculum to incorporate the principles of language-focused pedagogy. However, the professional development ultimately only allowed her to do one of these things. As an implementing teacher, she had opportunities to discuss her teaching with the three other implementers, but she was not involved in any of the curriculum development work that other members of the teacher working group were doing. Finding ways to incorporate principles of language-focused pedagogy into the literacy curriculum that the district required her to teach was a longstanding interest; she had mentioned her desire to do this during the first year of the project in 2014, and she continued to talk about it in June of 2017, during our final interview. However, the teacher working group did not create a space for her to do this. Instead, it focused more on engaging in dialogic instruction about language, which was not something that Kelly had as much interest in. In this sense, there was only a low degree of congruence between Kelly’s perceived needs and the professional development-as-system. The learning conditions created by the interaction between Kelly-as-system and the professional development system were not optimal. Similar conditions were also created by the interaction of the professional development- and school-level learning systems.

Congruence of the professional development system and school learning

system. As other researchers have documented, teachers are more likely to learn when professional development is coherent with school initiatives and reforms (e.g. Gehsmann & Woodside-Jiron, 2005; Penuel et al., 2007). When professional development and school priorities are similar, teachers often receive more support from administrators to implement ideas from professional development and face fewer structural roadblocks imposed by school and district systems that would hinder their efforts to change their practices. As described in Chapter Four, some of the priorities of the Language Awareness and Dialogic Reasoning professional development system and the Bilingüe school learning system were congruent. A top priority for the school learning system was the promotion of students' oral language development through increased opportunities for content-based discussions. Meanwhile, dialogic instruction was a focus of the professional development system. However, as I discussed previously, these similar priorities masked different visions of teaching and learning with regard to dialogic and student-centered instruction. The surface level congruence between the systems led system agents to perceive information as redundant, when in fact the foundations of these two approaches were quite different.

By way of illustration, Bilingüe teachers embraced *academic conversations* (Zwiers & Crawford, 2011) as the optimal way to bring more student talk into classrooms. When *academic conversations* are employed, multiple pairs of students converse simultaneously without teacher intervention. In contrast, in the professional development system we focused on *dialogic instruction*, which we conceptualized as instruction during which students and teacher collectively negotiate meaning. Some of

the teachers seemed to perceive dialogic instruction as synonymous with *academic conversations*. Thus, when facilitators talked about dialogic instruction, the information we shared was easily misconstrued. Kelly's contributions to four separate teacher working group discussions suggested that when we were talking about dialogic instruction, she was envisioning students engaged in independent conversations that were not facilitated by a teacher. Chapter Four included an excerpt from the November session, during which Kelly said that she hoped to learn about dialogic instruction. She posed the question, "How do you get kids to do that [engage in conversations] successfully without me mediating?" (Kelly, TWG 3). Her question reveals an early misconception about the term dialogic instruction; she believed that the end goal was for students to engage with one another without any teacher facilitation. In conversations about dialogic instruction during the January, March, and May sessions, Kelly shared practices that she used in her classroom to promote student independence in *academic conversations* and book clubs, both formats in which the students have a discussion without the teacher present. This pattern suggests that a mistaken belief that dialogic instruction was synonymous with *academic conversations* persisted throughout the year, and may have impeded Kelly's ability to recognize and engage with new information.

Structural congruence between the professional development- and school-level systems also impacts learning conditions. As discussed in Chapter Four, the professional development- and school-level systems lacked structural congruence. The inflexible school schedule was dissonant with beliefs expressed in the professional development system that teachers should extend the lessons through the use dialogic instruction. This was a real challenge for Kelly, as she tried to squeeze Language Awareness and Dialogic

Reasoning lessons into her regular teaching schedule. Given the restrictions of her schedule, which was further constrained by standardized testing, Kelly was only able to implement two-thirds of the lessons. In June, she remarked on the challenge of teaching the curriculum given school-based structures, observing, “It was stressful in the sense that I had to jam it into an already stressful schedule and I regretted that” (Kelly, interview 2). Under these conditions, Kelly could hardly be expected to experiment with new teaching methods that were likely to take longer than the limited time that she was able to carve out. Like informational congruence, structural congruence between the school- and professional development-level system shapes teacher learning conditions.

Teacher-Level Control Parameters

In addition to school- and professional development-level control parameters, I found three control parameters within a teacher’s learning system that contributed to creating conditions that fostered or hindered learning. These three parameters were metacognition, reflective habits, and connections among experiences. Stasis conditions are likely when teachers’ interactions with the professional development system are characterized by little use of metacognition, limited reflection, and disconnected experiences.

Metacognition. Metacognition refers to “the ability to reflect on, understand, and control one’s learning” (Schraw & Dennison, 1994, p. 460). It includes metacognitive knowledge, which is the knowledge of how one learns, and metacognitive regulation, which is the ability to use that knowledge during cognitive activities to ensure that a cognitive goal is met (Livingston, 2003). Metacognition allows an individual to approach learning strategically, by planning, monitoring, and coordinating learning. Most

individuals of normal intelligence engage in some metacognitive regulation when faced with a challenging cognitive task, but some demonstrate greater metacognition than others (Livingston, 2003). Highly metacognitive learners are able to use their knowledge of what they know and how they learn to successfully tackle cognitive efforts. In complexity terms, metacognition is a structural element that shapes the connections between an individual's experiences, knowledge, and beliefs. Highly metacognitive teachers are able to reflect on how their experiences have shaped their knowledge and practices and what additional experiences can help them to develop further knowledge and improve their practice. Their experiences are richly connected to their knowledge and practices. Conversely, those who are engaged in less metacognition are less aware of the relationship between their experiences on the one hand, and their knowledge and practices on the other. With less awareness of what they know and do not know, as well as how they learn, they may not be able to proactively seek out needed knowledge or make the most of the learning opportunities that they have. When teachers do not employ much metacognition in their interaction with professional development, this is a contributing factor in creating stasis conditions.

Kelly demonstrated relatively little metacognition with regard to the ideas that were explored in professional development, as shown in Figure 4. This is not to say that she lacked metacognitive knowledge generally. For instance, she was able to articulate aspects of her learning style. When I asked Kelly how she would describe herself as a learner, she responded, "I know that for me to really learn something, I have to write it down" (Kelly, Interview 1). She reported that she had discussed metacognition with her own students and had shared with them how writing helped her to remember things

(Kelly, TWG 5). However, while Kelly had metacognitive knowledge, she did not employ metacognitive regulation to approach professional development strategically. Namely, Kelly did not take notes during teacher working group sessions to help her remember the information and strategies that were discussed. Later on, she was not able to recollect specifics. When I asked in June what she had learned through the teacher working group sessions, she replied:

I always leave thinking I learned a lot of things, now I am not gonna come up with anything particular.... You guys always asked very thoughtful questions that made me kind of pause and think, ‘Oh why do I do that? Or what could I do differently?’ But I can’t think of anything specific. (Kelly, interview 1)

Her inability to recall anything specific that she had learned through the sessions suggests that she had probably not employed much metacognitive regulation.

Along with knowing how one learns, metacognition enables an individual to know what he or she does and does not know. Kelly had some awareness of gaps in her knowledge in skill. She observed that ideas about how children learn and what role the teacher should play in supporting learning had changed from when she initially became a teacher, more than 25 years previously. In her words, the expectation back then was, “You stand up in front of the class and you do all the talking and then kids just absorb it like little sponges” (Kelly, TWG 3). She was well aware that recent research and thinking about teaching and learning called for a shift away from these teacher-centered practices, toward more student-centered instruction, in which students do more of the talking. While she believed that her practice had become more student-centered, she recognized that she still had room to improve. For instance, Kelly had been trying to implement

academic conversations in her classroom, as part of a school-wide initiative, but she felt that there were problems in her implementation. She had observed that her students did not actually discuss the prompts unless she was standing right there, mediating the conversation. She realized that she did not know how to get kids to talk with each other about academic topics without her involvement. Clearly, Kelly had the metacognitive knowledge that she did not know how to support her students in developing greater independence when discussing academic topics. However, she did little to seek out the knowledge and skill that would help her strengthen this area of self-identified weakness. Later in the chapter, I show that her knowledge about how to promote increasingly independent conversations remained static, despite several discussions on the topic during teacher working group sessions. Again, it seems that Kelly did not employ metacognitive strategies during teacher working group sessions, even to help fill known gaps in her knowledge.

As these examples suggest, Kelly's chances of learning through the professional development were limited because she did not use metacognitive strategies. While I do not have evidence concerning why Kelly did not bring a metacognitive perspective to bear on the professional development, it is worth considering that this might have been related to the relatively low degree of congruence between the professional development system and Kelly's learning system discussed above. Perhaps she did not take notes during teacher working group sessions because the content was not something that she wanted to learn. Furthermore, as discussed in Chapter Four, during the first two years of the project we had not conceptualized teacher working group sessions as professional development, and it was challenging to re-purpose the sessions. Used to her previous role

as a teacher consultant, Kelly may not have perceived herself as a learner, needing to employ learning strategies during teacher working group sessions. Whatever the reasons, the effect was that Kelly's experiences in professional development remained disconnected from her general knowledge, beliefs, and practices. A low degree of metacognition is thus one of the control parameters that contribute to stasis conditions.

Reflective habits. As discussed above, the frequency and manner with which teachers reflect on their practice and learning is influenced by the school-level system, which can foster or limit opportunities for reflection. However, the extent and quality of reflection is also related to a teacher's own reflective habits. While a teacher's reflective habits are highly intertwined with school-level conditions, they can be teased apart; given the same school-level opportunities for reflection, some teachers may nonetheless reflect more frequently than others.

There was little evidence that Kelly reflected as a matter of routine. When we discussed lessons I had observed, it did not appear she had reflected on how the lessons went after teaching them. For instance, I asked her about an activity in which she had directed students to work independently to locate verbs in a text (Kelly, interview 2). She explained that she had wanted students to work alone rather than in partners in order to find more examples, which would lead to a richer discussion about verb tenses afterwards. This had not come to pass; instead, Kelly interacted with students individually while they worked, and there was no time for a culminating group discussion. Kelly did not seem to have noticed this outcome until I probed her decision to have students work alone rather than in pairs, at which point she said, "now that you say it, [working in pairs] probably would have led to more conversation, 'cause they would

have been talking with someone as they were looking for the verbs.” My questions prompted reflection that had not happened independently.

Kelly was certainly able to reflect on her practice when prompted. She demonstrated this both when I asked her to reflect on her teaching during lesson debriefs and when engaged in discussions with colleagues and facilitators during teacher working group sessions. At the January session, we had a discussion about the affordances of dialogic instruction, including how it creates opportunities for students to learn through articulating their understanding, discovering new ideas, and negotiating meaning with their peers and teacher. The whole group then watched a four-minute video clip from one of Kelly’s lessons, in which her students were collaboratively creating a word web. During the subsequent group discussion, Kelly reflected on her facilitation of the learning activity:

I felt like I was talking too much. Watching the video, I was like, ‘Oh, I think I was getting in the way of their learning,’ because a lot of times they were saying things, but I was talking as I was writing. I was repeating what they had said as I wrote it down, and I thought, ‘Oh maybe I shouldn’t be doing that.’ (Kelly, TWG 5)

In this comment, Kelly demonstrated the ability to critique her practice in relation to the ideas about dialogic instruction that we had just discussed. Through the act of reflecting, her knowledge about dialogic instruction became critical feedback on her facilitation practices, which could have prompted her to repeat students’ comments less often the next time she facilitated a similar lesson. However, because she had little chance to

reflect on her practice with regularity and depth, the elements of her learning system interacted relatively little, providing minimal feedback.

Independent reflection seemed to be crowded out by more pressing concerns. For instance, when I asked her in June if she would do anything differently if she taught the Language Awareness and Dialogic Reasoning curriculum again, she responded:

Yeah, I always want to do things differently. I think that next year I would definitely. Because I'll know the lessons a little more closely to begin with, I won't need to spend quite as much time preparing myself to teach the lesson, and I will be able to spend more time to think about how do I take myself out of the equation more, and get them talking to each other instead of me. (Kelly, interview 2)

This comment suggests that Kelly experienced a conflict between lesson preparation and deep reflection on previously taught lessons, which was likely due to the demands of Kelly's schedule. Given the need to prepare five or six lessons each day and her limited prep time, she prioritized preparing new lessons over reflecting on how the lessons she had already taught were going. Since she did not reflect on her practice in an ongoing manner, she did not get feedback that she could use to improve her upcoming lessons. As with metacognition, her habit of infrequent reflection limited the connection between ideas discussed during professional development and her classroom practice. This was another parameter that shaped her learning system, contributing to the creation of stasis conditions.

Connections among experiences. Connections among experiences is another key control parameter within the teacher-level learning system. Experiences are connected if

they can exchange information with each other, in the sense that a teacher thinks about one experience in relation to another. A teacher's experiences include experiences as a student and as a teacher, experiences in professional development, and many other life experiences. The degree of connection among the experiences in a learning system can vary dramatically. To illustrate, I return to the example of the 5th grade teacher and math specialist participating in the sheltered English immersion course, discussed above. As an elementary education major, the 5th grade teacher's undergraduate coursework addressed teaching bilingual students, and half of his students were emergent bilinguals. His experiences were richly connected to one another; while engaged in course activities, he thought about his undergraduate courses and his current and past teaching experiences, making sense of his new experience in relation to these other experiences. Contrast this with the math specialist who majored in math. When she sat in the course, she did not think about her experiences in college or her teaching experiences. Her disconnected experiences did not exchange information.

Kelly was somewhere in between these two hypothetical teachers. Figure 4 shows that the extent of connection among her experiences falls in the middle of the continuum, half way between disconnected and richly connected. Like the math specialist, Kelly's college studies as a Spanish major were disconnected from her current teaching and professional development experiences. Even her teaching preparation had happened so long ago that the model of a teacher she had learned then bore little relationship to the models put forth in her current professional development activities. However, while her past experiences were somewhat disconnected from her recent experiences, like the 5th grade teacher in the example above, her current professional development and classroom

experiences were connected to each other. She credited the Bilingüe principal for being “really dedicated to making sure that any [professional development] that we can offer within our building is really applicable to what we’re doing” (Kelly, interview 1). Since the school had been prioritizing students’ expressive language development for the past few years, not only were the professional learning activities connected to her work in the classroom, but many of the activities that she had participated in during that time had been connected to each other. Kelly perceived the Language Awareness and Dialogic Reasoning project as an extension of the school’s ongoing professional learning initiatives. In November, she expressed the belief that the project was “taking what we do to sort of a next level” (Kelly, interview 1). Her classroom and professional development experiences had multiple connections and were exchanging information. During teacher working group sessions, Kelly often mentioned ideas from previous school-based professional learning activities and shared practices that she was using in the classroom.

Kelly exhibited a moderate degree of connectivity among her experiences. As Figure 4 shows, this parameter was higher than the six other control parameters. Kelly’s experiences were connected enough that she could have learned through professional development, had some of the other parameters been higher as well. As I discussed above, the constellation of seven key control parameters together creates teacher learning conditions. Since the other six parameters were relatively low, in conjunction they created poor learning conditions. The connections among Kelly’s classroom teaching experiences and professional development experiences were not enough to overcome her limited autonomy, a lack of time for or habit of reflection, her limited use of metacognitive strategies, and a low degree of congruence among systems.

Static Beliefs and Practices

The constellation of control parameters discussed above combined to create stasis learning conditions. Over the course of the 2016-2017 school year, Kelly learned little that can be attributed to her participation in the teacher working group. Below I discuss her beliefs and practice across the school year and illustrate how the control parameters hindered her learning. Using Kelly as an example, I explain why stasis conditions result in little new learning.

Throughout the year, Kelly expressed a belief that instruction should be student-centered, by which she meant that students should talk more than the teacher and should figure things out for themselves, rather than having information fed to them by the teacher. She believed that students understood concepts more deeply when they had a chance to talk about what they were learning. In May, she posited that students “get a lot out of” conversations where they explore the meaning of a word on their own without the teacher “interjecting and... making all the points” (Kelly, debrief 1). She had found that as students discussed their ideas, they sometimes developed new ideas that she had not anticipated. When this happened, she felt it was important to adjust the planned lesson to make space for students’ ideas:

I try really hard to let them go with it, because that to them, it’s so powerful. That to them is me saying as their teacher, ‘You got this and you made something out of it,’ and giving them the chance to really do that, especially in front of a group, I think is really powerful, and I think it makes the learning deeper, cause they’re making those connections.... I abandon lessons all the time when kids come up with something interesting or better, as long as it is relevant. (Kelly, interview 2)

Kelly clearly valued students' ideas and felt committed to making a space for them to share their insights and innovations with her and with their peers. I observed her lifting up and highlighting students' ideas throughout the year by repeating them back to the group and validating their thinking, with affirmations like, "That's pretty good thinking" (Kelly, observation 4). When students made unsolicited comments, such as personal connections to a vocabulary word, Kelly encouraged these digressions as long as they were somewhat related to the topic under discussion. She often asked follow up questions to pursue these student-generated ideas. In these ways, Kelly enacted her belief that students construct meaning through talk and that students' ideas should shape the conversational space. From her perspective, her instructional practices were already fairly student-centered. However, there were underlying differences between Kelly's understanding of student-centered instruction and the understanding embraced by those of us who were facilitating the teacher working group.

Some of Kelly's beliefs were congruent with ours as the leaders of the professional development, including her beliefs that dialogue allows students to construct meaning and that students' ideas should be incorporated into lessons. However, her concept of student-centered instruction interacted with a different set of beliefs about her students' linguistic abilities, which lacked congruence with ours. In Chapter Four, I quoted Kelly talking about her students' proficiency in English and Spanish. She commented, "a lot of the kids coming in here are, they're not strong in either language, and so we don't have those really good role models for language on either side" (Kelly, debrief 1). This statement suggests that she viewed her students from a deficit perspective, as weak in both languages, rather than focusing on their linguistic resources

as emergent bilinguals. Believing that students learn language from a “good role model,” and that her students were not good role models for each other, she may have felt that she herself needed to be the language role model for her students. She also expressed negative views about her students’ abilities to engage in conversations with one another. She had observed that her students did not stay focused on *academic conversations* unless she was standing right with them, and she attributed this to their “developmental level and maturity level” (Kelly, interview 1). She posited that “a lot of them aren’t invested or that interested in being a part of the conversation” due to their age (Kelly, TWG 4). In essence, although Kelly believed that powerful learning could occur when students figured things out in discussion with one another, and that teacher intervention should be avoided, she seemed to believe that her own students were not actually able to learn without significant mediation by a teacher, both because of their language proficiency and their developmental level.

Kelly’s deficit views toward her students were dissonant with the underlying beliefs of the professional development facilitators. We embraced an asset orientation toward emergent bilingual students, as well as a view of knowledge as co-constructed within a group. These deep-seated convictions were at the root of the information that we brought into the professional development system. When we talked about dialogic instruction, we envisioned bilingual learners negotiating meaning with each other and their teacher to co-construct socially situated understandings, new ideas that emerged in interaction. We assumed that students could learn with and from one another, as well as with and from the teacher. This is not what Kelly envisioned. On the one hand, when she thought about what a student-centered classroom should ideally look like, she envisioned

a place in which students could talk with each other without teacher mediation, in accordance with Zwiers and Crawford's (2011) model of *academic conversations*. On the other hand, given her previous classroom experiences and her perception of her students as having limited linguistic capabilities, she envisioned dialogic instruction as a teacher-mediated conversation. In this regard, Kelly's learning system lacked congruence with ours as professional development facilitators, which is likely to have hindered effective communication. There is no evidence that any of Kelly's beliefs shifted over the course of the school year.

The stasis in Kelly's learning system is evidenced most clearly by comparing her instructional practices in lessons that she taught early in the year and similar lessons taught late in the year. Throughout the year, Kelly implemented the lessons from the Language Awareness and Dialogic Reasoning curriculum in largely the same way. Her instruction varied from lesson type to lesson type (e.g. she employed different practices in dialogic reasoning, semantics, and syntax lessons). However, there was very little shift over time. The one exception to this general rule is discussed in the next section.

Despite Kelly's perception of her instruction as "student-centered," in a literal, physical sense, her lessons were "teacher-centered." She taught her small group at a horseshoe table; she sat in the middle of the horseshoe, with her four students gathered around, facing her. Not only was she at the center physically, but she was also at the center verbally. Kelly used a mix of direct instruction, in which she presented information to students, and question-driven instruction, wherein she asked questions, and students supplied answers. Her lessons incorporated varying amounts of dialogue, depending on the lesson type. Syntax and morphology lessons were generally monologic;

she presented information about word parts and grammar and then asked primarily known-answer questions to check whether students were able to apply the information correctly. In these lessons, she rarely asked students to articulate their thinking or to offer their own ideas. Kelly's semantics and dialogic reasoning lessons were more dialogic, in the sense that she sought out and valued students' ideas. However, even in her most dialogic lessons, she mediated the dialogue, using traditional, teacher-centered turn-taking patterns (Rymes, 2015). She engaged individual students in dialogue one at a time, rather than encouraging the students in the group to interact directly with one another. Students usually looked at Kelly while they were speaking, as if they were speaking just to her, rather than to each other. She verbally acknowledged each contribution to the conversation. Sometimes she evaluated students' responses as right or wrong. Sometimes she asked follow up questions to elicit more information from students. Sometimes she repeated or summarized students' ideas. Regardless of her response, she was at the center of the conversation, and students waited for her response, rarely interacting with one another.

Kelly's teacher-centered approach to dialogic instruction is apparent in this exchange from a semantics lesson in which she was facilitating the joint construction of a word web related to the word *illegal*:

Kelly: When you think about illegal, what do you think?

Student 1: It's the rules.

Kelly: It's the rules. [*Writing on chart.*]

Student 2: The law.

Student 1: Yeah.

Kelly: The law. [*Writing on chart.*]

Student 2: And if you break it, if you break the law you can go to jail.

Kelly: You could go to jail if you break the law. [*Writing on chart.*]

(Kelly, observation 4)

Kelly began this exchange by asking an open-ended question to the whole group. Student 1 shared an idea, “It’s the rules.” Kelly then repeated Student 1’s idea while writing it on chart paper. Student 2 waited until Kelly was done writing to share her idea. Kelly repeated this new idea while recording it on the chart. The conversation stopped while Kelly wrote, as students awaited their turn to talk to her.

Kelly’s false perception that the concept of dialogic instruction discussed during teacher working group sessions was the same as her existing concept may have made it hard for her to recognize some of the ways that her instructional practice deviated from what we facilitators were trying to promote. This, combined with her limited reflection on her practice, may have contributed to her difficulties putting her practice in conversation with ideas that were discussed in professional development. Thus, she continued to employ a teacher-centered approach throughout the year.

While Kelly was not aware of the discrepancy between the instructional practices she used in her language-focused lessons and those encouraged by the facilitators, she recognized that her dialogic reasoning lessons were not going the way that they were supposed to. As explained in Chapter Three, the Language Awareness and Dialogic Reasoning curriculum includes seven dialogic reasoning discussions, which are intended to be small-group, student-led discussions about a contentious issue. Instead, Kelly facilitated dialogic reasoning lessons much the way that she facilitated the word web

activity. She asked students to share their stance on a contentious issue, such as whether wolves should be reintroduced in areas where they will encounter livestock, and students replied to her. She asked occasional clarifying questions, and then she summarized students' ideas orally and in writing on chart paper. While Kelly was writing, the students sat silently and waited for her to finish, rather than responding directly to each other's ideas. When she was done writing down what the previous student had said, she invited further participation by asking questions like, "Do we have any other opinions?" (Kelly, observation 3). This pattern continued throughout the year. Kelly knew that this was not the way that dialogic reasoning discussions were supposed to go. In June, Kelly commented about her Language Awareness and Dialogic Reasoning group:

I had sort of thought it would be really cool when they get, they really understand the purpose of this, that they are talking to each other and not to me. They'll just talk to each other, and they will just have a conversation, and that never really happened. It was—there would just be silence, and I would have to kind of prod to get them to continue sharing their thinking. So that was one thing that I thought that maybe I should have done something differently or I could have handled it better or something, because we never got to that point where there is a true flow of conversation. (Kelly, interview 2)

She was well aware of the gap between her facilitation of dialogic reasoning and the ideal. However, her comment, "maybe I should have done something differently or I could have handled it better or something" reveals a lack of knowledge about how to facilitate these conversations effectively.

When Kelly first began teaching the Language Awareness and Dialogic Reasoning curriculum in the fall, she recognized that she did not know how to help her students become more independent during dialogic reasoning discussions and other forms of peer-to-peer conversations. She hoped that the professional development could teach her. She told me during her first interview:

That's something that I'd love to learn more about—how to help students make the transfer from having those conversations with an adult to sort of mediate and be there, how to transfer it from them being really intrinsically interested in having those conversations on their own. I suppose some of it is sort of developmental level and maturity level, but I do get the sense that there's got to be a way to help them get over that hump of needing an adult to help them do that. (Kelly, interview 1)

Early in the school year, Kelly already had the metacognitive knowledge that she did not know how to promote conversational independence, and she expressed a desire to learn how to do this. Nonetheless, she did not use the professional development strategically as a chance to fill this gap in her knowledge.

Facilitating dialogic reasoning discussions was the focus of the December teacher working group session. In advance of the session, we asked the teachers to read Ossa Parra et al.'s (2016) article about dialogic reasoning, which includes a section on how to facilitate student talk and proposes that teachers gradually release responsibility, allowing students to take on more of the responsibility for carrying out the discussion as the year progresses. While talking about the article at the beginning of the session, Kelly mentioned that she had found it “very affirming” because “it said that [student

independence] doesn't happen right away, but it's gradual. First [dialogic reasoning discussions] have the teacher a little more involved" (Kelly, TWG 4). This information clearly resonated with the challenges that Kelly had experienced in getting her students to engage in *academic conversations*. As a group, we then watched a video of a dialogic reasoning discussion and analyzed the moves that the teacher had used. At the end of the session, we discussed how to support students in learning to have conversations with less teacher involvement. We talked about strategies such as teaching students how to invite each other into a conversation, encouraging students to respond directly to one another, and showing students video of their own discussions. Kelly participated actively in this conversation; she even pointed out an anchor chart, posted on her classroom wall, of sentence starters intended to help students to express their own ideas and to ask others to share their thoughts.

Despite her apparent engagement during the teacher working group session, Kelly's facilitation of dialogic reasoning lessons remained static. Her learning system was not impacted by the December session or subsequent conversations that touched upon ways to encourage students to interact with each other. I never observed her use any of the strategies for fostering independence that were discussed, including her own suggestion of using sentence starters. Not only did Kelly's practices remain the same, so too did her knowledge, or lack thereof. In June, Kelly had as little understanding about how to promote independent conversations as she did in November.

This stasis can be explained by a combination of three of the control parameters in the constellation discussed above. First, Kelly did not use many metacognitive strategies in the professional development context. Despite her awareness that she did not know

how to help students become independent in conversations, she did not approach the teacher working group session on facilitating dialogic reasoning strategically, as an opportunity to learn something that she needed to know. Second, Kelly had limited opportunities for reflection. Since she had little time to reflect while preparing to teach dialogic reasoning lessons or afterwards, Kelly did not have the benefit of a feedback loop between her classroom practice and the ideas about fostering independence that she had discussed during professional development. This feedback loop might have led her to experiment with different practices, leading to changes in her learning system. Third, Kelly did not have a habit of reflection. These control parameters combined to hinder any changes in Kelly's learning system from the professional development on facilitating dialogic reasoning. She continued to facilitate these lessons the same way all year, even though she recognized that they were not going well.

Limited Change under Stasis Conditions

Complex systems operate under conditions that are far from equilibrium (Cilliers, 1998). There is a constant flow of information into and within the system, even when the system is relatively stable, as it is during professional development under stasis conditions. In Kelly's learning system, her ongoing experiences were sources of new information, which interacted with the existing information in the system. Her daily experiences of teaching, talking with colleagues, participating in meetings and professional learning activities, and generally living in the world were all sources of new information. No teacher's learning system could absorb all of this information and remain totally unchanged. Each experience became part of the learning system. Thus even under stasis conditions, participating in the teacher working group led to a small shift in Kelly's

learning system, which assimilated the professional learning experiences among the existing knowledge, beliefs, experiences, and practices that comprised the system.

Through my analysis of the data that I collected on Kelly's learning system, I found two small changes. One was a slight change in her instructional practices. The other was a self-identified change in her knowledge. Below I discuss each of these changes and the mechanisms through which it may have come about, to highlight the limits of Kelly's learning through professional development.

As I analyzed Kelly's semantics lessons, I found a change in her questioning practices that I thought might be attributable to the professional development. The semantics lessons always involved introducing several target vocabulary words prior to reading the anchor text for the lesson cycle. The lesson plans called for teachers to ask, "What do you know about this word?" prior to providing the definition. This is an open-ended question, which students can answer in multiple ways. When Kelly taught her first semantics lesson in December, rather than asking this open-ended question, she asked students specifically for a definition. She introduced the word *balance* like this:

Kelly: What does balance mean?

Student 1: Like something heavy or something.

Student 2: Two things. [*Gestures with both hands to show a balance scale.*]

Basically weighing something.

Kelly: So something in balance has to do with weighing things. When you use a balance to weigh things, how do you want things to be as you weigh them?

Student 3: The same.

Kelly: The same, right.

(Kelly, observation 1)

In this teacher-centered exchange, Kelly was seeking out a specific piece of information, namely the definition for balance. She asked known-answer questions and evaluated students' responses, until students provided the sought-out information.

Four months later, Kelly orchestrated a similar lesson quite differently, creating a space for students to share their previous experience with target vocabulary words. Here is how Kelly introduced the word *march* in April:

Kelly: Okay. So here's another word. March.

Student 1: I think we kind of did something with this. Like people are marching on the streets.

Kelly: Marching on the streets. Tell me what that means to you.

Student 1: Like something like strike or something.

Student 2: Like a carnival.

Kelly: People might march at a carnival?

Student 2: Um hum.

Kelly: Maybe

Student 3: They might march at a parade.

Kelly: In a parade, you see a lot of marching. Any place else you can think of where people might march?

Student 4: In a war.

Kelly: In a war. Soldiers march. Let's see if we can figure out what that might mean. People march in war, they march in a parade, they march at a carnival, they march out in the streets sometimes.

(Kelly, observation 6)

This exchange was markedly different from the first one. While it was still teacher-centered, it was more dialogic, in the sense that Kelly sought out and valued a variety of ideas. She did this by asking a different opening question than what she had asked in December. Rather than asking, “what does _____ mean?” she asked, “Tell me what that means to you.” This slight change of phrase offered students a new way into the conversation. Instead of sharing a definition, for Kelly to evaluate as right or wrong, the students shared their prior knowledge about situations where people march. Three students spontaneously shared different marching situations (in the streets, at a carnival, and in a parade). Kelly then sought out more marching situations by asking, “Any place else you can think of where people might march?” which prompted the last student in the group to share that people march in a war. At this point, rather than providing the definition herself, Kelly prompted students, “Let’s see if we can figure out what that might mean,” encouraging them to infer a definition for the word based on their collective prior knowledge. This exchange is in keeping with Kelly’s espoused belief that dialogic instruction empowers students to figure things out on their own. She continued to be at the center of the conversation, responding to every student’s contribution, but she valued students’ ideas and entrusted them with generating knowledge.

As I compared these semantics lessons, I hypothesized that Kelly might have changed her instructional approach as a result of a conversation during a teacher working group session. During the previous month’s session, we had looked at a semantics lesson plan and discussed how to teach it dialogically. I had suggested:

This might become more dialogic if, depending on what the teacher does, so if a student is... responding to, 'What do you know about this word,' maybe you're asking follow up questions, maybe you're inviting other students into the conversation and learning more about what it is that students already know about these words. (Meredith, TWG 7)

Noting the follow up questions that Kelly asked and the way that she invited Student 4 into the conversation, I thought the idea that I promoted during the teacher working group might have influenced Kelly's actions.

When I asked Kelly directly about the change between her December and April semantics lessons, she did not attribute it to anything that she had learned in the teacher working group. She remembered reflecting in action during the December lesson about her questions, and realizing they did not provide students with "an out:"

If the word is march and I say, 'What does that mean?' and he says very confidently, 'It means to go into outer space,' then I have to say, 'Oh, you're wrong.' I don't know. It just feels a little more open-ended to me to say, 'What does it mean to you?' or, 'What do you think it means?' I don't know. It just feels a little more freeing, or kinder." (Kelly, debrief 1)

In order to create a safer learning environment in which students would feel comfortable sharing their ideas without fear of being shut down, Kelly had adopted a more open-ended questioning pattern. While the issue of learning environment is certainly relevant to dialogic instruction, we had not discussed dialogic instruction through this lens during our teacher working group sessions. However, this was a lens that Kelly was using frequently in her role as co-chair of the school's social-emotional learning committee. It

is not possible to say definitively what caused Kelly to ask more open-ended questions. As I showed above, Kelly did not approach the teacher working group metacognitively. She could well have been unaware of the influence of specific conversations on her practice. The professional development, and my facilitation, may or may not have been among the multiple, contingent causes of the shift in her practice.

Although Kelly did not and perhaps could not identify specific changes to her practices as result of the professional development, she expressed a belief that she had indeed learned through her participation in the teacher working group. As I discussed above, when I asked Kelly at the end of the year about what she had learned, she had trouble recollecting many specifics. She did mention one specific area of learning. Namely, she thought that teaching the Language Awareness and Dialogic Reasoning curriculum had made her more aware of her approach to language instruction:

It made me, I think, more aware when I was teaching in other areas of how I approach language and how I would like to approach language in the future. Just gave me a sort of a more concrete construct that I would like to apply to other areas, especially reading. So how we were talking about LADRizing things. You know, as I was teaching it, I was like, ‘Oh, why don’t I do this in other areas, like my reading teaching? When I am teaching them, for example, the unit on character and we study words to describe a character, character traits or whatever, why don’t I approach it in this way and give them sort of that metalinguistic understanding of these words?’ It’s something that I have known is sort of lacking in our curriculum here, that the vocabulary instruction is kind of nonexistent, and so this, you know working on this project for these three years has helped me

really start to think very seriously about how I want to change the way I present vocabulary and help kids really get deeper into the language that they are learning. (Kelly, interview 2)

In this quote, Kelly specified a complex, contingent, causal mechanism through which she learned: awareness.

I use Tilly's (2008) definition of causal mechanisms as "events that alter relations among some specified set of elements—as, for example, a broker's creation of a connection between two previously unconnected groups alters the two group's behaviors" (p. 139). Although Tilly is not a complexity theorist, his definition is nevertheless helpful for understanding how causal mechanisms bring about change in complex systems.

Causal mechanisms can be understood as time-bound events that induce self-organization among some elements of a complex system. In this case, the Language Awareness and Dialogic Reasoning project exposed Kelly to new information about teaching language and offered a model that was different from her current approach. She became aware that it was possible to help students develop metalinguistic awareness through focusing on language in the texts that they were already using. Her awareness was the mechanism that caused a shift in Kelly's learning system; she perceived something that she had not previously perceived and was able to articulate an idea that had not previously been part of her learning system. However, the learning induced by the awareness of new information was quite limited. While Kelly felt that she had learned about how to teach language, the quote attests to the limited extent of her learning. Even after three years of participating in the teacher working group, all that she had been able to achieve was to "start to think very seriously about how" to incorporate more language awareness

instruction into the existing curriculum. She had not actually made any changes. It was unclear whether she ever would be able to take the knowledge that she felt she had developed and put it into practice. Given her limited autonomy over the curriculum and her infrequent opportunities for reflection, conditions within the school would make it challenging for her to enact the changes that she hoped to make.

As I have shown, at the end of three years of participation in the Language Awareness and Dialogic Reasoning project, including one year of teaching the curriculum while taking part in teacher working group sessions structured as professional development opportunities, Kelly's learning system remained largely static. The constellation of seven control parameters laid out above created poor learning conditions. Among the seven parameters in the model, the six that were on the lower end of the continua (as illustrated in Figure 4), worked in conjunction to inhibit learning. Overall, the professional development was not congruent with Kelly's needs and interests, such as her interest in developing additional language awareness curriculum that she could use in her classroom. Even when teacher working group sessions were congruent with her interests, namely her interest in fostering students' independence in content-based conversations, limited use of metacognition, infrequent opportunities for reflection, and unreflective habits hindered her learning. A false sense of congruence between the information in the professional development system and in the school- and teacher-level learning systems meant that Kelly misconstrued ideas shared by the facilitators. Ultimately, Kelly believed that she had learned something from participating in the teacher working group, but she had very little to show for it. Although she had some new

ideas about teaching language awareness, her lack of autonomy would make it difficult for her to ever enact those ideas.

While the details of Kelly's experiences were certainly unique to her, the overall pattern of her experience in the professional development is not. An analysis of the experience of other teachers who change little as a result of their participation in professional development is likely to turn up a similar pattern of control parameters creating difficult learning conditions. A piece of the answer to the question of why a teacher does not learn through professional development can be found within the teacher herself: limited use of metacognition, unreflective habits, and disconnected experiences can all contribute. However, it is necessary to look at that teacher in interaction with the school and the professional development for the full picture, which is likely to include a lack of congruence between teacher, school, and professional development, top-down decision making structures that leave teachers with little autonomy, and a hectic pace without built in time for reflection. Under this constellation of conditions, learning would be challenging for any teacher.

CHAPTER SIX

Learning under Modification and Transformation Conditions

In Chapter Five, I presented a scenario that would discourage many school leaders and professional developers: a teacher participates in professional development for three years, with little learning to show for it. In this chapter, I turn to an analysis of a more successful learning experience—the experience of Martina, a 4th grade ESL teacher at Bilingüe, who was strongly influenced by her participation in professional development, and whose beliefs and practices were ultimately transformed. In striking contrast to Kelly, Martina experienced professional development under conditions that promoted learning, due to a very different constellation of control parameters.

My analysis of the evidence from observations, interviews, and teacher working group sessions revealed that Martina’s learning occurred in two stages: stage one, which lasted from November until April, was characterized by informational learning, while stage two, which went from April to June, was characterized by transformational learning. My analysis of Martina’s learning uses the analytic framework I developed and presented in the previous chapter. Drawing on the data, I examined the constellation of control parameters within and across systems that together created the learning conditions during each stage. Figure 5 depicts the conditions at each stage. Stage one conditions can be classified as modification conditions, promoting incremental learning, while transformation conditions developed in stage two.

This chapter is divided into two main sections, corresponding with the two stages. In the first section of the chapter, I lay out the complex constellation of control

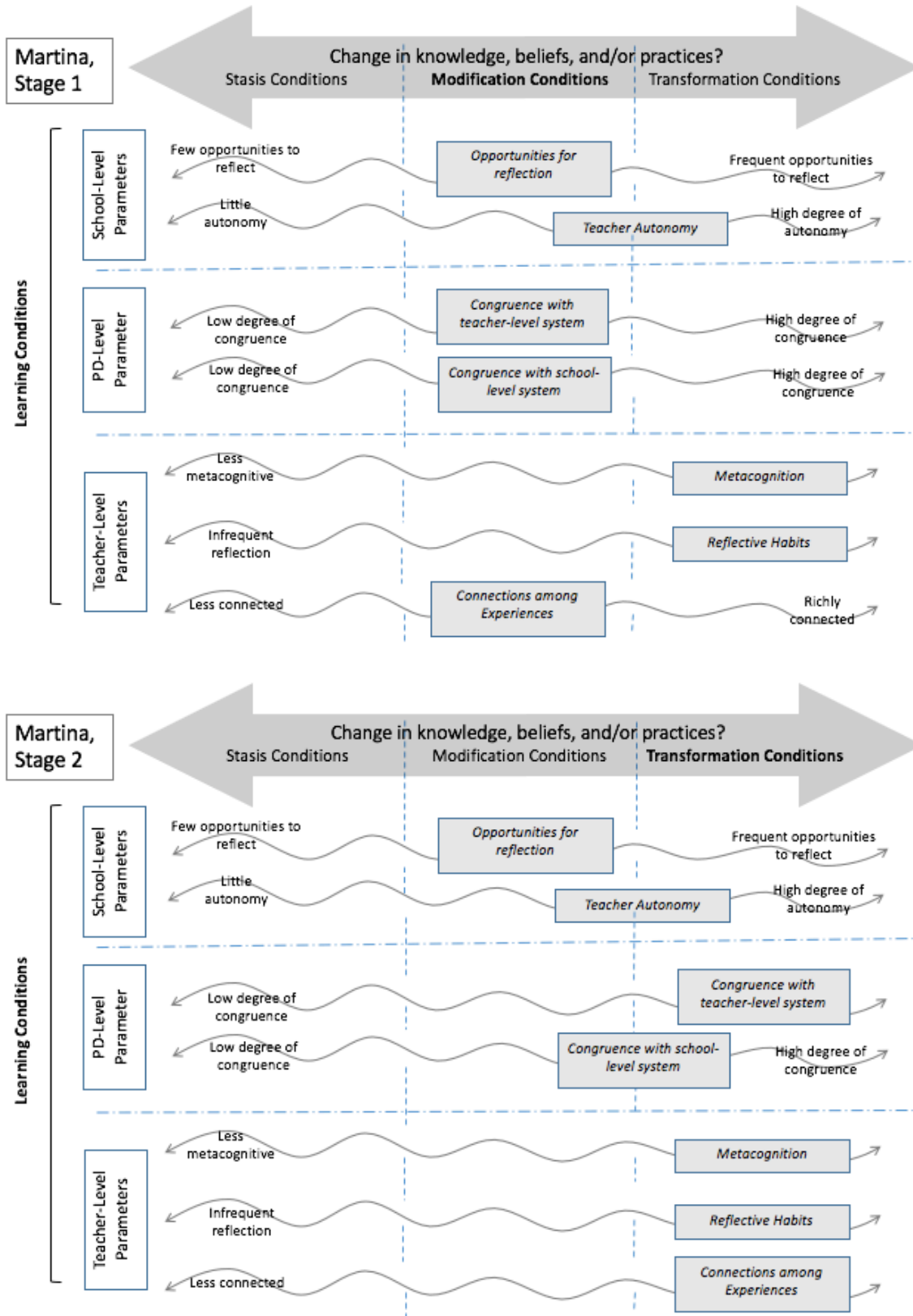


Figure 5. Modification and transformation conditions: Martina, Stages 1 and 2.

parameters that created conditions in which Martina was able to make gradual changes to her practice from November through April of the school year. Furthermore, in this chapter I identify the causal mechanisms that brought about these changes. In the second section, I explain how the constellation of parameters shifted, creating transformation conditions, under which Martina ultimately embraced and enacted a radically new perspective on teaching and learning. I show that a different set of causal mechanisms was at work during stage two. Throughout the chapter, I base the causal explanation in detailed description and analysis of Martina's learning system and of the ways it changed over the course of the year as she learned about language focused instruction for bilingual learners. While I focus on Martina, I posit that teachers who experience similar conditions are likely to have similar, successful professional learning experiences. An analysis of Martina's learning experience can thus help us to develop a better understanding of the conditions that promote learning through professional development, as well as some of the mechanisms through which teachers learn under these conditions.

Stage One: Learning under Modification Conditions

The 2016-2017 school year was Martina's first year as the 4th grade ESL teacher at The Bilingüe School. She transitioned into the role after eight years of experience as a second and third grade classroom teacher, including four years at Bilingüe. In her new role, it was her job to support the English language development of the 33 students across the seven 4th grade classrooms who were designated as English Language Learners. Like Kelly, Martina expressed enthusiasm for the Language Awareness and Dialogic Reasoning project, noting that she was "thankful" for the opportunity it provided her to "continue to learn and grow" (Martina, May meeting notes). Between November 2016

and April 2017, as she began to implement the curriculum with some of her students, while participating in ongoing teacher working group sessions, Martina made numerous small changes to her practice. Below I describe the conditions under which this incremental learning occurred, addressing the school-, professional development- and teacher-level parameters, which are depicted in the top half of Figure 5. As the diagram illustrates, throughout stage one, four of the control parameters were at the midpoint of their continua, while one was slightly higher, and two were at the upper end. Despite these two outliers, as a whole, the weight of the control parameters fell in the middle, creating modification conditions.

School-Level Control Parameters

In Chapter Five I discussed two school-level control parameters that I found to play a role in shaping conditions for teacher learning through professional development: opportunities for reflection and teacher autonomy. I showed that, in Kelly's role as classroom teacher, she was afforded few opportunities for reflection and little autonomy. Both of these control parameters contributed to the creation of stasis conditions. Despite teaching in the same school and at the same grade level, as an ESL teacher, Martina had a different experience. Below, I demonstrate that, although Bilingüe was by no means ideal for learning, it did offer Martina the necessary conditions for her to learn.

Opportunities for reflection. While all teachers at Bilingüe had busy schedules, just how hectic their days were depended on their roles in the school. As an ESL teacher, Martina's schedule was as packed as a classroom teacher's schedule. However, because she worked with small groups of four or five students at a time, rather than an entire class of 25 children, all clamoring for her attention, she noted that the day felt less hectic than

it had when she had been a classroom teacher (Martina, Interview 2). Furthermore, while Kelly was hard-pressed to find time to teach one Language Awareness and Dialogic Reasoning group, Martina was able to teach two groups. She taught one group on Mondays and Tuesdays, and the other on Tuesdays and Wednesdays. As she taught the first group, she “took mental notes on what to do the same or what to do differently” (Martina, interview 2). Thus, as Martina prepared to teach each lesson to the second group, the experience of teaching the same lesson on the prior day informed her preparation and ultimately her practice. She made many adjustments to her practice on the basis of her reflections on her first group.

The school-based professional learning activities at Bilingüe also afforded Martina with chances for reflection. Martina identified one professional learning activity in particular as a source of reflection: instructional rounds. This was a new structure that the ESL team was piloting; as a classroom teacher, Kelly was not involved. Once a month, the ESL teachers conducted group observations in one another’s classrooms, with a focus on what they termed “extended discourse,” or occasions in which the students were engaging with each other in discussions. They met as a group before each observation to discuss what they would be seeing, and they debriefed after the observation. Instructional rounds served as a monthly venue for teachers to collaboratively reflect on their own and others’ practice, in relation to ideas about extended discourse. This structure fostered learning by increasing the connectivity among the ESL teachers, permitting a (relatively) frequent exchange of information, and allowing teachers to observe firsthand the diversity within the group’s teaching practices. Instructional rounds created a space for the ESL team to learn as a group through

reflective discussions, as well as for the individual teachers on the team to learn through their internal reflections. However, learning was contingent on an additional control parameter within the school-level learning system: the degree of teacher autonomy.

Teacher autonomy. In contrast to Kelly, who had little autonomy as a classroom teacher, Martina had a relatively high degree of autonomy, due to her role as an ESL teacher. The district mandates that limited what Kelly could teach did not extend to ESL teachers, who were expected to make autonomous decisions about their curriculum. While the ESL department had recently adopted a curriculum, Martina described it as a “focal point,” but she felt no pressure to teach it “with fidelity” (Martina, interview 1). Instead, she was expected to decide whether or not to use the curriculum materials or to devise lessons using other materials, in accordance with her students’ needs. Unlike the role of a classroom teacher at Bilingüe, the role of ESL teacher required Martina to act autonomously. Martina was well positioned to learn through experimentation, by trying out new ideas, seeing what worked, and learning through the process. By providing Martina with autonomy and opportunities for reflection, the Bilingüe school-as-system established conditions that supported her learning. However, Martina’s learning also depended on professional development-level and teacher-level parameters.

Professional Development-Level Parameters

As discussed in Chapter Five, learning through professional development depends on the congruence between the professional development-level system and the school- and teacher- level systems. In order for Martina to learn from her participation in the teacher working group, it needed to be congruent with both Martina’s needs as well as with the school context.

Congruence of the professional development system and teacher learning

system. To carry out the responsibilities of an ESL teacher, Martina needed additional skills and knowledge that had not been as important in her previous role of classroom teacher. One aspect of her role that was new to her was designing or selecting curriculum to use with her students. As a classroom teacher, Martina had been handed the curriculum, with existing objectives for every unit, and many designated materials. In her new role, she was responsible for creating or finding curricula based on students' language needs. She had an anthology to use, but it was up to her to figure out whether and how to use it, and what additional materials to bring in. In December, she described this aspect of her job as "exhilarating but also frightening." To illustrate, she related her thought process after her students read one of the stories from the anthology:

I was like, 'Oh, this book would be great to pair with it, and oh, if we're talking about that, then we can start talking about national parks.' I was like, 'I think the kids are going to be really interested', but I'm like, 'I don't know. Is that exactly what they need right now?' And I have no way to tell. (Martina, interview 1)

Recognizing that she "had no way to tell" what her students needed to learn, Martina was eager to learn how to perform this and other aspects of her new role more competently.

To develop all the knowledge and skills that she needed, Martina had to look to external professional development, because the school learning system, did not offer learning opportunities that were congruent with her needs. As described in Chapter Four, the structures of the school-level learning system were harnessed to centrally established, school-wide priorities. For 2016-2017, the top priority was the oral language goal, and school-based professional learning activities focused on enacting ideas from the book

Making Thinking Visible (Ritchart et al., 2011). Martina believed that these ideas were not useful in her work as an ESL teacher. She needed something more tailored to her role. In another year, she might have received individualized support from a school-based coach; however, the former ESL coach had left at the end of the prior school year, and no one was scheduled to fill that role until the following year. Furthermore, her assigned supervisor was distracted by family emergencies. She needed to proactively seek out external professional learning opportunities in order to develop her skills and knowledge for teaching ESL.

The teacher working group was one among several professional learning activities that Martina participated in during the school year for the express purpose of developing needed competencies. When I asked her why she initially joined the teacher working group, she remembered thinking that the approach to teaching language awareness “is exactly what our students don’t have, our [English Language Learner] students, and what they need. And I want to learn more about how to better help our [English Language Learner] students, and if this curriculum does it, great!” (Martina, interview 1). She hoped that participating in the Language Awareness and Dialogic Reasoning project could bring about greater connectivity between her theoretically based knowledge of language acquisition and her classroom practices. Not only did she hope to build her repertoire of practices for teaching English learners, but she also anticipated that the project would help her to meet the new challenges of curriculum development. In December, she said, “I’d love to be able to recreate some of the skills from [the Language Awareness and Dialogic Reasoning curriculum] in my other teaching. Like even using the [district-adopted curriculum], okay, how can we look at the semantics or the

morphology here?” (Martina, interview 1). Martina saw the teacher working group as offering just the kind of professional development content that she needed, content that was directly connected to her classroom practice and her curriculum, and thus could potentially lead to informational learning. Perceiving the professional development system as congruent with her own learning system, she anticipated being able to learn from it. Unlike Kelly, whose perceived needs were not met by the teacher working group, Martina’s needs were well aligned with the professional development system.

Congruence of the professional development system and school learning system. Not only was the congruence between Martina’s learning system and the professional development system an important precondition for learning, so too was congruence between the professional development and the school learning system. In Chapter Five, I discussed the relatively low degree of structural and informational congruence between the school- and professional development-level systems that impacted Kelly’s learning. Even though they worked in the same school, Martina experienced greater congruence between the two systems, due to her different role.

While Kelly’s understanding of dialogic instruction was greatly influenced by her involvement in the school’s work on *academic conversations*, Martina was part of other related conversations in the school among the ESL teachers that broadened her conception of dialogic instruction. In their collective exploration of “extended discourse,” which they were undertaking during instructional rounds as well as weekly *collaboration* meetings, the ESL teachers were looking at a variety of practices for promoting dialogue among students. Martina commented on the overlap between the work she was doing in the professional development system and with her ESL team:

And we just had an ESL collaboration before the break... I was thinking to myself after the meeting just how neat it is that we keep—different things that I've been involved with and keep coming back to... So actually [Language Awareness and Dialogic Reasoning] has come up a bunch in that conversation, because it's kind of exactly what we're hoping. That is, [dialogic reasoning] is like the quintessential extended discourse. (Martina, debrief 4).

From Martina's point of view, what she was learning about in the teacher working group exemplified the practices that she was exploring with her school-based ESL team. She perceived the school learning system and the professional development system as perfectly congruent, their messages and aims as redundant. While the two larger systems were not always completely congruent in their visions for student-centered instruction, as discussed previously, there was enough redundancy in the ideas of extended discourse and dialogic reasoning that the systems could exchange information easily and effectively. When Martina raised ideas from the Language Awareness and Dialogic Reasoning project during school-based meetings, she brought information from one system into the other, putting ideas from the two systems into conversation with each other. In this way, congruence between the professional development and school learning systems helped to foster conditions for Martina's learning.

Teacher-Level Control Parameters

Not only did school- and professional development-level control parameters generally foster better learning conditions for Martina than for Kelly, so too did teacher-level parameters. As I have discussed, teachers' metacognition and reflective habits, as well as the degree of connectivity of among their experiences, interact with the school-

and professional development-level parameters to create learning conditions. Whether individual teachers actually experience informational learning depends on what they bring into the professional learning activity and how they interact with it. Below, I show that in Martina's case, all of these teacher-level parameters were of medium to high intensity within, thus working in conjunction with the other parameters to foster learning.

Metacognition. Whereas Kelly's learning system was characterized by limited use of metacognitive strategies in relation to the professional development, Martina employed high levels of metacognition. She demonstrated high degrees of both metacognitive awareness and metacognitive regulation. As described above, Martina was well aware that she lacked necessary knowledge and skills to perform the job of ESL teacher. She was able to name specific competencies that she needed to develop, including skills in curriculum development and knowledge of the WIDA English Language Development Standards (WIDA, 2014).⁵ Furthermore, Martina used metacognitive strategies to approach learning intentionally. She asked a lot of questions during professional development to fill in gaps in her understanding. She noted this tendency in an interview, commenting, "I ask a lot of questions, because I don't know something, or something's not clear to me... and I don't know if I'll have access to the answer, so I ask. But it really helps me obviously getting that information" (Martina, interview 1). For instance, during the January teacher working group session, she did not hesitate to express her confusion about the meaning of the term 'dialogic instruction,' saying, "I thought I had an understanding of the definition. Now I've kind of lost it. Of

⁵ Developed by a multistate consortium to foster social and academic language development for linguistically diverse students, the WIDA standards had been adopted at the state level. ESL teachers were expected to use them to analyze students' language development and decide upon an appropriate course of instruction.

what dialogic instruction is. It's almost like, would you say that metalinguistics is like synonymous with it?" (Martina, TWG 5). By recognizing what she did and did not understand, Martina was able to advocate for herself as a learner. This aspect of Martina's learning system supported learning through professional development, as it led to an increased flow of information between the professional development system and Martina as a learning system.

The particular situation that Martina was in during the 2016-2017 school year, a new ESL teacher, lacking some of the requisite knowledge and skill to enact her role competently, and acutely aware of these gaps, supported her learning. While the details of her situation are particular to her, many teachers find themselves in similar situations. Like Martina, they may take on new roles within the school. Perhaps they are required to implement new curricula or use new technology. Perhaps they have students in their classes with unique learning needs. Scenarios like this may prompt an increase in metacognitive awareness, as teachers who are used to performing their jobs competently recognize that they lack the knowledge or skills that are called for by a change in situation. This may prompt these teachers to approach professional learning activities strategically, as Martina did, contributing to the creation of positive learning conditions.

Reflective habits. Another teacher-level control parameter that supports learning through professional development is a habit of reflection, as discussed in Chapter Five. While school-level structures can support or limit opportunities for reflection, there are also differences at the teacher-level, in terms of habits of mind. The learning systems of teachers who reflect as a matter of habit are richly connected, and information flows rapidly.

In our many conversations, Martina revealed reflective habits of mind. In response to the question of how she would describe herself as a learner, Martina said, “I like to think of myself as a reflective person, so thinking like, ‘What goes well? What isn’t going well in lessons? What do I need to make it better?’” (Martina, interview 1). She revealed her reflective nature when she decided to make changes to the curriculum, unprompted by me, on the basis of her reflections. For instance, she emailed me in March to confirm that it would be okay for her to make a change to the lesson materials:

After doing the [dialogic reasoning] with my first group today, I think I am going to try out a different format for planning the [dialogic reasoning] discussion. We are in the midst of prepping for the [state test] and I want to help students make the connect between their essay writing and [dialogic reasoning]. I would like them to understand that their [dialogic reasoning] is a verbal essay of sorts. Is that ok? (Martina, personal communication)

It seems that teaching the lesson to her first group prompted Martina to reflect that the lesson would have been more successful if students were aware of how it was connected to the work they were doing in their other classes. She had reflected on her experience of teaching a dialogic reasoning lesson in relation to her other teaching experiences as well as her knowledge of teaching writing. Through reflection, these disparate aspects of her learning system exchanged information, prompting a change in practice.

In addition to reflecting on her teaching practice, Martina’s habit of reflection extended into professional learning situations. During teacher working group sessions, she reflected on the ideas under discussion in relation to her own practice. For instance, during the January session, we spent some time defining dialogic instruction as a group.

We facilitators then asked teachers to share how they used dialogic instruction in their own classes. After listening to her colleagues, Martina spoke up, saying “I think we do it a lot then, even more than we recognize, like any time you have a reading group or a reading minilesson, you’re talking about author’s meaning” (Martina, TWG5). In this comment, Martina reflected aloud on the concept of dialogic instruction in relation to her teaching. She continued reflecting on ideas discussed during teacher working group sessions on her own, as I show later in the chapter. Martina’s habit of reflection created connectivity and a constant flow of information within her learning system, which supported learning.

Connections among experiences. The final control parameter that supported Martina’s learning through professional development was the extent to which her experiences were connected. Similar to Kelly, Martina made connections between her experiences with the Language Awareness and Dialogic Reasoning project and her other experiences. During teacher working group sessions, she often mentioned other experiences, including events in the classroom and previous professional development activities. She even referenced her Masters coursework, connecting a theory that she had learned about in a class on sociolinguistics to an article that we read as part of the professional development (Martina, TWG 7). In contrast to Kelly, for whom the degree of connectivity was not enough to support learning, for Martina this control parameter was one among seven control parameters that were all of medium to high intensity. These complex and contingent teacher-level, school-level, and professional development-level control parameters created modification conditions, under which Martina’s learning system was primed to learn.

Modifying Beliefs and Practices: Learning during Stage 1

I turn now to Martina's learning process. As a process is best understood chronologically, I tell the story of Martina's learning from November through April as an analytic narrative. I relate what she learned, demonstrating that her learning was informational (Kegan, 1994), as she gradually and incrementally modified her practice to adapt to new ideas. Furthermore, I analyze how she learned, highlighting the complex, contingent, causal learning mechanisms. Like many narratives, some backstory is required. Before I can begin the narrative of Martina's learning, I offer as backstory some of the knowledge, beliefs, and practices that constituted her learning system when she first began teaching the Language Awareness and Dialogic Reasoning curriculum.

Initial beliefs and practices. As an ESL teacher, Martina was acutely focused on language. Her initial beliefs about what students needed to learn about language were informed by her experiences. In December, she expressed a belief in the importance of teaching metalinguistic awareness, acquired during her Masters program in applied linguistics with a focus on English as a Second Language. She remembered that her professors regularly spoke about the importance of helping students to develop metalinguistic awareness, and her response was always, "Yeah, you're right. How? How? How?" (Martina, interview 1). While Martina believed that it was important to help students develop metalinguistic awareness, she had little knowledge about how to do so.

Martina's espoused belief in the importance of teaching metalinguistic awareness coexisted with a belief that it was essential for English Language Learners to master the basic building blocks of language: vocabulary, grammar, and mechanics. She felt that the regular curriculum poorly served students who lacked skills with these elements of

language. She critiqued the Writers Workshop curriculum, which was used throughout the school, saying, “There’s no direct teaching of language, and that is the number one thing that our students need, or, if not the number one, one of the most important” (Martina, interview 1). Martina believed students would only master language conventions through a focus on this during instructional time. Martina’s student learning goal exemplified this value. In October, when she was required to submit to the district a single student learning goal that she would focus on for the next two years, she wrote a goal about improving sight word spelling knowledge, in keeping with her prioritization of language conventions (Martina, artifact 6). Thus, while Martina believed students needed to develop metalinguistic awareness, at the beginning of the school year her belief that students needed direct teaching to learn the building blocks of language took precedence.

Martina’s knowledge of how to provide students with “direct teaching of language” was informed by prior professional development on Readers Workshop. She had internalized what she called “the workshop model,” which she described as, “I’m going to tell you what we’re doing, I’m going to name it, I’m going to connect it to what we’ve already been doing, I’m going to show you how to do it, we’re going to do it together, and then you’re going to do it by yourself” (Martina, interview 1). The phrase “workshop model” might call to mind images of a loud room, such as woodshop, with people hard at work on self-directed projects. Perhaps it calls to mind a writing group, in which writers take turns “workshopping” their drafts, or getting feedback from their peers. However, Martina used the term to refer to a form of direct instruction, in which the teacher is positioned as the expert, transmitting knowledge and skills to students.

When Martina began to teach the Language Awareness and Dialogic Reasoning curriculum, she used direct instruction to teach language, emphasizing language use, rather than metalinguistic awareness. In December, she explained that she was adapting the lesson plans to fit the “workshop model” of direct teaching. “I think I have that formula always in the back of my mind with lessons. I feel like I’ve tried to kind of adapt that a little bit into [Language Awareness and Dialogic Reasoning]” (Martina, Interview 1). This workshop formula was very much in evidence in Martina’s language teaching in January. During a syntax lesson, she used direct instruction to name a new term and show students how to use it. She introduced the term *pronoun* like this:

Martina: A pronoun takes the place of a noun. What does a pronoun do?

Students: Take the place of a noun.

Martina: Keep that in your mind. (Martina, observation 2)

In this brief exchange, she presented a new piece of information and then quizzed students to check that the information had been successfully transmitted. She proceeded with direct instruction as she demonstrated how to modify sentences by replacing the subject or object with a pronoun. In accordance with the workshop model, Martina next had students practice as a group, and then work independently, applying the concept on their own. Students worked quietly on a Cloze passage, filling in blanks by selecting the appropriate pronoun from among three choices, while Martina monitored their work, checking that they were selecting the correct answer. Here, Martina’s implementation deviated significantly from the lesson plan, which called for students to work with partners on the Cloze activity. The teacher was instructed to, “Ask students to explain to their partner why they selected that particular pronoun.” This prompt would have pushed

students to think metalinguistically. However, in accordance with her beliefs and in keeping with her usual practices, Martina enacted the lesson in a way that emphasized individual students' accuracy and omitted metalinguistic development. These initial beliefs and practices were significantly different from the ideas about dialogic instruction and metalinguistic awareness that we facilitators espoused, as detailed in Chapter Four.

Martina distinguished skill-based instruction on language from instruction in subject areas that she considered to be open to interpretation. While Martina believed students needed direct instruction to develop language content and skills, she thought a more dialogic approach was both appropriate and necessary at other times. During the fall and early winter, I observed Martina employing an Initiation-Response-Feedback turn-taking pattern (Rymes, 2015) to engage individual students in conversation during discussions about the meaning of texts as well as when facilitating dialogic reasoning discussions. In the Initiation-Response-Feedback model, the teacher provides some sort of non-evaluative feedback for an ongoing interaction. Martina often asked an open-ended question about the text, a student shared a thought, and Martina asked a follow up question to that student, such as, "What makes you say that?" or "How come?" eliciting more information from the student. This approach was indeed more dialogic than the "workshop model" of direct instruction that Martina employed to teach language, in that she sought out students' perspectives and considered their interpretations valid. Nonetheless, it was teacher-centered, positioning Martina as the mediator of all ideas, deciding which ones to take up and which to ignore. She engaged in dialogue with students, but students did not engage dialogically with one another.

Martina incorporated an initiation-response-feedback pattern into the first dialogic reasoning discussions that she facilitated. While dialogic reasoning is intended to be student-led, Martina played a central role in her group's early discussions. She expressed a belief that this was necessary, because students were not good at listening to one another, saying, "I think even in a small group, sometimes it's hard for them to truly listen to what the others are saying; they almost need that guide or that facilitator" (Martina, TWG 5). During the first dialogic reasoning discussion that she facilitated in December, Martina encouraged every student to talk. When they did, she asked follow up questions to clarify students' ideas and to elicit further thoughts. During the nine-minute discussion, she repeated or rephrased students' ideas seven times, but never asked students to respond to one another directly, as exemplified in this exchange:

Student 1: They have to build a fence so the wolves can't get there.

Martina: So maybe they could build a fence?

Student 1: Yeah.

Martina: Where?

Student 1: Maybe around the farm or house, so they can get, so the children can play.

Martina: I just want to make sure I understand what you're saying. They should build a fence around the huge Yellowstone National Park?

Student 2: No.

Student 1: No, around their house.

Martina: Who should?

Student: The farm—ranchers and the people. That's my idea.

(Martina, observation 1)

In this exchange, Martina repeated Student 1's idea and then questioned him at length to help him clarify his idea. She explained later that she "was trying to clarify because it wasn't clear exactly what he meant, so for the other kids to be able to agree or disagree with that, they needed to understand too" (Martina, TWG 4). There is some evidence that this worked, as Student 2 interjected during the exchange, and a third student expressed disagreement after Martina finished interrogating Student 1. However, she never expressly invited other students to engage with this student's idea or any other idea.

Martina used the initiation-response-feedback pattern for the purposes of promoting individual students' comprehension and language development. When I asked Martina in February about her use of this practice during conversations about texts, she articulated several benefits:

I think it demonstrates comprehension, 'cause you can just give an answer, but you don't have to necessarily have comprehended the text to give an answer, so asking them, 'Why?' pushes their thinking. It gets them to talk more, and also in standardized testing and in a lot of classroom activities, part of the curriculum now, they have to explain their thinking. So it's absolutely necessary for them to do it, be able to do it orally, before they can do it in writing (Martina, debrief 4).

In this rationale, Martina expressed the value that she placed on individual students' comprehension and oral expression. Believing that students needed to develop their expressive skills, she drew them out individually. In the fall and early winter, her understanding of dialogic instruction was shaped by her focus on individual students' development, as well as her belief that the teacher was the best person to guide students'

continued development. Her perspective differed significantly from the perspective that we facilitators offered during teacher working group sessions that dialogic instruction was a way to help a group develop deeper, socially situated, co-constructed knowledge.

In the preceding description of Martina's initial beliefs and practices, I have drawn attention to several ways that her practices and beliefs differed from those shared by the facilitators during teacher working group sessions. Unlike Kelly, who continued to hold discrepant beliefs and practices throughout the year, Martina began to change. Throughout the winter and into the spring, her knowledge, beliefs, and practice shifted incrementally. I turn now to an analysis of these changes and their contingent, causal mechanisms.

Shifting beliefs and practices. As described above, Martina was eager to be involved with the Language Awareness and Dialogic Reasoning project, in part because she anticipated that it would help her meet the challenges of developing and selecting curriculum for her students, which was a self-identified area of weakness. She viewed it as a source of ideas that she could integrate with her existing curriculum. When teachers are aware of a need, they may appropriate ideas or resources from elsewhere to fill that need. Martina appropriated activity structures from the Language Awareness and Dialogic Reasoning curriculum that she could use as part of her regular ESL instruction. For instance, she added a dialogic reasoning discussion to one of her regular lessons. After students read a text about energy from the district-adopted anthology, she asked them to take a stance on a contentious issue related to the text and engage in a discussion using evidence from the texts and their life. Appropriating ideas was a form of informational learning. It did not require her to change any of her beliefs or abandon

current practices. Instead, her learning was additive; new system elements were added alongside existing elements. Throughout the year, Martina deliberately added to her limited repertoire of pedagogical practices and curriculum materials for teaching emergent bilingual learners.

My analysis showed that several contingent, causal mechanisms functioned in conjunction with each other to enable Martina to learn through appropriation; namely these mechanisms were the recognitions of a gap in her knowledge, consideration of new practices, and imitation. She recognized that her repertoire of practices for teaching ESL was limited and would need to be supplemented. Furthermore, she considered the new practices that she was learning about from the Language Awareness and Dialogic Reasoning project in relation to her other experiences, thinking about whether certain curriculum structures would be useful in her other ESL groups. Finally, she imitated the activity structures, taking structures from the Language Awareness and Dialogic Reasoning curriculum and employing them in a different context.

These mechanisms prompted new learning because Martina was experiencing the professional development under modification conditions, as outlined above. For instance, a reasonable degree of congruence among the professional development-, school-, and teacher-level systems was necessary for Martina to find anything in the professional development that she would want to or be able to appropriate. Had there been less congruence, Martina would not have wanted to and/or been able to appropriate anything. Recognizing a gap in her knowledge and realizing that she could fill it through professional development required her to employ metacognition. Considering new practices in relation to her own context necessitated connections among experiences.

Finally, the actual imitation of practices from the Language Awareness and Dialogic Reasoning curriculum in her classroom required autonomy; she needed the freedom to adapt her curriculum. Under stasis conditions, this type of learning could not have occurred. However, the conditions were ripe for appropriation, and Martina approached the professional development purposefully, with intent to learn in this manner.

Initially, Martina did not anticipate that she would learn anything from participating in the Language Awareness and Dialogic Reasoning project that would change her beliefs or lead to shifts in her habitual practices. She perceived the principles of language-focused pedagogy as perfectly congruent with her own practice. When I asked her in December whether she noticed anything in the lesson plans that required her to teach in a manner that differed from her regular teaching, her immediate answer was, “No” (Martina, interview 1). She saw the pedagogy as so similar to her own teaching style that she would not need to change her practices to teach Language Awareness and Dialogic Reasoning lessons. She was not aware that there were, in fact, differences between her vision of dialogic instruction and the facilitators’ visions. However, as time went on, Martina began to recognize some of the differences between her existing beliefs and practices and those espoused by other agents in the professional development system. Recognizing these differences enabled her to consider them, thinking about new ideas in relation to her existing ideas. Thus, not only did the consideration of new information support Martina’s learning by appropriation, this contingent, causal learning mechanism ultimately supported the development of a new frame of reference and a shift in practice.

Consideration of new information is a mechanism that occurs through reflection. As discussed above, reflection functions as a feedback loop that connects the different

elements within a teacher's learning system, effectively putting experiences, beliefs, knowledge, and practice "in conversation" with each other. When information is exchanged rapidly between multiple, diverse system elements, learning is likely to emerge (Stacy, 1996). In other words, teachers may develop new ideas that are appropriate to their own contexts and needs when they consider new information from professional development in light of the information already in their learning systems.

Researchers have documented the success of professional learning activities that prompt teachers to reflect on their own teaching practice and their students' learning (e.g. Kazemi & Franke, 2004; Sato et al., 2008). The use of artifacts of practice, such as student work, classroom videos, or curriculum materials, can be particularly effective as a springboard for reflection (Ball & Cohen, 1999; Kazemi & Hubbard, 2008), making new and unfamiliar ideas concrete. Such activities encourage teachers to consider these ideas in relation to their existing knowledge, beliefs, and practices, contemplating when, whether, and how to incorporate them into their practice, including how to tweak them.

As mentioned in Chapter Four, despite the many constraints upon the professional development system, we were able to include active learning activities using artifacts of practice, including classroom videos, lesson transcripts, and lesson plans, in four sessions. During the January teacher working group session, we facilitators used a video and transcript of a semantics word web activity from Kelly's Language Awareness and Dialogic Reasoning group as a springboard to discuss the use of dialogic instruction in language-focused lessons. As a group, we analyzed the lesson transcript, paying close attention to the turn-taking patterns, going so far as to count the number of student turns in between teacher turns. Martina credited the video with helping her to think differently

about her practice. She explained that reflective activities such as this encouraged her to change her own instruction:

I think what helped too was just like having the teacher working group meetings and I think we saw a clip from one of Kelly's word web activities, and then talking about dialogic instruction and thinking, like, 'How can I make this more interactive?' (Martina, interview 2)

In particular, she credited analyzing the script of Kelly's lesson with making her believe that she should and could make opportunities for students to talk with each other. "Seeing how they built off one another made me think, like, 'How can I do that?'" (Martina, interview 2). The video and transcript were concrete artifacts of practice that enabled Martina to consider the knowledge and beliefs discussed in the group in relation to her own practice and to envision ways to incorporate more dialogic instruction.

Considering information from professional development led to an elaboration on Martina's frames of reference for thinking about bilingual students and their language. Whereas previously she had viewed her students' language primarily through a narrow focus on their command of language conventions, during late winter and early spring, Martina began to think more broadly about the relationship between expressive language and literacy. In February, Martina noted that she was contemplating how to make more time for students to explain and discuss their ideas:

Because I think, as [English Language Learners], they don't always get that exposure--that opportunity in the large group to talk so much, and also I think that ultimately that practice will improve their literacy skills. I think the research shows, and I like to believe that that's true. (Martina, debrief 4).

Increasingly, Martina felt it was important to create opportunities for students to talk, out of a newly prioritized belief that talking would lead to improved literacy skills. While this was not a brand new belief, Martina had elaborated on it, as artifacts of practice used during teacher working group sessions supported her to consider ideas from professional development in relation to her own experiences.

While the artifacts of practice sparked reflection within Martina's learning system, the conversations that took place during teacher working group sessions about these artifacts were occasions of dialogic reflection at the professional development system level, as agents in the group exchanged ideas and information, sharing their diverse views. Davis and Sumara (2006) suggest that conversations in which various possible actions are considered and discussed in order to decide on one course of action are likely sites of emergence. Just as Percy et al. (2015) and Pella (2015) have found, new ideas emerged in the teacher working group when teachers collaboratively analyzed and planned lesson. In the March teacher working group session described in Chapter Four, the idea of productive dialogue emerged during a discussion about a specific semantics lesson plan, in which we facilitators asked the group to consider whether to modify the plan as written to include more dialogic discussion. As the group discussed the plan and shared different perspectives about when to use dialogic instruction versus direct instruction, a new idea emerged about "productivity." The group came to consensus that teachers should use their judgment to decide whether it would be productive to engage students in dialogue at any one moment in time.

While it can be said that the professional development system as a whole changed at that moment, Martina was skeptical of the group's consensus. During the discussion,

Martina questioned whether students really had enough familiarity with morphology, syntax, and semantics to engage in much productive dialogue about new language concepts. However, despite her skepticism, she was considering the new concept of productive dialogue in relation to her own practice; the concept of “productive dialogue” was there, not yet a belief or a practice, but part of her constantly shifting learning system nonetheless. A shift in learning conditions was necessary for her awareness of this new concept to lead to changes in her beliefs and practice.

As the year progressed, the congruence between the professional development- and school-level learning systems increased. As discussed above, Martina was part of multiple conversations about student talk as an agent in both systems. At the school level, the ESL team continued to discuss extended discourse throughout the year, while at the professional development level, the focus on dialogic instruction increased in the winter. These conversations had a number of redundancies, including a shared exploration of the benefits of student talk, which enabled these elements of Martina’s system to exchange information easily and effectively. Moreover, these experiences increased the overall diversity of Martina’s learning system, as other participants in these conversations expressed ideas that differed from her own beliefs and practices. Thus, the increasing congruence between these two systems created conditions of redundancy and diversity that foster emergence (Davis & Sumara, 2005).

As Martina exchanged information with the school and professional development systems, she viewed the information that she received from each in relation to the other, rather than as discrete pieces of information. The fact that the information that she was exchanging with these two larger systems was congruent made it take on more

significance. It is easy to ignore a different viewpoint as an outlier the first time it is heard. Considering the phenomenon of social movements, for example the movement for marriage equality, is helpful here. Before the year 2000, few people in the United States championed same-sex marriage, and little attention was paid to those who did. However, after Massachusetts became the first state to legalize same-sex marriage in 2003, it became part of the public discourse. Support for marriage equality grew rapidly after that, and it was only 12 years later that the Supreme Court gave same-sex couples the same marriage rights as opposite-sex couples. This exemplifies a common pattern of change within social systems. Once multiple people start championing the same viewpoint, it becomes hard to ignore. Each time an individual hears that view expressed by a different person, new connections are formed within his or her learning system. Bombarded with redundant information about dialogic instruction and extended dialogue from two increasingly congruent systems, Martina could not help but attend. She explained that these related conversations were prompting her to consider how she could incorporate more dialogic instruction into her practice. “It’s getting me to think, okay, so how can I have them explain? How can I have them explain? How can I have them discuss?” (Martina, debrief 4). She considered how she could enact in practice the ideas that were entering her learning system through redundant experiences. Gradually, through reflection during and outside of professional learning activities, she shifted both her beliefs and her practice.

By the middle of the year, Martina was experimenting with adding more opportunities for students to talk during language-focused instruction. For instance, Martina made some space for students to talk during a semantics lesson in February,

when she introduced the word *captivity*. Before providing the definition, Martina asked an open-ended question that invited students to share their observations:

Martina: Today we have captivity. Does that word remind you of another word that you know, or do you see parts of another word that you know?

Student 1: No.

Martina: Just please say it.

Student 2: Cap

Martina: Okay.

Student 1: Activity.

Martina: What sweetheart?

Student 1: If you take the p out, if you switch these around, take the p out, activity.

Martina: Hm, there's no c in there to say activity, but they both end in -ivity, you're right.

Student 3: If you take the, take the, take the—

Martina: Okay, let's take a look at what it means.

(Martina, observation 5)

Although this discussion was brief, lasting less than 30 seconds, this was the first time that I observed Martina invite students to share ideas about language and explore a word together. When I asked Martina about this later, she explained that she was hoping students would make connections that would help them to read or interpret the word *captivity*. She believed that the connection with *activity* was helpful, because not only do the two words contain the same suffix, their Spanish cognates also share a suffix

(Martina, debrief 4). Martina's language teaching practice was changing, in accordance with her newly elaborated frame of reference. However, she was still hesitant to let students take a lot of time exploring, as evidenced by the end of the exchange, when she interrupted Student 3's observation to transition to direct instruction. While extensive and repeated consideration of dialogic instruction had led her to try it out in a language-focused instruction prior to her normal direct instruction, another contingent, causal mechanism was needed for Martina to make dialogic instruction more central to her teaching practice.

Once again, reflection provided a structure in which learning could occur. As described above, Martina's role as ESL teacher afforded her a moderate degree of opportunity for reflection and the data revealed that she had a habit of thinking deeply and critically about her lessons during and after teaching. These control parameters were necessary for Martina to move beyond appropriating a practice from professional development for occasional use to making that practice a regular feature of her teaching. Martina's habit of reflection created a continual feedback loop. As she reflected on her experiments with dialogic instruction, considering her actions and students' learning in light of her knowledge and beliefs, she received both positive and negative feedback. For example, when she perceived that her students made a meaningful connection between the words *captivity* and *activity*, this positive feedback supported her decision to allow students to explore words through dialogue prior to delivering direct instruction.

The lesson debriefs that I conducted with Martina were another feedback loop through which she reflected on her instructional experiments. Prompted by my questions about changes that I had noticed in her practice, Martina reflected on how her lessons had

gone. She articulated what students had learned, critiqued her own pedagogical moves, and developed plans to try the next time she taught a similar lesson. At the end of one debrief, she commented, “This conversation is helpful. That’s what I’ll do next time” (Martina, debrief 6). Through these feedback loops, Martina eventually concluded that the new practices she was trying were beneficial and worth adding to her repertoire. Drawing a conclusion about a new practice can be understood as another contingent, causal learning mechanism through which Martina learned.

Martina was able to consider new information from professional development in relation to her own teaching context, experiment with it in her own classroom, and then conclude that it worked because she was experiencing professional development under modification conditions. In other words, the mechanisms through which she learned were contingent upon the learning conditions created by the constellation of control parameters. Had there been less congruence between the systems, fewer opportunities for reflection, less autonomy, fewer connections among experiences, and so forth, Martina would not have learned as she did. However, due to the modification conditions that characterized Martina’s professional learning experience during the first part of the year, these contingent, causal learning mechanisms brought about ongoing, incremental learning through professional development. She did not abandon her old practices or beliefs, but added new practices and new frames of reference alongside the old.

As a result, by April, Martina was making much more time for students to explore the meaning of words together. I observed her devote three minutes of a semantics lesson to a conversation about the differences between the words *rally* and *march* that was driven by students’ background knowledge about these words (Martina, observation 6).

When I asked her about this incident, Martina described using reflection-in-action to connect new ideas from professional development to her in-the-moment facilitation moves:

I remember consciously thinking, because I feel like the concept [of dialogic instruction about language] that we talked about [in the teacher working group] last time is like a relatively—not that it's new to me, but that the actual practice of it is kind of new..., so I'm still like figuring, testing the waters a little bit, and I remember thinking like, 'Should I stop them? Should I let them go on?'

(Martina, debrief 5)

Again, feedback loops enabled Martina to bring information gleaned from her experiences in the teacher working group in contact with her teaching practices. Even though she had initially expressed skepticism about using dialogic instruction to discuss language concepts, that idea had become part of her learning system. As she listened to her students making meaning about semantic distinctions through dialogue, she received positive feedback that reinforced the concept, initially embraced by others, that time spent in such discussions could be highly productive.

Limited changes. While Martina's learning system was constantly shifting throughout the winter and early spring, overall the changes were relatively minor. Her experiences in the professional development system and the school as system had been added into the familiar structure of her learning system, alongside existing elements. While her beliefs and practices had shifted a certain amount as she recognized gaps in her knowledge, considered new information, concluded that it worked, and imitated some practices and structures, these changes were tweaks, not transformations. After six

months of participating in the teacher working group under modification conditions, the status quo in her classroom had only shifted in minor ways.

This was exemplified by Martina's continued hesitation about teaching language dialogically. During the March teacher working group session in which we were discussing whether to use dialogic instruction to teach language awareness, she said:

My instinct is to make [language lessons] a more traditional lesson, because it's something that they don't have a lot of familiarity. It's like, there's still a time and a place for direct instruction. You're teaching them something new that they don't know. Maybe it's just my own comfort level with it. (Martina, TWG 7)

With her acknowledgement that her own “comfort level” was impacting her beliefs, Martina revealed that she was grappling with two competing beliefs. Her developing beliefs about the importance of creating opportunities for student talk interacted with other beliefs about students' capabilities. She expressed the opinion that students had more relevant background knowledge about semantics than about morphology and syntax. In April, Martina shared that she felt that it was unproductive to give students time to discuss the meaning of morphology or syntax concepts, “because they usually don't have as much of a concept, and then it's just like nonsensical talking, and not meaning making, so I want to get on to the meaning” (Martina, debrief 5). While she felt that student talk was important, she doubted that students could learn much through talking about language. Within her own learning system, she was harboring diverse viewpoints. Despite making changes to her practice, she continued to view her role as a teacher in fundamentally the same way. That is, she believed that it was her job to provide students with direct instruction about language, because she had information that

her students needed. In keeping with this belief, her language instruction remained generally teacher-centered, with isolated moments of student-centered discourse. Conditions would need to change and different mechanisms would be needed to precipitate a radical transformation.

Stage Two: Learning under Transformation Conditions

In May, things changed. Conditions shifted slightly, enabling a perturbation to trigger a radical transformation. Below I offer a causal explanation of the control parameters and mechanisms that led Martina to transform her beliefs and practices for teaching language to bilingual learners. I argue that this causal explanation can fruitfully be used to understand how incremental learning can turn into radical transformation, not just for Martina, but for other teachers under similar conditions.

Changing Control Parameters

The lower half of Figure 5 depicts Martina's learning conditions during Stage 2. A direct comparison with the top half reveals that only three parameters changed between Stage 1 and Stage 2: congruence between the professional development- and teacher-level systems, congruence between the professional development - and school-level systems, and connections among experiences. The other control parameters remained the same. At the school level, Martina continued to have some opportunities for reflection and a moderately high degree of autonomy. At the teacher level, she continued to employ metacognition and make a habit of reflection. However, while only three parameters changed, the weight of these parameters clearly moved to the upper ends of the continua, creating conditions in which transformative learning was possible.

Connections among experiences. Martina's learning system, which was characterized by a moderate degree of connectivity among experiences during Stage 1, became even more connected as the year progressed. In January, Martina enrolled in a semester-long course on skillful teaching. She used course assignments to bridge the divide between information from the course and her own practice. For instance, as her interest in dialogic forms of instruction was growing, due to the dual focus in the teacher working group and school-level learning system, Martina decided to bring her Language Awareness and Dialogic Reasoning work into the skillful teaching course. For a course assignment on mastery objectives and criteria for success, she selected a dialogic reasoning lesson to analyze. This example illustrates how Martina established new connections between her system and other systems, and between elements within her learning system. While her experience with the Language Awareness and Dialogic Reasoning project could have remained separate from her experience in the skillful teaching course, she intentionally connected these experiences. She acted similarly as she collaborated with a 4th grade colleague to develop a presentation about the relationship between social-emotional learning and academic language learning for a local educators' conference. For her portion of the presentation, Martina decided to use dialogic reasoning videos from her Language Awareness and Dialogic Reasoning groups. She created yet another connection, a channel through which information could travel between her experiences, practice, knowledge, and beliefs. The increase in within- and across-system connectivity contributed to the emergence of transformation conditions.

Congruence of professional development system, school-level system, and teacher learning system. As connectivity increased, there was a corresponding increase

in the amount of information about student talk that was entering Martina's system. As discussed above, redundant messages are more powerful than isolated messages. In the winter, Martina was well aware of the congruence between the information in the teacher working group and the school learning system, which, as discussed above, increased throughout the winter. By May, not only was she thinking about dialogic instruction through her work with the Language Awareness and Dialogic Reasoning project and talking about extended discourse with her colleagues on the ESL team, but she was also receiving redundant messages from additional sources.

One source was her collaboration with the colleague with whom she developed the conference presentation. According to Martina, this colleague's classroom was notably more student-centered than others in the school. Students routinely engaged in conversations with one another about academic topics, while the teacher generally played a facilitative role in the classroom. As Martina spent time in this teacher's classroom and collaborated on the presentation, she saw firsthand an example of what a truly student-centered classroom could look like. The second source was the course on skillful teaching. At the beginning of May, Martina was assigned two readings about creating student-centered classrooms, in which students do most of the talking. Martina was thus thinking about student learning through talk in four discrete arenas. As she described it, "I'm fortunate for these opportunities and even, and it's really cool that they like overlap too, and like reinforce one another" (Martina, May meeting). This overlap can be understood as a powerful redundancy. As Martina said, these four redundant experiences "reinforced" each other, taking on great weight within Martina's learning system.

Transforming Beliefs and Practices: Learning during Stage Two

Under these conditions, Martina's learning system was primed for transformation. This transformation was brought about through several complex, contingent, causal learning mechanisms including the recognition of internal discrepancy, questioning assumptions, and the development of a new theory. I analyze the mechanisms and the changes that they triggered below.

Martina's radical change began with a perturbation. Rejecting a linear logic in which a line-based series of events is seen to lead to a major change, complexity theorists (e.g. Cilliers, 2008; Morrison, 2008) have used the metaphor of a pile of sand to explain how radical transformation occurs in a complex system. As with the grains of sand added to the pile, events in a complex system accumulate, until one final perturbation triggers an avalanche. This perturbation should not be understood as the cause of change, but rather as the trigger, which finally disrupts the system and precipitates a transformation. Within a teacher learning system, a perturbation is often an event that surfaces dissonance or cognitive conflict (Opfer & Pedder, 2011). Cognitive dissonance occurs when a teacher becomes aware of a discrepancy within elements of her learning system. For instance, an experience may introduce her to an idea that differs from and makes her question her knowledge and beliefs, or it may surface a discrepancy between her espoused beliefs and enacted practices. While some researchers have found that the dissonance may be so great that teachers revert to the status quo (e.g. Coburn, 2001; Remillard & Bryans, 2004), my analysis suggests that, under transformation conditions, a perturbation can lead teachers to change dramatically in order to reconcile discrepancies.

For Martina's learning system, reading the two articles on student-centered instruction for her course on skillful teaching was a perturbation, the final event that

triggered the avalanche. *Never Say Anything a Kid Can Say* (Reinhart, 2000) is a brief article written by a middle school math teacher that describes a metamorphosis in his pedagogical practices, from teacher-centered instruction, to student-centered instruction, and from sage to facilitator. *24 Operating Principles and the Verbal Behaviors that Go with Them: Cultivating Classroom Discourse to Make Student Thinking Visible* (Saphier & Haley-Speca, 2015) is a three-page list of behaviors that teachers can use to create an environment of student-to-student discussion. After months of considering student-centered teaching practices, revising her beliefs about the role of talk in the classroom, and tweaking minor aspects of her practice, the data suggest that these two readings perturbed Martina's learning system. These articles would not have functioned as a perturbation for every teacher, or even for Martina, if conditions had been different. Had she read the articles a few months earlier, before spending hours discussing student-centered instruction in teacher working group sessions and with her ESL teacher colleagues and experimenting in her classroom, it is likely that the articles would not have triggered the same transformation. However, many redundant experiences over the course of six months had increased the congruence and connectivity among the teacher-, school-, and professional development-level systems. Under these new conditions, reading two articles that reiterated the same ideas that were already on Martina's mind was merely the final experience that triggered radical change.

The complex, contingent, causal mechanisms that brought about transformational learning emerged through reflection, like the mechanisms that supported informational learning. However, transformation conditions enabled qualitatively different reflections. Martina engaged in critical reflection, a form of reflection in which people critique the

assumptions underlying their beliefs (Mezirow, 2000). As she reflected critically, three mechanisms operated in conjunction to bring about transformative learning. The first mechanism was the recognition of internal discrepancy, or a lack of alignment between her teaching practice and her beliefs. Martina explained, “I think those articles, those two readings, like really kind of struck me, and I’m trying to take them more, put them more into practice, not just like believing them to be good teaching” (Martina, interview 2). In this comment, Martina acknowledged the dissonance within her learning system, in which her beliefs about “good teaching” were not fully enacted in her practice. Reading and reflecting on the vivid vignettes and concrete teaching moves in the two assigned texts alerted Martina to this dissonance.

The recognition of an internal discrepancy set into motion another mechanism, which was questioning her assumptions. According to Mezirow (2000) assumptions tend to be acquired uncritically during childhood, through a process of socialization, in the context of relationships with parents, teachers, and other authority figures. They are then reinforced through the lifetime as people interpret their experiences through the lens of early assumptions. When people open these assumptions to critique, they may have to reject not just their beliefs and practices that are aligned with those beliefs, but they may also have to reassess many past experiences. In complexity terms, critical reflection causes a learning system to rid itself of certain elements, and alter others. The remaining system elements self-organize to fill the void, and a new set of beliefs and practices may emerge to replace the old.

When Martina read the two articles on student-centered teaching, she experienced cognitive dissonance, as the articles surfaced discrepancies in her learning system. She

recognized that the classrooms described in the article did not correspond to her own classroom. Although she had spent the past six months developing strong beliefs about the importance of student talk and adapting her practice to allow more space for talk, she had done so without questioning the assumptions underlying her conception of the role of a teacher. The articles made her realize that a wide gap remained between her practice and a truly student-centered classroom. This dissonance led her to question her assumptions about the role of the teacher in a student-centered classroom. She realized that her beliefs and practice had been rooted in images of teaching acquired during her own history as a student in teacher-centered classrooms and as a student of education (Martina, May meeting notes). She began to question the assumption that she had developed along the way that the teacher must play the role of expert and font of knowledge. The articles gave her concrete examples of classrooms that functioned well when students were positioned as sources of knowledge. Through critical reflection, long-buried assumptions in Martina's learning system interacted with new sources of knowledge and recent experiences. As information was exchanged within the system, her assumptions about the role of the teacher were overturned by the counter examples offered by more recent experiences. Ultimately, Martina rejected her assumptions about the role of the teacher, and with these assumptions, some of her beliefs began to crumble.

As Martina rejected one set of beliefs, there was another mechanism that supported the emergence of a new set of beliefs. This mechanism was the development of a new theory. She volunteered that she had a "theory brewing" about the kind of pedagogy that would promote deep learning:

We should be taking more time to teach the skills, and we should be teaching way less curriculum and really slowing down instruction like, ‘How do you do this?’ not like, ‘This is what you are going to do and this is how you are going to get there.’... And when kids talk about it, that is a way to get there. (Martina, May meeting notes)

With this theory Martina rejected a transmission model of teaching and learning which assumes that students will learn when the teacher uses direct instruction to pass on knowledge to students. In its place, new beliefs were emerging about the importance of teaching for deep understanding and transfer, through engaging students in dialogue.

This theory was a transformation. Martina’s initial belief that direct instruction using a gradual release of responsibility model was the most appropriate approach for teaching language skills had been replaced by a new belief that dialogic instruction was the ideal method of teaching. She explained her new ideal: “It’s basically establishing your classroom culture as one where the teacher really is just facilitating, except for the time of course when he or she is teaching like explicit skills” (Martina, May meeting notes). She embraced a belief that students should be doing the majority of the talking in a classroom. While she continued to believe that the teacher needed to teach some skills explicitly, she held that once the teacher “front-loaded” instruction, she should then move into a facilitative role, giving the students time to talk about whatever they were learning in order to construct their own understanding (Martina, interview 2). She continued to prioritize students’ individual academic language development, but believed that students could learn from one another, not just from their teacher. Thus the teacher should facilitate in such a way that students “were responding to one another's ideas more, rather

than a back and forth” between the teacher and an individual student (Martina, interview 2). This was a radical departure from her initial understanding of dialogic instruction as an exchange in which a teacher draws out an individual student. Through critical reflection, Martina had recognized an internal discrepancy, questioned her assumptions, and developed a new theory of teaching and learning. As her beliefs transformed, so too did many, but not all, of her practices.

By the end of May, Martina’s pedagogy during lessons that involved dialogic reasoning, semantics, and morphology was transformed. No longer was she positioned as the only authority in the room, but students were now at the center of many activities, interacting with one another and with Martina. For instance, Martina’s final dialogic reasoning lesson in May differed dramatically from the initial lesson in December, during which she had played the role of an intermediary, repeating students’ ideas in order to make them comprehensible to one another. By May, Martina’s facilitation was oriented toward encouraging students to engage in dialogue with one another. She did not repeat students’ ideas even once. Instead, she encouraged students to listen carefully and to respond directly to one another. For instance, she coached Antonio to better communicate with Jennifer: “Listen and if she misunderstood, you can have a chance to clarify what you said. [To Jennifer] Can you repeat why you disagree with Antonio?” (Martina, observation 10). In this instance, her practice closely corresponded to her espoused belief that the role of the teacher was to facilitate conversation between students.

Martina also acted in accordance with her new beliefs in some of her language lessons. For instance, she began to create more space when teaching semantics for students to explore the meaning of words dialogically. This is obvious through a direct

comparison of two semantics lessons in which students created a word web to explore the relationship between words. The lesson plans gave the same directions: “Guide students to create a word web showing words associated with these terms. How are these words similar? How are they different?” In January, Martina modeled the activity on the board and then asked students to work silently, adding words to their individual graphic organizers. After a few minutes, Martina had students suggest words from their individual word webs to add to the word web on the board (Martina, observation 2). In May, instead of having students work individually, she gave each student a marker and asked them all to write their ideas on a single piece of chart paper that she laid across the table (Martina, observation 8). As they worked, Martina questioned them about the words that they were adding, and encouraged them to listen and respond to each other’s contributions. She had altered the structure of the lesson in keeping with her new belief on the value of students constructing knowledge through dialogue with each other. When asked about the difference between the two lessons, Martina explained:

At first the word web, I was doing on the board and they were just copying from the board onto their papers, and there wasn’t a lot of dialogue going on. I found that when I made it so it was like more co-created on the anchor chart, then they were responding to one another’s ideas more, rather than a back and forth between me and one student at a time. (Martina, interview 2)

Prioritizing this back and forth between students, Martina deviated from the lesson plan in order to make space for student-to-student dialogue. She was teaching in accordance with her new theory about dialogue as a means to promote deep learning.

Lastly, Martina's morphology instruction underwent a similar transformation, as she enacted her new theory of student learning through talk. In May, I observed her implement a lesson on the suffixes *-tion* and *-sion*. The lesson plan as written followed the same formula as all the other morphology lesson plans in the Language Awareness and Dialogic Reasoning curriculum, using direct instruction to introduce a new morpheme. However, Martina rejected this approach. Instead of explaining the concept, she laid out vocabulary cards containing pairs of words (e.g. adapt/adaptation; immerse/immersion; communicate/communication) in the center of the table for students to see, and then asked, "What changes in all of these cards? How does the word change when it starts as a verb and becomes a noun?" (Martina, observation 8). Students began to share their observations, while Martina asked guiding questions to help students notice the suffixes in each of the nouns and figure out how the suffix changed the words. When I asked her about this section of the lesson, she explained:

I wasn't just reading them the definition of the suffix. I was trying to have them arrive at it on their own, like in the meantime clearing up any confusion, trying to support them in their understanding of what it was. (Martina, interview 2)

Rather than using direct instruction to tell students the meaning of a word or morpheme, as she did in her morphology lessons in the winter, Martina began with dialogic instruction, letting students explore the meaning on their own, only stepping in with information when it became clear that students were confused or uncertain. Abandoning the belief expressed in April that having students talk about morphology concepts was unproductive and that the teacher needed to play a central role, she had transformed her practice in keeping with her new belief about the role of teacher as facilitator.

Even though Martina transformed her pedagogy in the lessons she taught involving dialogic reasoning, semantics, and morphology, other aspects of her practice remained unchanged. This is the case because radical change does not equate to a complete dismantling of the status quo within the system (Byrne & Callaghan, 2014). Thus, even as elements of Martina's learning system transformed, the status quo remained in place in some parts of the system. For instance, she continued to teach syntax lessons in the same way all year. Why was this the case? How could her learning system undergo radical change without impacting her syntax instruction? While her learning system changed radically, it is important to recognize that it did not disintegrate. The system still consisted of many of the same elements, just organized in a new way, for instance with more connections and a faster flow of information between Martina's beliefs about student talk and her practices for teaching semantics, morphology, and syntax. One of the system elements that weathered the transformation was Martina's long-standing belief in the importance of students developing the basic building blocks of language. While this belief had become less of a priority since the fall, and was increasingly disconnected from other elements in Martina's learning system, it was still part of the system. Similarly, she still believed that students needed to be taught some skills explicitly. As described above, her beliefs about which skills needed to be taught explicitly had altered through feedback loops, as she saw students developing semantic and morphological understanding through talk. However, the belief had not gone away.

At the end of the school year, Martina's belief that syntax should be taught through direct instruction remained static. The data suggest that this could have been due in part to one control parameter: connections between experiences. The professional

development system included little information about syntax. During teacher working group sessions, we focused more on dialogic reasoning, morphology, and semantics than on syntax. Only one session addressed syntax instruction. Similarly, Martina was not taking part in conversations about syntax with colleagues in the school learning system. Syntax was not taught formally at Bilingüe, except through the Language Awareness and Dialogic Reasoning curriculum. For the most part, Martina's knowledge of and beliefs about syntax instruction came from her own education, in which she presumably experienced traditional models of grammar instruction. Martina's experiences with syntax were relatively disconnected from her other experiences, separated from the new theories of teaching and learning that had emerged within her transformed system. This disconnection may help to explain why the transformation in other parts of Martina's learning system did not impact her syntax teaching practices.

This lack of connectivity provides some explanatory insight into why Martina could discuss syntax in a teacher working group session, but not incorporate ideas from that discussion into her practice. During the April session, Martina analyzed a syntax lesson plan from the Language Awareness and Dialogic Reasoning curriculum with a small group, facilitated by Jada. The group discussed ways to modify the plan, which used direct instruction and emphasized accurate language use, to better promote metalinguistic awareness through dialogue. Martina participated actively in the discussion, responding to ideas from Jada and her colleagues and suggesting several of her own. For instance, she suggested questions that a teacher could ask to promote metalinguistic awareness, such as, "Why do writers put two clauses together instead of leaving two separate simple sentences?" (Martina, TWG 8). She also volunteered ways

that a teacher could draw out students' ideas and could encourage students to engage with each others' ideas. Despite Martina's participation during this activity, it seems that Martina did not connect the ideas discussed in the group with her own practice.

In contrast to the redundant information about promoting student talk and developing semantic awareness that was entering Martina's learning system through multiple interactions, her system was receiving little information about syntax from the professional development- and school-level systems. In the absence of rich connectivity and a fast rate of information flow, Martina was unlikely to engage in reflection about teaching syntax, through which she would have considered ideas from professional development in relation to her own practices. By the time she implemented the syntax lesson in late May, almost two months after analyzing it, she may have had little recollection of the lesson analysis activity. Whatever the reasons, she taught the lesson in just the same way that she taught initial syntax lessons in the winter (Martina, observation 9). She used direct instruction to introduce the terms *clause*, *compound sentence*, and *conjunction*, without asking a single question to prompt metalinguistic understanding, like those that she had brainstormed with her colleagues. Throughout the lesson, Martina primarily used an Initiation-Response-Evaluation turn-taking pattern (Rymes, 2015), in which she asked known-answer questions to check students' application of the concepts and evaluated their answers. She did not provide students with opportunities to articulate their understanding or to interact with each other's ideas. This was dissonant with her new beliefs that students make meaning through talk and that teachers should play the role of facilitator. Instead, it corresponded to her initial beliefs that the basic building blocks of language should be taught through direct instruction.

This example illustrates the limits of change, even under transformation conditions.

When a system self-organizes in dramatically new ways, elements that were not richly connected to other elements can remain unchanged. The transformation remains partial.

Throughout the chapter I laid out a causal explanation of Martina's learning process over the course of 2016-2017 that highlighted the control parameters and mechanisms that contributed to her learning. I first analyzed those parameters and mechanisms that, in conjunction, led to her initial informational learning and incremental changes, and, second, those that ultimately brought about transformational learning and radical change. Along the way, I carefully specified the details of Martina's circumstances in order that this causal explanation might be generalized to other teachers in similar conditions, with similar control parameters. This causal explanation challenges the widely-embraced linear model that posits that professional development leads teachers to change their practices, resulting in improved outcomes from students (Desimone, 2009; Guskey, 2002). Martina's learning process, with its redundancies and reflective feedback loops, its coexisting transformations and stasis, was anything but linear.

CHAPTER SEVEN

Rethinking Teacher Learning with a Complexity Analytic Framework: Implications for Theory, Research, Practice, and Policy

Professional development is widely viewed as a key lever for school change. The common theory of change posits that professional development can lead to improvement in teachers' classroom practice and ultimately to improvement in students' learning outcomes (Desimone 2009; Guskey, 2002). It is estimated that \$18 billion is spent annually on professional development in the United States, and a typical American teacher devotes 89 hours a year to professional learning activities (K-12 Education Team, 2015). Much professional development is local, including district-sponsored workshops and courses, as well as job-embedded, school-based structures such as instructional coaching and professional learning communities. Many outside providers are also involved in professional development, including non-profit and for-profit organizations focused exclusively on professional development, independent consultants, universities, publishers, teachers' unions, education technology companies, and more. When deciding on a path for professional learning, teachers, schools, and districts are thus faced with an overwhelming number of options in regard to the content, format, and provider of the professional development.

During the past twenty years, many researchers have sought to evaluate various models of professional development and to identify key features that are associated with improved outcomes (e.g. Garet et al., 2001; Heck et al., 2008). As I discussed in Chapter Two, there is a growing consensus about several features of professional development

that are associated with improved outcomes (e.g. Darling-Hammond et al., 2009; Desimone, 2009). This body of research suggests that professional development should be content-focused, with the goal of increasing teachers' content knowledge and/or pedagogical content knowledge, and should incorporate active learning opportunities that require teachers to engage with ideas and practices (e.g. Desimone et al., 2002; Garet et al., 2001). Furthermore, it should be consistent with other school, district, and state initiatives and reforms (e.g. Cohen & Hill, 2011; Garet et al., 2001) and should last for an extended duration (e.g. Heck et al., 2008; Supovitz & Turner, 2000). Finally, many researchers have found that collective participation of teachers from the same school, grade, or department is correlated with teacher learning (e.g. Garet et al., 2001; Penuel et al., 2007). Desimone (2009) terms these five characteristics "critical features."

Despite the growing consensus about what constitutes quality professional development, other researchers have found significant variation in teacher learning, even when teachers participate in professional learning activities that include these critical features (e.g. Kennedy, 2016; Spelman & Rohlwing, 2013). This variation is only surprising when teacher learning is conceived of as a linear process, with professional development as the cause and learning as the effect. In this dissertation, I reject a linear view of teacher learning. Following Opfer and Pedder (2011), I conceptualize teacher learning as a complex system that evolves through the interaction of three overlapping, interconnected complex systems, namely an individual teacher's learning system, a particular school-as-system, and a professional development activity-as-system, all of which are situated within macro-level, sociopolitical systems. Complex systems do not behave in predictable ways. Thus, variation in teacher learning is to be expected.

In Chapter Two, I employed Opfer and Pedder's (2011) conceptualization of the three overlapping complex systems involved in teacher learning as an organizational frame to synthesize the literature on professional development. Although few of the studies that I reviewed conceptualize teacher learning in this way, by framing the review in this manner, I was able to put distinct bodies of literature in conversation with one another, illuminating gaps in the research. At the level of individual teacher learning systems, researchers have found that teachers' learning through professional development is influenced by the knowledge that they bring to the professional development (e.g. Brownell et al., 2014; Wilson et al., 2014), their beliefs about teaching and learning (e.g. Remillard & Bryans, 2004; Supovitz & Turner, 2000), their past experiences as students and teachers (e.g. Bransford, 2000; Drake et al., 2001), and their current teaching practice (e.g. Coburn, 2001; Fore et al., 2015). At the level of the school-as-learning system, researchers have analyzed how the schools where teachers work shape the conditions under which they experience professional development. Some of the school-level factors that have been shown to impact teacher learning include the demands on teachers' time (e.g. Datnow, 2011; Mouza, 2009), collective orientations and beliefs about teaching and learning (e.g. Coburn, 2001; Gehsmann & Woodside-Jiron, 2005), the degree of autonomy that teachers are granted within their classrooms (e.g. Achinstein & Ogawa, 2006; Brownell et al., 2014), and school-wide learning priorities (e.g. Firestone et al., 2005; Li et al., 2016). While many researchers have identified particular professional development-level, teacher-level, or school-level factors that seem to impact teacher learning, little research looks at the intersection of the three complex systems. There is a

critical need for more research that examines teacher learning holistically, exploring the learning of particular teachers in specific contexts.

The intention of this dissertation was to explore the learning processes of two teachers from the same school who were participating in the same professional development initiative in order to shed light on the complex constellation of factors that impact learning. By developing causal explanations that accounted for the conditions and mechanisms of teacher learning, I hoped to develop a more nuanced understanding of the relationship between teacher-as-system, school-as-system, and professional development-as-system. Ultimately, I hoped that this dissertation could move us closer toward an explanatory theory of teacher learning through professional development.

In Chapters Five and Six, I showed that the Language Awareness and Dialogic Reasoning professional development's impact on Kelly and Martina was dramatically different. Kelly underwent little change. Although she seemed to enjoy the teacher working group sessions and expressed the sentiment that she had learned a lot, an analysis of the data revealed almost no discernable change in either her practice or her beliefs over the course of the year. With Martina, on the other hand, beliefs and practices changed gradually and incrementally throughout much of the year, and then, in the final two months, major aspects of her knowledge, beliefs, and practice were transformed. Through my analysis of Kelly and Martina as systems, in the larger context of the Bilingüe School as a system and the professional development as a system, I identified a constellation of seven control parameters that worked in conjunction to establish professional learning conditions. My argument is that the differences in what and how much Martina and Kelly learned as well as in how they learned it can be understood

through an analysis of these parameters. These parameters therefore provide a useful analytic framework for analyzing teacher learning through professional development. In the next section, I develop this framework further through a direct comparison of Kelly's and Martina's professional learning experiences.

Toward a Complexity Analytic Framework of Teacher Learning Through Professional Development

The analytic framework for professional development learning conditions, first introduced in Chapter Five, is reprinted here as Figure 6 for easy reference. It includes seven control parameters, which are clustered as school-level, professional development-level, and teacher-level parameters. My analysis of Kelly's and Martina's experiences revealed significant differences across all of these parameters.

The school-as-system is not just the backdrop in which a teacher engages in professional development, but it structures the way that she can engage with professional development content. The extent to which she can learn and enact changes in her classroom is contingent upon the opportunities for reflection and the extent of autonomy that the school affords her. Although Martina and Kelly were colleagues in the Bilingüe School, these school-level parameters differed for them, due to their differing roles.

As a 4th grade classroom teacher, Kelly had a hectic schedule that required her to spend most of her day with 25 active children. During her limited prep time, she had to prepare five or six discrete lessons each day. Under these conditions, there was little time in which she could reflect on her teaching in relation to the ideas that she was thinking about during professional learning activities. Martina, on the other hand, had more opportunities to reflect due to her role as an ESL teacher. She taught smaller groups of

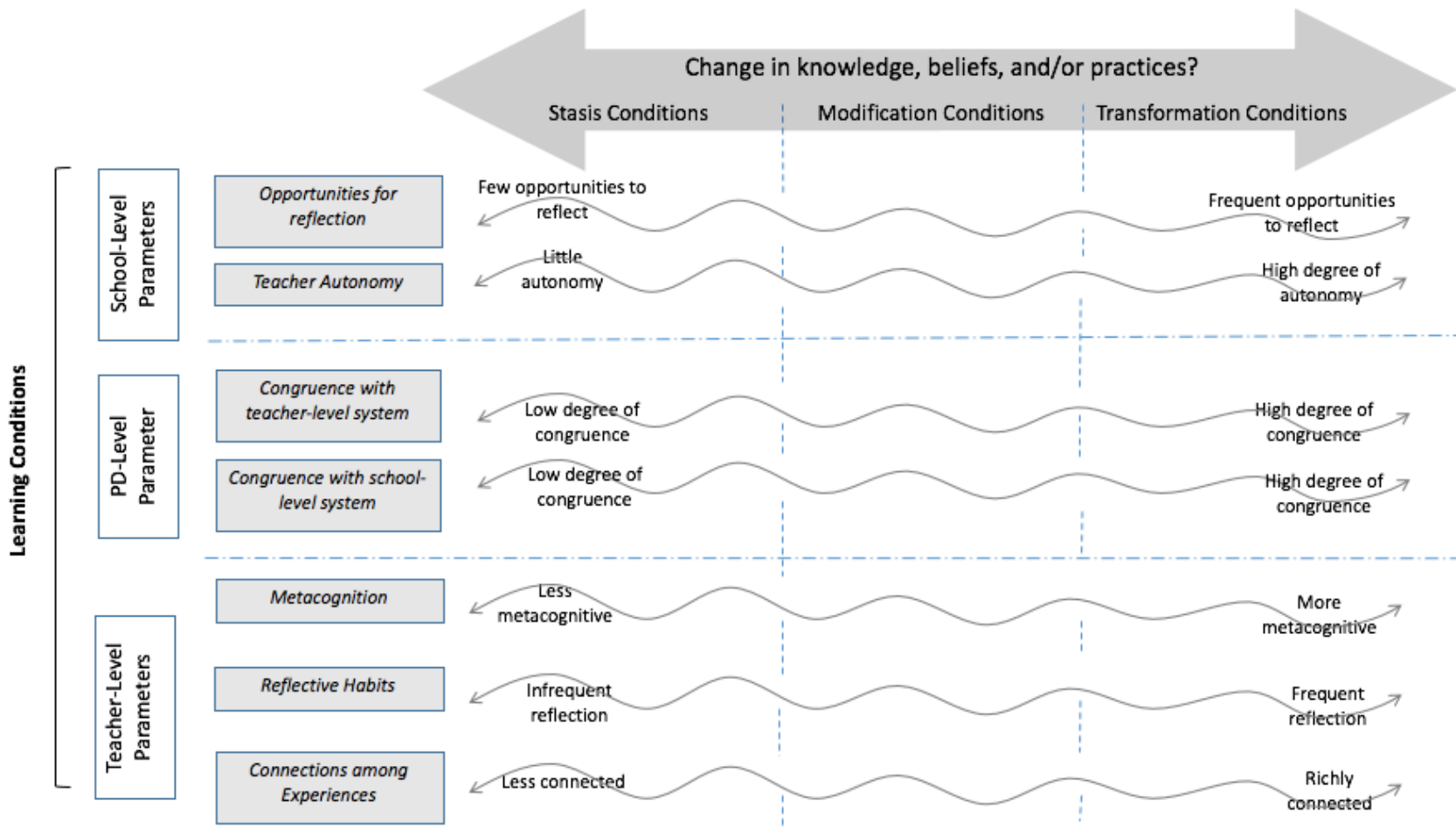


Figure 6. Analytic framework for professional development learning conditions

four or five students at a time, and she taught the Language Awareness and Dialogic Reasoning lessons twice, which offered a built-in chance to reflect as she readied herself for the second lesson. These school structures impacted the frequency with which the teachers were able to think about ideas from professional development, thus impacting the rate of information flow between the professional development system and the teacher-level learning systems. A higher rate of information flow fostered learning for Martina, while a slower rate hindered Kelly's learning.

Furthermore, Kelly and Martina experienced different degrees of autonomy. All teachers at Bilingüe had to stick to tight schedules, in order to stay synchronized with other teachers with whom they shared students. However, classroom teachers at Bilingüe had less autonomy than ESL teachers with regard to the curriculum that they taught. They were required to implement literacy, math, science, and social studies curricula that had been adopted at the district level. This made it almost impossible for Kelly to try out some of the ideas that were discussed during the teacher working group sessions. Not only was it hard to even fit in the Language Awareness and Dialogic Reasoning lessons among her other obligations, she also did not have the autonomy to independently modify the district-wide literacy curriculum in accordance with the principles of language-focused pedagogy. Martina, on the other hand, could teach what she wanted as an ESL teacher. She was able to prioritize the Language Awareness and Dialogic Reasoning lessons and to incorporate the principles into other aspects of her practice as well. When the school-as-system offers more autonomy, teachers have the agency to adapt their practice on the basis of ideas from professional development. A higher degree of autonomy allows teachers an opportunity to make connections between their experiences

in professional development and other elements of their learning systems. Whether they actually make connections is contingent upon professional development-level parameters.

At the professional development level, the most important control parameters shaping teacher learning conditions have to do with congruence, namely the degree of congruence between the professional development system, the school-as-system, and the teacher-as-system. Even if the school-level control parameters support teacher learning through professional development, the teacher is unlikely to learn much if the professional development itself is not a good fit with the school context and/or with the teacher's own learning system. As discussed in previous chapters, optimal learning conditions necessitate both diversity and redundancy among agents within a system (Davis and Sumara, 2005). Diversity, or variation, is the source of new ideas. In order for a teacher to learn through professional development, other agents in the system must hold ideas that are different from her own, which she can learn from. However, system agents must also have enough redundancy, or common ground, that they can communicate effectively. The teacher must have enough in common with other agents in the professional development system, including the facilitators, that she can exchange information with and understand the information she receives from the system.

The congruence among the teacher- and professional development-level systems depends on the relationship between a teacher's interests and needs and the professional development content. Other researchers have found that teachers are more likely to learn through professional development that they perceive as interesting, practical, and relevant (e.g. Cameron et al., 2013; Wetzels et al., 2016). While both Kelly and Martina considered the Language Awareness and Dialogic Reasoning project interesting, the

professional development was more closely aligned with Martina's needs than with Kelly's. Since she was required to teach set curriculum, Kelly hoped that she would have a chance to think about ways to infuse more language-focused instruction into that curriculum. However, this was not the main focus of teacher working group sessions. Thus, there was a low degree of congruence between Kelly's perceived needs and the professional development system. Martina, on the other hand, was eager for ideas about what to teach, since she was new to the ESL teacher role. The professional development was immediately practical and became even more congruent with her interests over the course of the year, as she developed increasing awareness of the role of talk in emergent bilingual students' language development.

Not only does congruence between the professional development- and teacher-level system impact teacher learning, so too does the degree of congruence between the professional development- and the school-level system. Researchers have found that teachers are more likely to learn when professional learning activities are congruent with school initiatives and reforms (e.g. Gehsmann & Woodside-Jiron, 2005; Penuel et al., 2007). A high degree of congruence means that teachers are more likely to receive support from administration to implement what they have learned. Furthermore, teachers can better understand ideas from professional development that are congruent with information in the school-as-system. As I discussed in Chapter Four, there was some congruence between the Bilingüe school-as-system and the Language Awareness and Dialogic Reasoning professional development system, given that both systems prioritized increased opportunities for emergent bilingual students to talk about academic content. However, the school and the professional development system had different and in some

respects dissonant visions for how student talk should be structured and for what role the teacher should play. The dissonance was greater for Kelly. Her knowledge, beliefs, and practice had been influenced by a school-based professional development initiative a few years earlier on *Academic Conversations*, which promoted carefully controlled conversations between pairs of students. In contrast, we facilitators encouraged small group conversations in which students and the teacher all talked freely. Martina experienced a higher degree of congruence, because she was concurrently participating in an ongoing exploration of extended discourse with the schools' other ESL teachers. As the year went on and she was involved in conversations related to dialogic instruction in both systems, the congruence between the two systems increased.

In complexity terms, a high degree of congruence among the teacher-, school-, and professional development-level systems can be understood as fostering connections within and between systems. Information in the school- and teacher-level system can be connected to congruent information within the professional development-level system. Redundancies permit information to be exchanged easily and effectively. As this information is exchanged, shared language and concepts make it possible to identify and examine diverse perspectives, creating a space for emergence. Whether these connections are actually created, and whether emergence ultimately occurs under these conditions, depends on teacher-level control parameters.

I found three teacher-level parameters that impacted how the teacher's learning system interacts with the information in the professional development system. Namely, these are metacognition, reflective habits, and connections among experiences. Metacognition allows an individual to approach potential learning experiences

strategically, by planning, monitoring, and coordinating learning. In any potential learning situation, an individual may employ more or less metacognition. Kelly used relatively few metacognitive strategies during the teacher working group, which may be related to the lack of congruence between her needs and the professional development content. Although we did devote a teacher working group session to exploring how to facilitate dialogic reasoning discussions, an area about which Kelly wanted to learn, she did not employ much metacognitive regulation during that or other sessions. For instance, she did not take notes during teacher working group sessions, a practice that she described as essential for her to remember what she learned. Martina, on the other hand, demonstrated high levels of metacognition throughout the professional development experience. She was aware of gaps in her knowledge and skill. Since the professional development was congruent with both her needs and the school context, she intentionally employed learning strategies during teacher working group sessions such as asking questions to fill in knowledge gaps. As a result, metacognition enabled Martina to forge new connections between the knowledge, beliefs, and practices in her learning system and the information in the professional development system.

Additionally, a habit of reflection is another teacher-level control parameter that shapes how a teacher's learning system interacts with and learns from the professional development system. While school structures create or limit opportunities for reflection, what the teacher does with those opportunities varies from teacher to teacher. When teachers reflect regularly, they foster connections and a fast rate of information flow among their knowledge, practice, beliefs, and experiences. Regular reflection creates feedback loops through which learning occurs. For Kelly, reflection was crowded out by

more pressing concerns, and she did not find a way to make a regular habit of reflection. Conversely, Martina reflected habitually. She reflected on ideas from professional development when preparing new lessons, and she reflected on how her previous lessons had gone when readying to teach them a second time and when preparing similar lessons. Her reflections were a source of continual feedback on her practice, knowledge, and beliefs.

My analysis revealed one additional teacher-level control parameter impacting learning, which is the extent of connection among a teacher's experiences, in the sense that a teacher thinks about one experience in relation to another. This parameter overlaps with congruence. For the professional development to have a high degree of congruence with the teacher's learning system, the teacher has to be able to make connections between the professional development and her classroom experiences. Likewise, for professional development to have a high degree of congruence with the school-level system, it has to be related to school-level priorities. When this is the case, a teacher is likely to make connections between the professional development system and other professional learning activities that are part of the school's initiative. Connections among experiences also include experiences that are unrelated to professional development, as the richer the connectivity among experiences, the more that the teacher's learning system can learn and adapt from new information. Kelly's and Martina's learning systems were both initially characterized by a moderate degree of connectivity among experiences. As the year progressed, Martina's experiences became increasingly connected, as student talk became a focus of multiple activities in which she was involved, including a different professional development course and a conference

presentation. These connections were all channels through which information could travel.

What I am asserting in this dissertation is that, in conjunction, multiple control parameters create the learning conditions under which a teacher experiences professional development. Figure 7 consists of three schematic diagrams of teachers' learning systems under different conditions. Although it is impossible to capture a complex system with only a few dots and lines, these diagrams represent key differences among teachers' learning systems. The three circles depict individual teachers' learning systems. The black dots represent system agents—experiences, practices, beliefs, and knowledge. The lines connecting the dots show neighbor interactions among agents within the system, and the bi-directional arrows at the top represent interactions between the teacher's learning system and other systems. The thickness of the lines and arrows suggests the rate of information flow; thicker lines signify a faster rate.

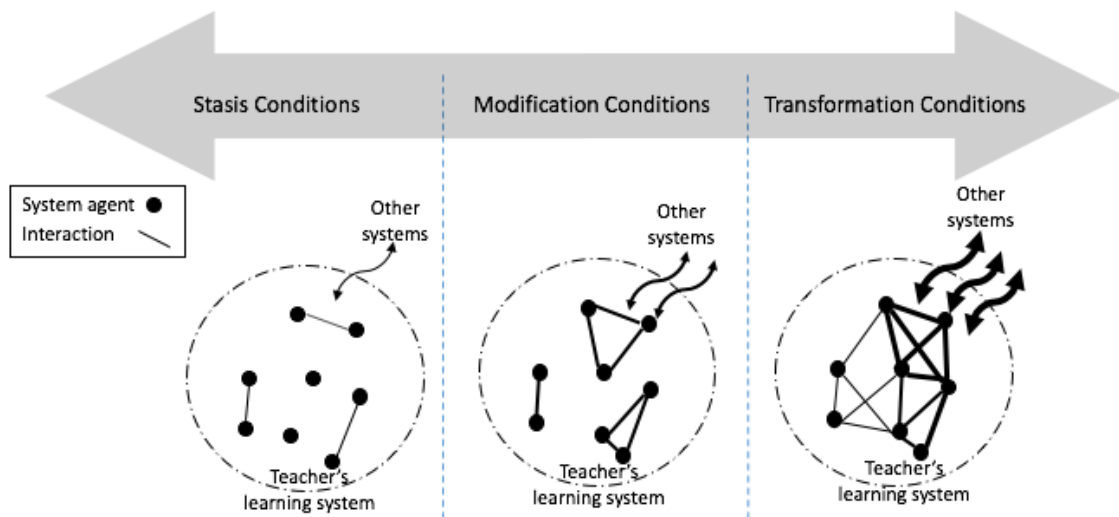


Figure 7. Schematic diagrams of teachers' learning systems under stasis, modification, and transformation conditions.

From left to right, the learning systems in Figure 7 have increasing internal and external connectivity, and a faster rate of information flow, due to the control parameters described above. The diagram on the left depicts a teacher's learning system under stasis conditions. The system is shaped by relatively little use of metacognition, disconnected experiences, infrequent reflection, a low degree of autonomy, and a low degree of congruence among the teacher-, school-, and professional-development level systems. Together, these control parameters result in a system in which elements are connected to few if any other elements, and information flows slowly. Moreover, little information is exchanged with other systems. In this system, under these conditions, learning is difficult.

In contrast, the diagram on the right, which depicts a teacher's learning system under transformation systems, looks very different. This system is shaped by a high degree of metacognition, a habit of frequent reflection, richly connected experiences, a high degree of autonomy, and high levels of congruence among the teacher-, school-, and professional-development level systems. These control parameters create a system in which elements are richly connected. Furthermore, information flows rapidly among many system elements, as illustrated by the thick black lines. The three, thick, bidirectional arrows flowing between the teacher-level system and other systems signify rapid exchanges of information between a teacher's learning system and multiple other systems. This is a system at the edge of chaos, with the potential for radical change at the system level.

These diagrams illustrate that the control parameters, in conjunction, result in very different learning conditions. The extent to which a teacher can learn through professional development is largely dependent upon these conditions. Stasis conditions

promote stasis, or a lack of learning; as long as stasis conditions persist, a teacher cannot learn much through professional development. Under modification conditions, informational learning can occur; a teacher can gradually and incrementally learn new practices or develop additional frames of reference. However, transformational learning, in which a teacher's learning system radically changes, is only possible under transformation conditions.

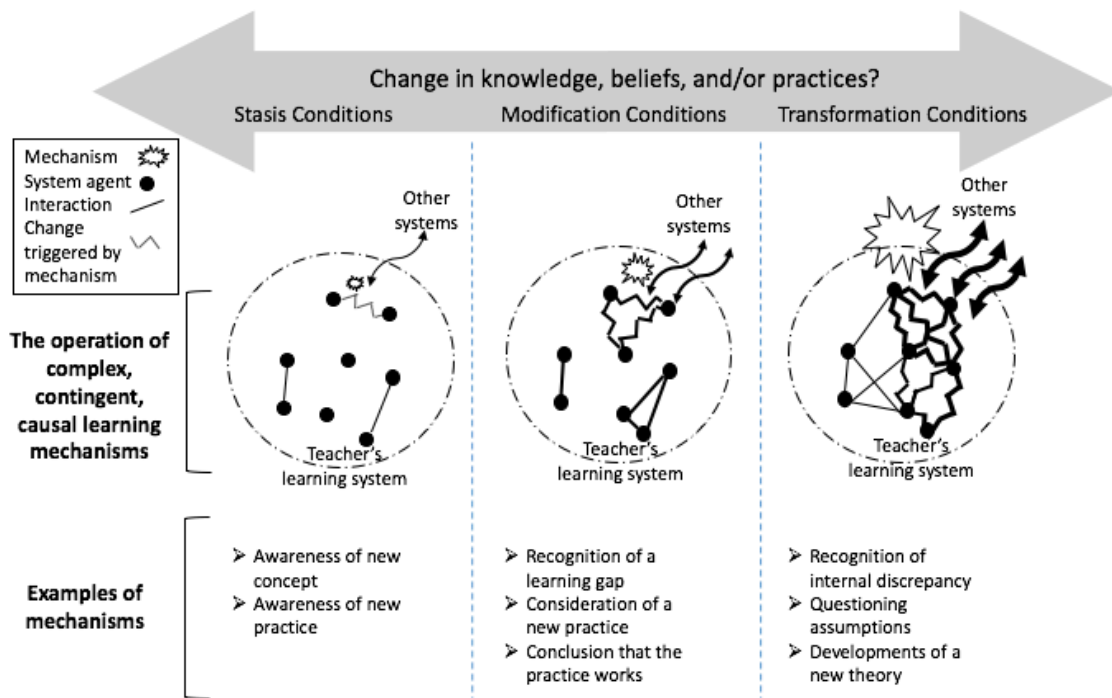


Figure 8. The operation of complex, contingent, causal learning mechanisms in teachers' learning systems under stasis, modification, and transformation conditions.

While the extent of learning is determined by these conditions, the conditions themselves are not the proximal causes of learning. Rather, complex, contingent, causal learning mechanisms trigger learning. These mechanisms operate differently based upon the conditions, as illustrated in Figure 8. Like Figure 7, this figure includes schematic

diagrams of teachers' learning systems under different learning conditions. However, this figure illustrates the operation of complex, contingent, causal learning mechanisms in teachers' learning systems. Little explosions represent these mechanisms to suggest that they induce self-organization within a learning system in unpredictable, nonlinear ways. Like a grain of sand that triggers an avalanche in a sand pile, new information in the system can reverberate from one system agent (the experience) to other connected system agents (knowledge, practices, beliefs), potentially changing multiple elements of the system. The zig-zag lines represent the resulting self-organization among specific system agents, while the explosion size corresponds to the amount of change that mechanisms can cause under those learning conditions.

The explosion under stasis conditions is tiny, as any learning through professional development that occurs under these conditions is insignificant. There is limited connectivity both within the teacher's learning system and between the teacher-level system and other systems, and information does not flow quickly. Thus, when a teacher is introduced to a new concept in professional development, her learning is limited. She may become aware of the new concept. If you ask her about it afterwards, she might be able to tell you about it, just as Kelly was able to assert her new knowledge that language-focused instruction could be integrated into other curriculum areas. Awareness of a new concept is a causal mechanism, in the sense that it is an event that alters the relations between two elements, namely Kelly's knowledge of language-focused instruction and her knowledge of curriculum. However, under stasis learning conditions, awareness is a weak mechanism, unable to trigger further change in the learning system.

Kelly's awareness of a new approach to teaching language did not lead to changes in her beliefs or practice.

Complex, contingent, causal learning mechanisms are somewhat stronger and can bring about more learning under modification conditions. Figure 8 represents this with a medium-sized explosion. As I have discussed, modification conditions occur when most of the control parameters are of moderate intensity. This means that teachers have some degree of autonomy, some opportunities to reflect, a reasonable degree of congruence among the professional development-, school- and teacher-level systems, and their experiences are somewhat connected. They also employ some metacognition and reflect with a degree of regularity. Under these conditions, an individual teacher's learning system has a moderate degree of internal connectivity and connectivity to other systems, and information flows at moderate speed, as depicted in the diagram. Thus, when a teacher is introduced to a new concept during professional development, changes to her knowledge, beliefs, and practice can follow. She is able to reflect on the new concept in relation to her knowledge, beliefs, practice, and experiences. As she reflects, contingent, causal mechanisms, such as recognition of a learning gap and consideration of a new practice, can trigger learning. During the first part of the year, these and other mechanisms altered the relations among Martina's knowledge, beliefs, and practices related to using dialogic instruction in specific types of language-focused lessons. In conjunction, over a period of time, they operated to bring about incremental, informational learning. Alongside her existing knowledge, beliefs, and practices, Martina added a new frame of reference for thinking about student talk and new pedagogical moves for engaging students in talk.

Shown in Figure 8 as a large explosion, the complex, contingent, causal learning mechanisms that can operate under transformation conditions are stronger still, with the potential to bring about radical change. Under transformation conditions, teachers reflect more and employ greater metacognition. They have the autonomy to make decisions about their teaching, their experiences are richly connected, and the professional development is congruent with both their needs and the school as a system. When these conditions are in place, information from professional development can trigger far-ranging and radical changes, due to the rich connectivity and fast rate of information flow within the teacher's learning system and between the teacher's learning system and other systems. The same mechanisms that cause informational learning under other conditions may still occur. For instance, a teacher might still consider a practice, conclude that it works, and add it to her repertoire. However, stronger mechanisms such as recognizing an internal discrepancy, questioning assumptions, and developing a new theory can cause transformational learning, as they did with Martina. She recognized that her practices were not in line with her beliefs about the importance of student talk, questioned her assumptions about teaching and learning, and developed a new theory about how students learn. These mechanisms caused radical changes to her teaching practice that extended to multiple contexts; not only did she transform her small group Language Awareness and Dialogic Reasoning lessons, but she also transformed the writing lessons that she co-taught with a 4th grade classroom teacher.

These same mechanisms could not have occurred during the first part of the year, under modification conditions. At that point, there was not enough congruence between Martina-as-a-system and the professional development system for information from

professional development to trigger the recognition of internal discrepancies or the development of a new theory. Martina viewed the Language Awareness and Dialogic Reasoning project as a source of curriculum material and ideas to add to her repertoire for teaching emergent bilingual learners, and no more. She was not particularly interested in learning about dialogic instruction at that point, and she had not yet had the multiple, redundant experiences discussing student talk that she would as the year progressed. Thus, Martina was probably not able to take in and reflect on ideas that differed significantly from her own. Only when her experiences grew more connected, and the congruence among the systems increased were Martina's experiences, practices, beliefs, and knowledge connected enough that strong mechanisms could make information from professional development reverberate throughout many elements of her learning system. Radical change occurred as these elements self-organized in response to this information.

In the remainder of the chapter, I discuss the implications of a complexity-based analytic framework for teacher learning through professional development. I address implications for theory and research. I take up the relationship between sociocultural theory and complexity theory, critique the existing literature on professional development effectiveness, and suggest directions for future research. I also consider implications for practice and policy, and provide suggestions for increasing the congruence among professional development-, school-, and teacher-level systems. In conclusion, I call for a paradigm shift in our approach toward professional development and argue that the analytic framework described above offers a useful lens for envisioning such a shift.

Implications for Theory and Research

This study has implications for the use of sociocultural theory and complexity theory in research on teacher learning. Sociocultural theory has been used much more frequently than complexity theory for such research. Therefore, I anticipated that it would be helpful throughout my research, as I would be able to build on the work of other scholars both to plan professional learning activities and to analyze the teachers' learning. However, I found sociocultural theory was only useful at the planning stage; at the analysis stage, it was ultimately limiting.

Building on Vygotsky's (1978) sociocultural theory of development, scholars have advanced concepts such as communities of practice (Lave & Wenger, 1991) and the Vygotsky Space (Harré, 1983) that help to explain human learning as a social process. Some professional development providers employ these concepts to design spaces and activities that are likely to foster teacher learning (e.g. Clayton & Kilbane, 2016; Kazemi & Franke, 2004; Percy et al., 2015). Likewise, as we researchers conceptualized the professional development, sociocultural theory informed our thinking. As described in Chapter Four, we conceived of the teacher working group as a community of practice, with the joint enterprise of understanding how to use a set of principles for language-focused instruction to foster learning for emergent bilingual students (Wenger, 1998). We considered how to create spaces for teachers to appropriate, transform, publish, and conventionalize new ideas about curriculum and pedagogy, in accordance with Raphael and colleagues' (2014) conceptualization of a sociocultural approach to professional development.

While sociocultural theory was useful when planning the professional development, it was not helpful in analyzing the variation among the participating

teachers' learning. I originally anticipated that the concept of the Vygotsky Space (see Figure 1, Chapter Two) would help me to explain the teachers' learning processes. Raphael et al. (2014) use the Vygotsky Space as a heuristic to explain how teacher learning occurs through an iterative, cyclical process when teachers participate collectively in ongoing professional development. Although this heuristic matches the learning experience of some teachers (e.g., Gallucci, 2008), my analysis showed that Kelly's and Martina's experiences deviated significantly from this pattern. For instance, while Kelly became aware of new concepts and practices that were introduced by the facilitators and discussed with her colleagues, she never appropriated them. As I have described, the particular configuration of control parameters shaping the intersection of her learning system with the school- and professional development-level systems created stasis conditions, under which she could not go through the cyclical learning process depicted in Figure 1. Although Martina did appropriate and transform some ideas from professional development, her learning process did not match the neat, cyclical process either. Her learning was greatly influenced by the congruence of the professional development with multiple, concurrent experiences. The Vygotsky Space does not account for the teacher-, school-, and professional development-level control parameters that create so much variation in teacher learning. Thus it is not useful for analyzing what actually happens when specific teachers from specific school contexts take part in that professional development.

In order to generate causal explanations of Martina's and Kelly's learning, I needed complexity theory. Rather than viewing learning as a social process and focusing on particular social and cultural activities in which learning would be predicted to occur,

I viewed learning as a complex system. Complex systems behave in unpredictable ways. Thus, understanding the nature of complex systems requires a holistic view. Only by viewing the teachers' learning systems holistically was I able to identify multiple, contingent, and varied causes of learning, as well as the conditions in which learning occurred.

In the last few decades, many education scholars have recognized the potential of complexity theory to offer insights into learning and teaching from nonlinear perspectives (Davis, Phelps, & Wells, 2004). Opfer and Pedder's (2011) framing of teacher learning through professional development as a complex system, evolving through the interactions of three systems (the teacher, the school, and the learning activity) created a lot of excitement. Some have used this framing to generate post hoc descriptions of the impact of professional development on specific teachers in specific contexts (e.g. Taylor, 2017; Walton, Nel, Muller, & Lebeloane, 2014; Wetzels et al., 2016). These studies demonstrate the utility of Opfer and Pedder's conceptualization and offer additional examples of how teacher learning occurs for different teachers in specific contexts. While this is useful, Opfer and Pedder argue that studies illustrating the variation in teacher learning are not sufficient. They call for research that enables us to make generalizations about the way that professional development activities relate to teacher learning that are true across multiple teachers in different school contexts. They suggest that the ultimate goal of research into teacher learning should be the generation of an explanatory theory of teacher learning that can "distinguish between those aspects of professional learning that are unique and those that are generalizable to other teachers and contexts of practice" (p. 394). This dissertation is a step in that direction.

While still a work in progress, the analytic framework for teacher learning through professional development that I have laid out here offers an approach that can be used to understand how professional learning contexts (created through the interaction of the professional development-, school-, and teacher-level systems) create conditions that foster either stasis, modification, or transformation. In conjunction, the seven control parameters in the framework establish the level of connectivity, the rate of information flow, the degree of redundancy and diversity, and the size of the power differentials within a complex system of teacher learning. The framework can be applied to any professional learning situation. Recognizing that learning can happen in a multiplicity of ways, I do not suggest that all teachers, schools, and professional development activities must have specific characteristics or features. Rather, I suggest that the clusters of parameters that foster stasis, modification, or transformation conditions may be generalized across multiple teachers in different school contexts. These parameters have to do with the interactions within and among systems, as opposed to any specific features. Thus, the framework can be broadly used to investigate teacher learning through a multi-level analysis of the relationship between the teacher, school, and professional development systems.

This study has implications for the direction of professional development research. As I have discussed, the most common focus of research in this field during the past two decades has been evaluating various models of professional development. Numerous small scale studies have assessed the effects of particular programs (e.g. Driessner & Stark, 2015; Haug & Sands, 2013), while large-scale studies have compared multiple programs in an attempt to isolate the features that result in improved outcomes

(e.g. Garet et al., 2001; Heck et al., 2008). In this tradition, Hill, Beisiegel, and Jacob (2013) proposed that the field of professional development research should undertake more cross-site studies in which the content would be held constant but features of professional development would be varied, in order to isolate the impact of specific features. They suggested varying features such as in-person versus online delivery of content.

My dissertation suggests that this focus may be misguided. While the professional development effectiveness research has helpfully raised awareness of some features that are associated with teacher learning, it is time to move beyond the focus on features to develop a better understanding of what works, for whom, and under what circumstances. To understand the limitations of a “critical features” approach to professional development research, consider the teacher working group in terms of the five features that Desimone (2009) described: content focus, active learning, coherence, duration, and collective participation. The teacher working group incorporated all of these features. It was focused on language and literacy pedagogy. Active learning experiences included analysis of classroom videos and lessons plans. The professional development was aligned with the Bilingüe School’s goal of developing students’ oral language skills through increasing opportunities for content-focused discussion. Eight upper elementary school teachers from the school participated collectively in the group. The whole group met monthly throughout an entire school year, supplemented by occasional one-on-one meetings between teachers and facilitators. While the professional development had the so-called “critical features,” as I have shown throughout this dissertation, these features did not simply translate to teacher learning.

First, it is not just the absence or presence of these features that contributes to teacher learning, but their quality and intensity. As I discussed in Chapter Four, the teacher working group was constrained by the goals and structures of both the larger research project within which it was nested and the Bilingüe school with which it shared agents. These constraints impacted the quality and intensity of the professional development features. Second, as my analysis of Kelly's and Martina's learning has shown, there is no way to anticipate the effectiveness of professional development without knowing more about the school context and the individual teachers who are participating. How much time do teachers in the school have for reflection? How much autonomy do they have to try out new practices in their classroom? Are the teachers using metacognitive strategies during the professional development? Do they have a habit of reflecting on their practice in relation to ideas from professional development? How is the professional development related to teachers' other experiences? Are the teachers interested in the topic? Do they perceive it as relevant and necessary? Finally, even if the school's priorities align with the topic, to what extent is the school's instructional vision congruent with the vision promoted through professional development? As these questions suggest, efforts to evaluate professional development on the basis of its features fail to account for the complexity of teacher learning. While such efforts may surface correlations among a particular feature and learning for the "average" teacher, they are of little use in understanding the variation within teacher learning, and therefore in helping to design professional development that will foster learning for different teachers in disparate contexts.

It is time for more research on this variation. As this dissertation shows, researchers can employ complexity theory for a more nuanced understanding of teacher learning. The analytic framework that I presented offers an initial approach to investigating individual teachers' learning. Additional case studies of different teachers, from different schools, participating in different professional development activities are needed to test and further develop the analytic framework. While case studies permit in-depth analysis of individual teachers' learning systems in context, the analytic framework could be incorporated into research using other methods. I agree with Opfer and Pedder (2011) that exploring the variation in teacher learning does not necessitate the use of any particular method, so long as the methods that are used are sensitive to individual differences and do not mask variation by aggregating data across participants. In my own future research, I hope to employ other qualitative methods that will permit me to collect rich data from a larger number of research participants, in order to test the analytic framework more widely.

Implications for Practice and Policy

This study has important implications for the design and selection of professional learning experiences that will help to establish the conditions that foster teacher learning. I focus first on two, related sets of implications for the professional developers who design and facilitate professional development, as well as for the administrators and policymakers who make decisions about and create guidelines for professional development. Namely, I discuss implications for fostering congruence between the school and professional development activity as well as the teacher and the professional development activity. I conclude with a few suggestions for professional developers to

support the design and facilitation of professional learning activities that may positively impact some of the teacher-level control parameters that influence learning conditions.

The concept of congruence as discussed in this dissertation is related to the concept of coherence, which Desimone (2009) included on her list of critical features. Other researchers have documented a positive association between teacher learning and professional development that is coherent with school, district, and state initiatives (e.g. Cohen & Hill, 2011; Firestone et al., 2005), as well as consistent with teachers' existing knowledge, practice, and beliefs (e.g. Drits-Esser & Stark, 2015; Remillard & Bryans, 2004). However, while Desimone and others (e.g. Darling-Hammond et al., 2009; Penuel et al., 2007) frame coherence as a feature of professional development alongside other features such as duration and content-focus, a complex view of teacher learning implies that congruence is not a feature of the professional development system, but rather a characteristic of the interactions among the three overlapping systems. Moreover, the other "critical features" will not cause teacher learning if the professional development is not congruent with the teacher and the school. It is not enough for professional developers like myself to design content-focused, active learning experiences or create structures for collective participation over an extended period of time. Instead, professional developers and others who hope to improve the effectiveness of professional development should start by attending to its congruence with individual teachers and specific schools.

When considering professional development through the lens of congruence, one logical implication is that more decision making should happen at the school level. It is harder to ensure congruence when the district requires teachers to participate in particular

professional development programs, than when those decisions are made at the school level. School-level administrators would benefit from more autonomy when creating annual improvement plans and deciding upon the professional development needed to achieve the objectives outlined therein. This study's findings suggest that administrators would be wise to attend to the connection among various professional development activities. Martina's transformative learning experience was fostered by her involvement in multiple, concurrent professional learning activities that were all related to the topic of student talk. While other researchers have found that schools that undertake multiple initiatives simultaneously can interfere with teacher learning (Dagen & Bean, 2014; Wood, 2007), Martina's experience has further implications. Not only should schools limit the number of initiatives, but they could also encourage teachers to participate in multiple professional learning activities related to the same school initiative.

As I discussed in Chapter Five, a lack of congruence between the Language Awareness and Dialogic Reasoning professional development and the Bilingüe school was one of the factors that hindered Kelly's learning. Although we facilitators had some familiarity with the school context, we did not do enough to address issues of congruence. When external professional developers come in to lead school-based professional development, they would benefit from more information about the school context. My findings suggest that professional developers should educate themselves about the school context and modify or design professional learning activities accordingly. School administration can help professional developers learn about the school ahead of time by encouraging school visits during which they deepen their understanding of the school's priorities and culture by observing classes and talking with

administrators and teachers about their needs and the school context. Armed with this knowledge, they may be able to design professional learning activities that are more congruent with the school-as-system.

Even when professional developers have done their research about the school-as-system, as we Language Awareness and Dialogic Reasoning facilitators did, it is still possible for a lack of congruence to go unrecognized. As we discovered, surface-level agreement about priorities can mask deep-seated differences among conceptions of teaching and learning. In order to foster effective communication and ultimately learning, it is essential to unearth and explore these differences. Professional development facilitators can surface divergent understandings through strategies such as pressing participants to explain their reasoning and clarifying a participant's comment to ensure common understandings (van Es et al., 2014).

Along with congruence between the school and the professional development, this dissertation has implications for fostering greater congruence between the teacher and the professional development. While I argued above that more decisions about professional development should be made at the school level, so too should teachers be allowed to make more of their own decisions about professional development. As the example of Kelly and Martina demonstrates, teachers within the same school can have very different professional learning needs. This study supports Firestone et al.'s (2005) finding that requiring teachers to participate in professional development that is aligned with school priorities, without regard to the teachers' experience or subject area, can limit teachers' learning. Rather than mandating participation in specific professional development activities, administrators might encourage teachers to select professional development

that is congruent with their own needs and interests. In order to allow for more teacher choice without sacrificing school-level congruence with professional development, administrators could consider providing a menu of options that are congruent with the school-as-system as well as vetting teacher-selected professional development for congruence with the school context.

While the selection of professional development can increase congruence, professional developers can also increase congruence through the design of learning activities. One approach to building congruence is by using artifacts of practice, such as student work samples, curriculum materials, and classroom videos. Martina's experience of learning through reflecting on classroom videos illustrates that such artifacts of practice may help to forge connections among teachers' classroom and professional learning experiences, by showing teachers the relevance and applicability of ideas from professional development in their own contexts. Professional developers can also incorporate more choice into the design of learning activities. As Opfer, Pedder, and Lavicza (2011) found, teachers' learning through professional development is influenced by their "orientation to learning," or their perception of their own learning, including the value they place on different types of learning. If learning activities provide teachers with more choices about how to learn (e.g. independently or collaboratively), teachers can make choices that are congruent with their own orientations.

The above implications for practice and policy focus on increasing the congruence among professional development-, school-, and teacher-level systems. I conclude with a few suggestions that professional developers can use to design learning activities that positively impact teacher-level control parameters. As I have argued

throughout this dissertation, teacher learning cannot be explained in terms of simple causes and linear effects. Thus, I am hesitant to suggest that professional development need to incorporate specific features, as I know full well that no activity will lead to learning for all teachers in all schools. Nonetheless, my findings about the important role of metacognition and reflection in teacher learning suggest that professional developers can support learning by designing activities that encourage teachers to employ metacognition and to reflect on the relationship between ideas from professional development and their own knowledge, beliefs, and practices. For instance, at the beginning of a professional development program, facilitators could promote a metacognitive stance by asking teachers to examine what they already know about the topic and to articulate gaps in their knowledge or skills that they are hoping to fill. Throughout the program, the facilitator might incorporate pauses in which teachers monitor their learning, either in conversation with other teachers or in writing. At the end, teachers could write down what they have learned and how it relates to what they were hoping to learn. Professional development facilitators might promote reflection by questioning teachers about their own contexts, in relation to the professional development content. Activities that use artifacts of practice are prime opportunities for teachers to reflect on how ideas from professional development apply to their own classroom contexts.

While such activities may create connections between professional development and classroom practice by bringing the classroom into the professional development, another approach to increasing connectivity is bringing the professional development to the classroom. Although the Language Awareness and Dialogic Reasoning professional

development model did not include explicit coaching, my analysis showed that my debriefing conversations with Martina created additional feedback loops that supported her learning. This finding supports the use of professional development models that include classroom-based observations and coaching. Another possibility for bringing the professional development to the classroom is through “homework assignments” that require teachers to incorporate ideas from professional development in their classrooms and then report back on what happened. Professional developers can neither create more opportunities for reflection during the school day, nor control teachers’ reflective habits or use of metacognition outside of the professional learning activity. However, by promoting metacognition, reflection, and connectivity during professional development, they may be able to positively influence some of the teacher-level control parameters that shape teacher learning conditions.

Conclusion

This dissertation raises many questions about the assumption that professional development leads to teacher learning in a linear progression (e.g. Desimone, 2009; Guskey, 2002). Using complexity theory, I argue that teacher learning is unpredictable, and, like all complex systems, it is more than the sum of its parts. Nonetheless, I agree that professional development can be a lever for teacher change. Good teachers continue to learn throughout their careers, developing their knowledge about curriculum and students, adding to their teaching repertoires, and adapting to changing contexts. Professional learning activities are therefore an important means to support teachers in their ongoing learning. However, improving the effectiveness of professional development does not mean figuring out the best model or the most important features,

and then designing all professional development accordingly. Rather, if we want professional development to lead to better outcomes, we need to understand the conditions under which and the processes through which individual teachers actually learn through professional development.

In this dissertation, I have attempted to shift the conversation about professional development in that direction. By conceptualizing teacher learning as a complex system, at the intersection of the professional development-, school-, and teacher-level systems, I foregrounded the individual and contextual differences that, in conjunction with the professional development itself, create different learning conditions. Through carefully describing and analyzing the learning processes of two teacher colleagues with different roles, experiences, and habits of mind who were participating in the same professional development, I shed light on the complex constellation of control parameters that impacted their learning, as well as the mechanisms through which learning occurred. It is my belief that the analytic framework that I developed to explain Martina's and Kelly's learning can be widely applied to identify patterns of learning among other teachers in other contexts. Furthermore, it can be used prospectively to design and select professional development that will meet the needs of particular teachers in particular school contexts.

For professional development to live up to the high expectations of policymakers and administrators, for it to be worth 89 hours per year of the average U.S. teacher's time and \$18 billion annually, a paradigm shift is needed. We need to move away from a top-down, one-size-fits-all approach to professional development, toward a bottom-up, teacher-centered and school-centered approach. This dissertation provides a lens for thinking about how to make such a shift.

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APPENDICES

Appendix A: Language Awareness and Dialogic Reasoning Curriculum Overview

Table A1

Curriculum Units, Lesson Cycles, and Focal Texts

Unit Topic	Focal Texts
Unit 1: Nature How do plants and animals depend on one another? What are the different ways that humans can impact nature?	Cycle 1: <i>The Wolves Are Back</i> , by Jean Craighead George Cycle 2: Species Revival
Unit 2: Rights How can people stand up for their rights? What can people do to change things that are unfair?	Cycle 1: <i>Ivan: The Remarkable True Story of the Shopping Mall Gorilla</i> , by Katherine Applegate. Cycle 2: <i>Yes, We Can! ¡Sí, Se Puede!</i> , by Diana Cohn
Unit 3: Immigration How does immigration affect communication and culture? Should schools make sure that students learn more languages than just English?	Cycle 1: <i>Home at Last</i> , by Susan Middleton Elya Cycle 2: Bilingual Education Debate

Table A2

Unit Structure

Lesson Cycle	Day	Topic
Cycle 0	Day 1	Introduction to Unit
Cycle 1: Text-based	Day 1	Text & Semantics
	Day 2	Text & Semantics
	Day 3	Morphology & Semantics
	Day 4	Syntax
	Day 5	Dialogic Reasoning
Cycle 2: Text-based	Day 1	Text & Semantics
	Day 2	Text & Semantics
	Day 3	Morphology & Semantics
	Day 4	Syntax
	Day 5	Dialogic Reasoning
Cycle 3: Writing	Day 1	Planning
	Day 2	Drafting & Revising

Table A3

Principles Underlying the Language Awareness and Dialogic Reasoning Curriculum

Principle	Summary
1. Linguistic & Metalinguistic Awareness	Instruction in linguistic awareness and metalinguistic awareness promotes reading comprehension.
2. Text-based language learning	Text is a vehicle for language instruction. Text includes: written text, visual & digital media, students' experiences.
3. Prior Knowledge	Activating prior knowledge about language facilitates bilingual learners' comprehension in new contexts.
4. Explicit and dialogic instruction	Explicit and dialogic instruction should be used to teach morphology, semantics, and syntax.
5. Talk	English learners need opportunities to use expressive language in school. This is provided through dialogic instruction about language and dialogic reasoning discussions.
6. EL Supports	English learner supports should be infused throughout all instruction and discussion. Number and variety of supports has increased.

Appendix B: Lesson Debrief Guide

Part 1: Teacher's overall perception of the lesson:

How do you think the lesson went?

1. *What went well? What makes you say that?*
2. *What didn't go as well as you hoped?*

Part 2: Interrogation of lesson episode(s)

Now I'm going to ask you in detail about one or two short episodes from the lesson. I may ask you some things that seem obvious, but I want to make sure that I am not misinterpreting your thinking. Sometimes I may ask about something that you hadn't thought about at the time. I'd rather you be honest and say that you hadn't thought about it than making up an explanation now.

Introduce the episode

Take a look at this lesson episode. [Show video clip].

1. Focus: How does the teacher understand the episode?
 - a. *Can you describe what happened there?*
 - b. *What was that about?*
 - c. *What did you make of that?*
 - d. *What did you see that motivated you to do that?*
2. Focus: Why did the teacher act as she did?
 - a. *What was your reason for...?*
 - b. *What made you...?*
 - c. *Why did that matter?*
 - d. *Are there other ways that you could have handled this situation?*
 - e. *Do you have any reservations about what happened here?*
 - f. *What if you had more time...?*
 - g. *How would you change the lesson plan?*
 - h. *Some teachers say it's a good idea to.... What do you think of that idea?*
 - i. *During a teacher working group meeting we discussed doing... What do you think of that idea?*
3. Focus: Has the teacher always acted in this way?
 - a. *Was there a time earlier in your career when you would have handled this situation differently?*
 - b. *Have you always acted in this way?*
4. Focus: If the teacher's practices have changed, what has led to these changes?
 - a. *What brought about this change?*
 - b. *What made you change your mind?*

Appendix C: Conversational Guides for Interviews

Note: The conversational guides include a handful of main questions, which are numbered. The italicized questions below are possible follow up questions. Main questions may be omitted or reordered, and additional questions may be added as needed.

Teacher Interview #1

Introduction: Thank you for agreeing to talk with me today. As I explained previously, I am interested in learning more about what and how teachers learn through participating in professional development. Today I am going to ask you primarily about your previous experiences with professional development as well as your hopes and expectations for participating in the Language Awareness and Dialogic Reasoning project.

- 1) Tell me a bit about your teaching career.
 - a) *How many years have you been teaching?*
 - b) *How long have you been at this school?*
 - c) *How long have you been in this position?*
- 2) You are a [position at school]. Describe your role and responsibilities.
 - a) *Tell me about a typical day.*
 - b) *For ESL teachers: How many students do you work with? How many teachers? How do you coordinate with homeroom teachers?*
- 3) Tell me about previous professional development/learning experiences that you have participated in.
 - a) *How much PD do you typically participate in? When? Where? What types?*
 - b) *Is your participation required or voluntary?*
 - c) *How do you select PD?*
- 4) Can you think of a previous professional development/learning experience that has influenced your teaching practice? Describe the PD.
 - a) *Why did you take part in it?*
 - b) *What was the format (e.g. class, workshop, study group)?*
 - c) *What and how did you learn?*
 - d) *How has it influenced your teaching practice?*
 - e) *Why was the PD influential for you?*
- 5) How would you describe yourself as a learner? How do you like to learn?
 - a) *With others or alone?*
 - b) *From an "expert," from peers, or on your own?*
 - c) *Through lectures, video, discussions, books, hands-on practice?*
 - d) *Give me an example of a successful/unsuccessful learning experience.*
- 6) Would you say that your professional learning is supported at [name of school]? How?
 - a) *What school/district policies promote/get in the way of professional learning? (E.g. shared planning time; subs to cover classes; use of grade-level meetings; opportunities to share professional learning; administrative involvement)*
 - b) *What helps/hinders you from putting your learning to use in the classroom?*

- 7) How did you come to participate in the LADR project?
 - a) *Why did you decide to join the project?*
 - b) *What do you expect to get out of your participation in the project?*
 - c) *Do you anticipate learning anything in LADR that might be useful to you?*
- 8) As you know, the LADR curriculum is intended to develop language awareness through explicit and dialogic instruction about language. It is also designed to provide opportunities for students to use expressive language. [Show principles of LADR list.] How comfortable do you feel about teaching the LADR curriculum? Why?
 - a) *How does LADR compare with your current practices?*
 - b) *What, if anything, do you anticipate will be difficult about teaching these lessons? [Prompt interviewee to look through curriculum binder.]*
- 9) As we have discussed, we are planning to use teacher working group meetings to support you and the other implementing teachers in teaching LADR lessons. What do you hope to learn in this project and how can we help you learn it?
 - a) *What topics would you like to see addressed during teacher working group meetings?*
 - b) *What types of activities/approaches would help you learn during teacher working group meetings? (e.g. lesson preparation; sharing how its going; looking at student work)*

Teacher Interview #2

Introduction: Thanks for making the time for another interview. The focus of our conversation today is going to be on your learning, specifically what and how you learned through participating in the LADR project this year.

1. As you reflect back on a year of teaching LADR, how did it go?
 - a. *What went well?*
 - b. *What was most challenging?*
2. Think back to the first LADR lesson cycle that you taught in the fall on the reintroduction of wolves to Yellowstone National Park. Did you teach the final lesson cycle in the same way that you taught that first cycle?
 - a. *What were some of the differences in your instruction? Describe these differences.*
 - b. *[If possible, show brief video clip from first lesson cycle, paired with recent video clip, illustrating researcher-identified changes in instructional practice.] I'm going to show you two video clips that I think indicate a change in your instruction. Afterwards, I want you to tell me what you notice.*
 - c. *To what do you attribute these changes?*
3. Over the course of the year, as you taught the LADR lessons, has anything shifted in your understanding of [principle undergirding the curriculum]?
 - a. *How do you understand it now?*
 - b. *How did you understand it before?*
 - c. *What brought about that change?*

4. Can you think of anything that you have learned during teacher working group sessions?
 - a. *What ideas have you gotten from teacher working group sessions?*
 - b. *Who did you get these ideas from?*
 - c. *Has this impacted your teaching? How?*
5. Do you ever discuss your work with LADR outside of our monthly teacher working group sessions?
 - a. *Tell me about those conversations. Who do you talk to you? (Other LADR participants? Other teachers? Administrators? Others?) For what purpose?*
 - b. *Have these conversations affected the way that you teach LADR lessons? How so?*
6. Describe how you prepare to teach a LADR lesson.
 - a. *While planning, what changes do you make to the lessons, if any? Why?*
7. What have you learned through actually teaching the LADR lessons to your students?
 - a. *What have you learned from your students about language-focused instruction? How did you learn this?*
8. [If applicable] At a recent teacher working group meeting, you talked about [topic of conversation]. Why did you bring that up? What did you think about the conversation that ensued?
9. I understand that the Bilingüe school has been working on several pedagogical initiatives this year (e.g. making learning visible, academic conversations, bridging). How do these school-wide initiatives influence your work in LADR?
 - a. *Do you incorporate the school-wide goals into your LADR teaching? Why or why not? If so, how?*
10. Can you think of anything that we haven't discussed that you have learned from participating in the LADR project?
 - a. *Has participation in the group changed your teaching practice in any way? Can you give an example of this change? How do you explain this change?*
11. Do you anticipate using anything that you have learned through your participation in LADR in your future teaching? Why or why not?

Conversational Guides for Principal Interview

Background

- 1) How long have you been the principal of Bilingüe?

Principal's direct involvement in/support for teachers' professional learning

- 2) Can you describe your role as an instructional leader here at Bilingüe?
 - a) *What is your role with regards to professional development?*
 - b) *Do you play a role in deciding what PD teachers should participate in?*
 - c) *Do you play a role in supporting teachers to implement ideas from PD?*

- d) *Can you think of a situation in which you have supported a teacher's professional learning?*

Collective orientations & beliefs about teaching and learning; collective norms of practice

- 3) I understand that there are some school-wide learning goals. Can you tell me about these?
- a) *What are the school-wide learning goals?*
 - b) *Where do these goals come from?*
 - c) *How do you promote these shared learning goals?*
 - d) *What would you do if a teacher wanted to focus on a goal that was not aligned with the school's shared learning goals (e.g. integrating the arts throughout the curriculum; creative writing)?*
- 4) How does accountability pressure from the state and/or district impact Bilingüe as a professional learning environment? (By accountability pressure I'm referring to expectations around MCAS/PARCC scores.)
- a) *Does accountability pressure impact your expectations for the kinds of teaching and learning that should be happening in classrooms? If so, how?*
 - b) *How much leeway do your teachers have to decide how to use instructional time? How much leeway do they have to select curriculum and/or deviate from district-adopted curriculum?*
 - c) *Does accountability pressure impact your goals for teacher learning? If so, how?*
 - d) *How does the teacher evaluation system impact the school as a professional learning environment?*
 - e) *How has Bilingüe changed as a professional learning environment as the accountability environment has shifted?*
- 5) The LADR curriculum is based on five principles:
- i. Development of language awareness & skills in morphology, semantics, & syntax
 - ii. Text-based language learning
 - iii. Explicit and dialogic instruction about language
 - iv. Structures that support student talk
 - v. EL supports
- (Provide handout of LADR principles for reference.)
- How do these principles mesh with school-wide norms for teaching and learning?
- a) *How easy or hard do you anticipate that it will be for teachers to incorporate these principles into their teaching? Why?*
 - b) *Are some of these principles more closely aligned with current practices than others? Which ones?*
 - c) *Which of these principles might not be a great fit, given current practices and beliefs about teaching and learning here at Bilingüe?*

Contexts that support teacher learning & capacity to achieve learning

- 6) I understand that there are certain structures during the school day and across the school year that promote teacher learning and foster teacher collaboration here at Bilingüe. Can you tell me about these?

- a) *Tell me about common planning time and Collaboration time. What are your expectations for how teachers will use these times? Who creates the agendas? Sets the tasks?*
 - b) *Tell me about school-based professional development. Who plans these PD sessions? How are decisions made about using this time?*
 - c) *Are there other structures that support teacher learning?*
- 7) Are you able to support teachers who want to participate in learning activities outside of these structured times? If so, how?
- a) *Do teachers get release time to participate in professional learning activities?*
 - b) *Are teachers compensated for participating in PD?*
- 8) Do you have the resources that you need to support teacher professional learning as you wish? Consider both human and material resources.
- a) *What resources are you able to put towards teacher learning?*
 - b) *Do limited resources ever inhibit teacher professional learning? When? Can you provide an example?*
 - c) *In an ideal world, what other resources would you like to have?*
- 9) Is there anything else that gets in the way of teacher professional learning here at Bilingüe?
- a) *Are there school or district policies that hinder teacher learning?*
- 10) Is there anything else that you would like to tell me about Bilingüe as a professional learning environment?

Appendix D: Sample Lesson Plan

Unit: Immigration
Text: *Home at Last*
Lesson: Syntax

Cycle: 1

Day: 4



Lesson Objectives:

CCSS	Lesson Objectives
<p><u>CCSS.ELA-LITERACY.L.3.1.H</u> Use coordinating and subordinating conjunctions.</p>	<p>Students will identify coordinating conjunctions and compound sentences in the <i>Home at Last</i> text.</p> <p>Students will create and analyze compound sentences using coordinating conjunctions.</p>
<p><u>CCSS.ELA-LITERACY.L.3.1.I</u> Produce simple, compound, and complex sentences.</p>	
<p><u>CCSS.ELA-LITERACY.L.4.1.F</u> Produce complete sentences, recognizing and correcting inappropriate fragments and run-ons.</p>	
<p><u>CCSS.ELA-LITERACY.L.4.2.C</u> Use a comma before a coordinating conjunction in a compound sentence.</p>	



Materials:

Teacher	Students
<ul style="list-style-type: none"> <input type="checkbox"/> Parts of Speech Anchor Chart <input type="checkbox"/> Chart paper or white board <input type="checkbox"/> The <i>Home at Last</i> text <input type="checkbox"/> Sentence Combining Game materials 	<ul style="list-style-type: none"> <input type="checkbox"/> Student Workbook

Review/Instruction on Simple, Compound, and Complex Sentences (10 minutes)

Parts of Speech Anchor Chart + Chart paper to create the Simple, Compound, and Complex Sentences Anchor Chart

State lesson objectives.

Review the concept of complete sentence structure from unit 1 and the parts of speech anchor chart. Explain that subject-verb-object combinations are called clauses. Explain that sentences that only have one clause (subject-verb-object) are simple sentences and sentences that have more than one clause are compound or complex sentences. Explain that students will discuss compound sentences in this cycle and complex sentences in the next cycle. Note: Today teachers will start creating the “Simple, Compound, and Complex Sentences” anchor chart, which they will complete in the next cycle.

Share the language objective of the day with the students: *Today we will learn about creating compound sentences when we talk and write.*

Write a compound sentence on a chart paper from the Home at Last text:

Ana was too shy to speak in the morning, but by afternoon she was saying hello back.

Ask students what they notice about this sentence. *What does the first part say? What does the second part say? How are these two parts of the sentence connected?*

Tell students today they will focus on compound sentences, which are made of two or more independent clauses. Explain that independent clauses are clauses that can stand on their own as complete sentences. Independent clauses are connected by conjunctions (linking words).

Write the following conjunctions on the anchor chart: *but, and, or*. Explain that conjunctions make the relationship between our ideas clearer. Tell students that a comma is used before “and,” “but,” and “or” when they connect two independent clauses.

Guide students to analyze the parts of the sentence (above) and note that each independent clause could be a sentence on its own. Ask students, *How the word “but” is used in this sentence?* Tell students that “but” is a conjunction. Its job is to show contrast or difference.

Review “and,” indicating adding more; and “or,” indicating alternatives. Use the chart below.

For teacher reference:

Independent clause	Conjunction	Independent clause
Ana was too shy to speak in the morning,	but	by afternoon she was saying hello back.

Ana speaks Spanish with her family	and	she speaks English with her classmates.
Ana had to learn English	or	she wouldn't understand what her teacher and classmates were saying.

Language in Text (10 minutes)

Home at Last + Student Workbook

Instruct students to open their Student Workbooks to the Day 4 Language in Text activity. Assign each individual or pair of students to one-to-two pages (suggested pages are 11, 14, 16, 17, 20, 22, and 27).

Guide students to look for conjunctions listed on the chart paper (but, and, or). Tell students to complete the tables in their workbooks using the compound sentences they find in the text.

For teacher reference:

Page #	Independent clause	Conjunction	Independent clause
11	Mamá tried to argue about the price,	but	she could only say the words in Spanish.
11	Ana tried to help explain,	but	the clerk was too busy.
14	They went to a different market,	but	with having to carry Julio, Jesús, and the groceries on the bus, it was too hard.
16	Ana couldn't read the cursive style,	and	Mamá couldn't read the English.
16	Ana's dress had gotten too short	and	there was no more hem to let down.
17	A man came into the hall,	but	he didn't understand her frantic Spanish.

20	Papá went for medicine,	and	Ana helped give Jesús a sponge bath to bring down his fever.
22	He borrowed Uncle Luis' car,	and	they all rode there together.
27	Papá stood up to go,	but	Mamá said, "No, I go".

Students might choose a sentence such as "Mamá needed the chicken and had to pay the higher price" (p.11), which is not a compound sentence. Explain that in order to be a compound sentence, the clauses connected with "and" and "but" must be complete. This means that they both must have a subject and a verb.

Language Play (10 minutes)

Sentence Combining Game

Guide students to practice generating compound sentences given two clause cards and one conjunction card. Subordinating conjunctions and clauses are taken from the *Home at Last* text. Please see the attached Sentence Combining Game materials for directions and examples.

1. Group students into pairs.
2. Place all the cards face up on the table.
3. Ask pairs to select two clause cards and a conjunction card to connect them, and to use them to form a logical compound sentence.
4. Prompt other students to determine whether the new sentence makes sense.
5. As a group, discuss the meaning of the sentence.
6. If time and student level allows, have students experiment with using different conjunctions and changing the order of the clauses. Guide them to notice how the meaning changes.

Closing: As the closing activity, ask students to make a compound sentence about *Home at Last* text.